INTERNATIONAL YEAR OF LIGHT 2015

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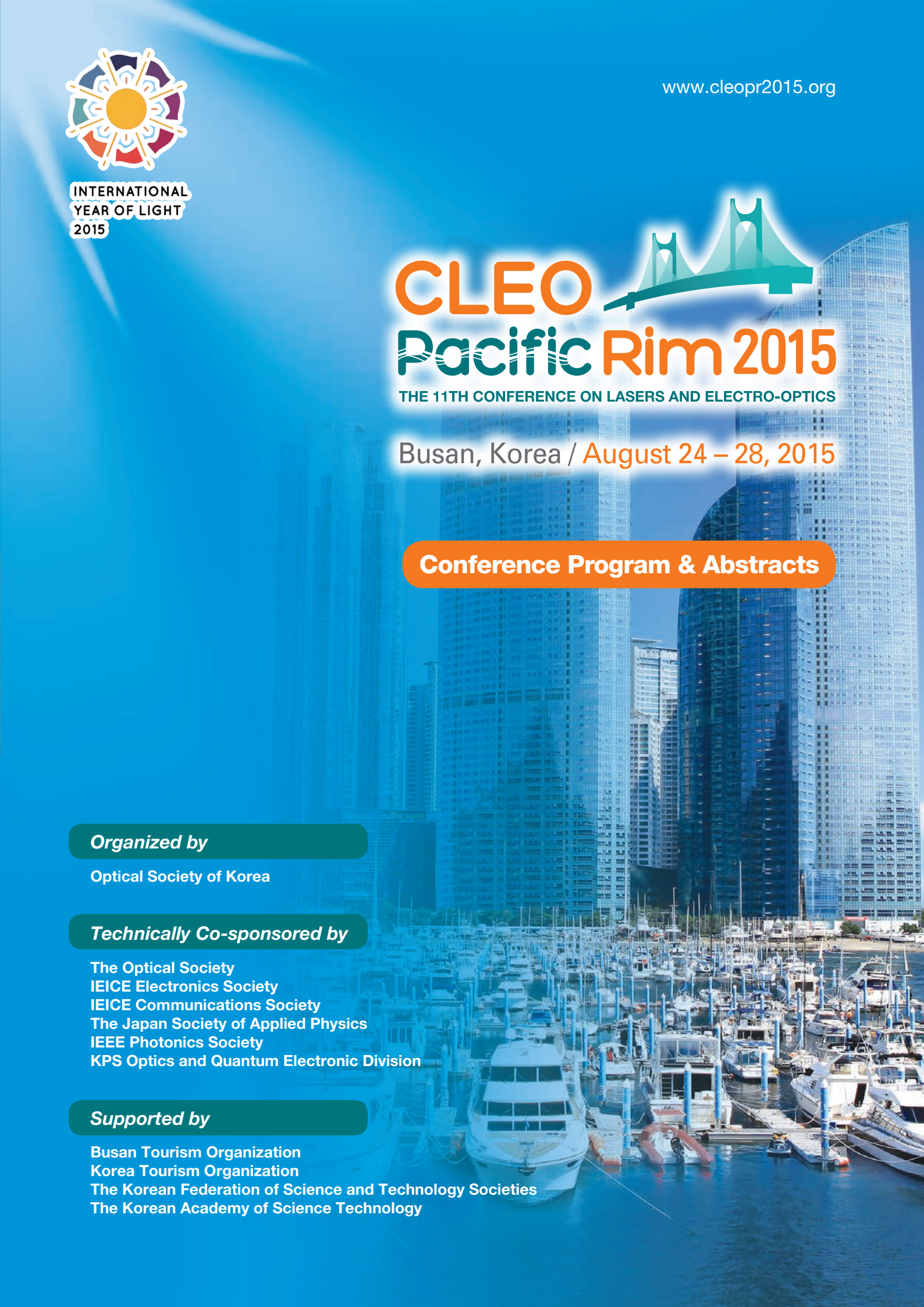
CLEO Pacific Rim 2015

THE 11TH CONFERENCE ON LASERS AND ELECTRO-OPTICS

Busan, Korea / August 24 – 28, 2015

Conference Program & Abstracts



Organized by

Optical Society of Korea

Technically Co-sponsored by

The Optical Society
IEICE Electronics Society
IEICE Communications Society
The Japan Society of Applied Physics
IEEE Photonics Society
KPS Optics and Quantum Electronic Division

Supported by

Busan Tourism Organization
Korea Tourism Organization
The Korean Federation of Science and Technology Societies
The Korean Academy of Science Technology

Program at a Glance

Aug. 24 (Mon)

Time	101 (Room A)	102 (Room B)	103 (Room C)	106 (Room D)	107 (Room E)	108 (Room F)	201 (Room G)	202 (Room H)	203 (Room I)	204 (Room J)	205 (Room K)
16:30~17:30							Short Course I	Short Course II	Short Course III		
17:30~18:30											
18:30~20:00	Get-together Party (Lobby, 3F)										

Aug. 25 (Tue)

Time	101 (Room A)	102 (Room B)	103 (Room C)	106 (Room D)	107 (Room E)	108 (Room F)	201 (Room G)	202 (Room H)	203 (Room I)	204 (Room J)	205 (Room K)
08:40~09:00											Opening Ceremony
09:00~09:45											Plenary Talk I
09:45~10:30											Plenary Talk II
11:00~12:30	[25A1] T01: Raman Lasers	[25B1] T13: Novel Devices and Systems for Display	[25C1] T02: Femtosecond Laser	[25D1] T04: High Power, High Energy Lasers	[25E1] T05: Plasmonics and Metamaterials I	[25F1] T07: Optical Metrology and Sensing I	[25G1] T08: Quantum Optomechanics	[25H1] T09: Nanostructures	[25I1] T10: Plasmonic Devices	[25J1] T12: Silicon Photonics Interconnection	
13:45~15:15	[25A2] T01: Optical Frequency Combs	[25B2] T01: Material Processing & Applications	[25C2] T02: Attosecond Physics	[25D2] T04: High Power, High Energy Lasers	[25E2] T05: Plasmonics and Metamaterials II	[25F2] T07: Optical Metrology and Sensing II	[25G2] T08: Quantum Information I	[25H2] T09: Material and Device Characterizations	[25I2] T10: Plasmonics and Subwavelength Structures	[25J2] T12: Silicon Photonics Integration	
15:45~17:45	[25A3] T01: Q-switched Lasers	[25B3] T01: Solid-State & Diode Lasers	[25C3] T02: Nonlinear Optics	[25D3] T06: Novel Laser Process for Electronic Devices	[25E3] T05: Plasmonics and Metamaterials III	[25F3] T07: Optical Metrology and Sensing III	[25G3] T08: Atom-Photon Interaction I	[25H3] T11: Multiphoton Microscopy	[25I3] T10: Photonic Crystals	[25J3] T12: Silicon Photonics Hybrid Integration	

Aug. 26 (Wed)

Time	101 (Room A)	102 (Room B)	103 (Room C)	106 (Room D)	107 (Room E)	108 (Room F)	201 (Room G)	202 (Room H)	203 (Room I)	204 (Room J)	205 (Room K)
09:00~10:30	[26A1] T01: High-Power Solid-State Lasers	[26B1] T06: Laser Processing for Flexible Electronics	[26C1] T02: Fiber Laser	[26D1] T04: Ultrahigh Intensity Lasers I	[26E1] T05: Plasmonics and Metamaterials IV	[26F1] T07: Optical Metrology and Sensing IV	[26G1] T08: Atomic Physics	[26H1] T09: Growth and Fabrications	[26I1] T10: Waveguides	[26J1] T12: Micro Cavity Devices	
11:00~12:30	[26A2] T01: Mode-Locked Lasers I	[26B2] T06: Ultrashort Pulsed Laser 3D Processing	[26C2] T02: Novel Materials	[26D2] T04: Ultrahigh Intensity Lasers II	[26E2] T05: Plasmonics and Metamaterials V	[26F2] T07: Optical Metrology and Sensing V	[26G2] T08: Quantum Information II	[26H2] T11: Optical Coherence Tomography	[26I2] T10: Advances in Metamaterials	[26J2] T12: III-V Integrated Photonics	
13:45~15:15	Poster Session 1 (Exhibition Hall, 1F)										
15:45~17:45	[26A3] T01: Mode-Locked Lasers II	[26B3] T13: 3D Display	[26C3] T02: Supercontinuum Generation	[26D3] T06: Novel Laser and Optical Technologies in Manufacturing I	[26E3] T05: Plasmonics and Metamaterials VI	[26F3] T07: Optical Metrology and Sensing VI	[26G3] T08: Atom-Photon Interaction II	[26H3] T11: Tissue Imaging	[26I3] T10: Micro/Nano Lasers	[26J3] T12: Nanophotonics Applications	
18:00~20:00	Banquet (301)										

Aug. 27 (Thu)

Time	101 (Room A)	102 (Room B)	103 (Room C)	106 (Room D)	107 (Room E)	108 (Room F)	201 (Room G)	202 (Room H)	203 (Room I)	204 (Room J)	205 (Room K)
09:00~09:45											Plenary Talk III
09:45~10:30											Plenary Talk IV
11:00~12:30	[27A1] T01: Tm Fiber Lasers	[27B1] T03: Terahertz Technologies and Applications I	[27C1] T02: Strong Field Physics	[27D1] T04: High Power, High Energy Lasers I	[27E1] T05: Plasmonics and Metamaterials VII	[27F1] T07: Optical Metrology and Sensing VII	[27G1] T08: Atom-Photon Interaction III	[27H1] T09: Novel Materials and Devices	[27I1] T10: Biosensors	[27J1] T12: Integrated Optical Devices	
13:45~15:15	Poster Session 2 (Exhibition Hall, 1F)										
15:45~17:45	[27A2] T01: Solid-State & Mid-IR Lasers	[27B2] T03: Terahertz Technologies and Applications II	[27C2] T02: Characterization of Ultrashort Laser Pulses	[27D2] T10: Quantum Phenomena in Micro/Nano Optics	[27E2] T06: Novel Laser and Optical Technologies in Manufacturing II	[27F2] T07: Optical Metrology and Sensing VIII	[27G2] T08: Quantum Information III	[27H2] T11: Innovative Methods in Biophtonics	[27I2] T13: Advanced Imaging Techniques	[27J2] T12: Microcavity Integrated Devices	
18:00~19:30	Post-deadline Papers										

Aug. 28 (Fri)

Time	101 (Room A)	102 (Room B)	103 (Room C)	106 (Room D)	107 (Room E)	108 (Room F)	201 (Room G)	202 (Room H)	203 (Room I)	204 (Room J)	205 (Room K)
09:00~10:30	[28A1] T01: Fiber-based Sources	[28B1] T03: Terahertz Technologies and Applications III	[28C1] T02: Nonlinear Optics	[28D1] T04: High Power, High Energy Lasers II	[28E1] T05: Plasmonics and Metamaterials VIII	[28F1] T07: Optical Metrology and Sensing IX	[28G1] T01: Novel Lasers & Techniques	[28H1] T11: Plasmonics in Biophotonics	[28I1] T13: Holographic Display	[28J1] T12: Band-broadening Photonics	
11:00~12:30	[28A2] T01: Mid-IR OPOs & High-Power Fiber Lasers	[28B2] T03: Terahertz Technologies and Applications IV	[28C2] T09: Light Emitting Devices	[28D2] T10: Micro/Nanophotonics	[28E2] T05: Plasmonics and Metamaterials IX	[28F2] T07: Optical Metrology and Sensing X	[28G2] T01: Optical Mode Control	[28H2] T11: In vivo and In vitro	[28I2] T13: Optical Storage and Information Processing	[28J2] T12: Nano Grating Lasers	

T01 Solid State, Fiber, and Other Laser Sources
T02 Ultrafast Phenomena and Nonlinear Optics
T03 Terahertz Technologies and Applications
T04 High Power, High Energy Lasers
T05 Plasmonics and Metamaterials
T06 Laser Processing and Innovative Applications
T07 Optical Metrology and Sensing
T08 Quantum Optics, Atomic Physics, and Quantum Information
T09 Nitrides, Other Widegap Semiconductors
T10 Micro and Nanophotonics
T11 Biophotonics and Medical Optics
T12 Semiconductor and Intergrated Optical Devices
T13 Display, Storage, and Applications

INTERNATIONAL YEAR OF LIGHT 2015

CLEO Pacific Rim 2015

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CLEO
Pacific Rim 2015
THE 11TH CONFERENCE ON LASERS AND ELECTRO-OPTICS
Busan, Korea / August 24 – 28, 2015

I. Greetings from the Conference Chair of CLEO Pacific Rim 2015

It is my great pleasure to welcome all of you to the 11th Conference on Lasers and Electro-Optics Pacific Rim (CLEO Pacific Rim 2015) which is being held from August 24 to August 28, 2015, at the BEXCO Convention Center in Busan, Korea.

CLEO Pacific Rim convenes for the eleventh time, and I would like to point out with much satisfaction that it has grown to be a world-best conference as a forum for exchanging up-to-the-date research results and views on future advances in all fields of lasers and electro-optics, serving not only the Pacific Rim region but also the entire worldwide technical community.

I am pleased to announce that the conference will showcase four plenary talks encompassing recent developments and glimpses into the future of optical sciences and technologies, including presentations on:

1) Optical Antennas; Spontaneous Emission Faster Than Stimulated Emission;
2) FTTH – Past, Present, and Future;
3) Coherent Ising Machine Based on Optical Parametric Oscillator Network; and
4) 5PW High Gain Large Aperture Ti: sapphire CPA Amplifier.

In addition, the conference will offer a wide range of technical activities including 3 short course lectures, 3 tutorials, 113 invited talks and a total of 608 contributed papers to be presented in both oral and poster sessions. (380 oral and 228 poster presentations)

Busan, the host city of this year's conference, is the second largest city in Korea embracing the beautiful natural sceneries. In particular, the Haeundae Beach, located near the conference venue BEXCO, is very popular among Koreans, with millions of people spending their vacations there every summer. Busan is also the largest port in Korea, which serves as a main gateway for the entire Northeast Asian region as well as the Korean Peninsula.

Finally, on behalf of the Organizing Committee I would like to express my heartfelt gratitude to all of you as well as the various committee members who have generously contributed their time and effort to make the CLEO Pacific Rim 2015 a great success. We are all too aware that this would not have been possible without the enthusiastic participation by the dedicated scientists and engineers.

Thank you once again and welcome to the CLEO Pacific Rim 2015.

Yong Hee Lee
Conference Chair

II. Committee Members

Organizing Committee

Conference Chair
Yong Hee Lee (KAIST, Korea)

General Arrangement
Sang Bae Lee (KIST, Korea)

Technical Program Committee Chairs
Chil-Min Kim (DGIST, Korea)
Byoungho Lee (Seoul National University, Korea)

Publicity & Publication
Jung H. Shin (KAIST, Korea)

Treasury
Sun-Kyung Kim (Kyung Hee University, Korea)

Exhibition
Jae-Won Hahn (Yonsei University, Korea)

Local Arrangement
Han Seb Moon (Pusan National University, Korea)
Yeong Mun Yu (Pukyong National University, Korea)

Steering Committee

Fumio Koyama (Tokyo Institute of Technology, Japan), Chair
Yung Jui Chen (National Sun Yat-Sen University, Taiwan)
Benjamin Eggleton (University of Sydney, Australia)
Sang-Kook Han (Yonsei University, Korea)
Jian-Jun He (Zhejiang University, China)
Byoungho Lee (Seoul National University, Korea)
Sang Bae Lee (KIST, Korea)
Yong Hee Lee (KAIST, Korea)
Ai-Qun Liu (Nanyang Technological University, Singapore)
Yoshiaki Nakano (The University of Tokyo, Japan)
Chang Hee Nam (GIST, Korea)
Shu Namiki (AIST, Japan)
Takashige Omatsu (Chiba University, Japan)
Alex Wai (Hong Kong Polytech University, Hong Kong, China)
Bingkun Zhou (Tsinghua University, China)

Technical Program Committee

T01. Solid State, Fiber, and Other Laser Sources

Fabian Rotermund (Ajou University, Korea) Co-chair
Takashige Omatsu (Chiba University, Japan) Co-chair
Stuart Jackson (University of Sydney, Australia)
Yoonchan Jeong (Seoul National University, Korea)
Jiwon Kim (Hanyang University, Korea)
Jungwon Kim (KAIST, Korea)
Ju Han Lee (University of Seoul, Korea)
Arkady Majoy (University of Manitoba, Canada)
Akira Shirakawa (University of Electro-Communications, Japan)
Thomas Südmeyer (University of Neuchatel, Switzerland)
Fengqui (Frank) Wang (Nanjing University, China)
Pu Wang (Beijing University of Technology, China)

T02. Ultrafast Phenomena and Nonlinear Optics

Chang Hee Nam (GIST/IBS, Korea) Co-chair
Kaoru Yamanouchi (The University of Tokyo, Japan) Co-chair
Zenghu Chang (University of Central Florida, USA)
Hideki Hashimoto (Osaka City University, Japan)
Masayuki Katsuragawa (University of Electro-Communications, Japan)
Dong-Eon Kim (POSTECH, Korea)
Kyung Taec Kim (GIST/IBS, Korea)
Andy Kung (Institute of Atomic and Molecular Sciences, Taiwan)
François Légaré (INRS, Canada)
Zhi Heng Loh (Nanyang Technical University, Singapore)
Peixiang Lu (HUST, China)
Katsumi Midorikawa (RIKEN, Japan)
Parinda Vasa (IIT Bombay, India)
Zhiyi Wei (IOP, China)
Nan Ei Yu (APRI/GIST, Korea)

T03. Terahertz Technologies and Applications

Gun-Sik Park (Seoul National University, Korea) Co-chair
Sakai Kiyomi (NICT, Japan) Co-chair
Jaewook Ahn (KAIST, Korea)
Eunmi Choi (Ulsan National Institute of Science and Technology, Korea)
Haewook Han (POSTECH, Korea)
Jae-Hyung Jang (GIST, Korea)
Tae In Jeon (Korea Maritime and Ocean University, Korea)
Youngwook Jeong (KAERI, Korea)
Kodo Kawase (Nagoya University, Japan)
Pilhan Kim (KAIST, Korea)
Sangin Kim (Ajou University, Korea)
Chiko Otani (RIKEN, Japan)
Kyung Hyun Park (ETRI, Korea)
Joohiuk Son (University of Seoul, Korea)

Technical Program Committee

T04. High Power, High Energy Lasers

Yong-Ho Cha (KAERI, Korea) Co-chair
Kiminori Kondo (Japan Atomic Energy Agency, Japan) Co-chair
Xiaoyan Liang (Shanghai Institute of Optics and Fine Mechanics, China)
Changhwan Lim (KAERI, Korea)
Zhiwei Lu (Harbin Institute of Technology, China)
Yasuo Nabekawa (RIKEN Center for Advanced Photonics, Japan)
Liejia Qian (Shanghai Jiao Tong University, China)
Jae Hee Sung (GIST, Korea)
Dong-Il Yeom (Ajou University, Korea)
Hidetsugu Yoshida (Osaka University, Japan)

T05. Plasmonics and Metamaterials

Q-Han Park (Korea University, Korea) Co-chair
Hongxing Xu (Chinese Academy of Sciences, China) Co-chair
Wonshik Choi (Korea University, Korea)
Sergey Gaponenko (National Academy of Sciences of Belarus, Belarus)
Yuri S. Kivshar (Australian National University, Australia)
Hong-Gyu Park (Korea University, Korea)
Junsuk Rho (POSTECH, Korea)
Yung Doug Suh (KRICT, Korea)
Hong Wei (CAS, China)
Jeong Weon Wu (Ewha Womans University, Korea)

T06. Laser Processing and Innovative Applications

Jiyeon Choi (KIMM, Korea) Co-chair
Ya Cheng (SIOM, China) Co-chair
Sung Hak Cho (KIMM, Korea)
Sung Ho Jeong (GIST, Korea)
Sae-Chae Jeoung (KRISS, Korea)
Saulius Juodkazis (Swinburne University, Australia)
Dongsik Kim (POSTECH, Korea)
Yan-Qing Lu (Nanjing University, China)
Yoshiki Nakata (Osaka University, Japan)
Hong-Jin Park (LTS, Korea)
Martin Richardson (University of Central Florida, USA)
Koji Sugioka (RIKEN, Japan)
Xia Yu (SIMTECH, Singapore)

Technical Program Committee

T07. Optical Metrology and Sensing

Seung Kwan Kim (KRISS, Korea) Co-chair
Terubumi Saito (Tohoku Institute of Technology, Japan) Co-chair
Bo-Hun Choi (Dong-A University, Korea)
Haiyong Gan (NIM, China)
Jonghan Jin (KRISS, Korea)
Masashi Kuwahara (EPRI/AIST, Japan)
Dong-Hoon Lee (KRISS, Korea)
Tim J. Malthus (CSIRO, Australia)
Hyug-Gyo Rhee (KRISS, Korea)
Atsushi Sato (Tohoku Institutue of Technology, Japan)
Dai Hyuk Yu (KRISS, Korea)
Akio Yoshizawa (EPRI/AIST, Japan)

T08. Quantum Optics, Atomic Physics, and Quantum Information

Yoon-Ho Kim (POSTECH, Korea) Co-chair
Christian Kurtsiefer (National University of Singapore, Singapore) Co-chair
Kyung Soo Choi (University of Waterloo, Canada)
Jiangfeng Du (USTC, China)
Keiichi Edamatsu (Tohoku University, Japan)
Hyunseok Jeong (Seoul National University, Korea)
Dzmitry Matsukevich (NUS, Singapore)
Jian-Wei Pan (USTC, China)
Scott Parkins (University of Auckland, New Zealand)
Geoff Pryde (Griffith University, Australia)
Yoshiro Takahashi (Kyoto University, Japan)
Xiang-Bin Wang (Tsinghua University, China)

T09. Nitrides, Other Widegap Semiconductors

Jong-In Shim (Hanyang University, Korea) Co-chair
Satoshi Kamiyama (Meijo University, Japan) Co-chair
Jong Hyeob Baek (KOPTI, Korea)
Yong-Hoon Cho (KAIST, Korea)
Jen-Inn Chyi (National Central University, Taiwan)
Jung Han (Yale University, USA)
Hideki Hirayama (RIKEN, Japan)
Jong Kyu Kim (POSTECH, Korea)
Dong-Seon Lee (GIST, Korea)
In-Hwan Lee (Chonbuk National University, Korea)
Sung-Nam Lee (Korea Polytechnic University, Korea)
Tien-Chang Lu (National Chiao Tung University, Taiwan)
Yi Luo (Tsinghua University, China)
Hideto Miyake (Mie University, Janpan)
Dong-Soo Shin (Hanyang University, Korea)
Xinqiang Wang (Peking University, China)
Chih Ching Yang (National Taiwan University, Taiwan)

Technical Program Committee

T10. Micro and Nanophotonics

Bumki Min (KAIST, Korea) Co-chair
Masaya Notomi (NTT Basic Research Laboratories, Japan) Co-chair
Hyunyong Choi (Yonsei University, Korea)
Muhan Choi (Kyungpook National University, Korea)
Ki-Hun Jeong (KAIST, Korea)
Young Chul Jun (UNIST, Korea)
Dong-Wook Kim (Ewha Womans University, Korea)
Jin Tae Kim (ETRI, Korea)
Zee Hwan Kim (Seoul National University, Korea)
Seungwoo Lee (Sungkyunkwan University, Korea)
Ding Ping Tsai (National Taiwan University, Taiwan)
Qihua Xiong (National University of Singapore, Singapore)

T11. Biophotonics and Applications

Dug Young Kim (Yonsei University, Korea) Co-chair
Chen-Yuan Dong (National Taiwan University, Taiwan) Co-chair
Min Gu (Swinburne University of Technology, Australia) Co-chair
Jin U. Kang (Johns Hopkins University, USA)
Satoshi Kawata (Osaka University, Japan)
Byeong Ha Lee (GIST, Korea)
Qingming Luo (Huazhong University of Science and Technology, China)
Yuan Luo (National Taiwan University, Taiwan)
Yong Keun Park (KAIST, Korea)
Junle Qu (Shenzhen University, China)
David D. Sampson (The University of Western Australia, Australia)
Yoshiaki Yasuno (University of Tsukuba, Japan)
Andy Yun (Harvard University, USA)

T12. Semiconductor and Intergrated Optical Devices

Kyoungho Ha (Samsung Electronics Co., Ltd., Korea) Co-chair
Kazumi Wada (University of Tokyo, Japan) Co-chair
Benjamin J. Eggleton (University of Sydney, Australia)
Norbert Grote (Fraunhofer HHI, Germany)
Il-Ki Han (KIST, Korea)
Jong-Moo Lee (ETRI, Korea)
Jifeng Liu (Dartmouth College, China)
Nobuhiko Nishiyama (Tokyo Institute of Technology, Japan)
Hyo-Hoon Park (KAIST, Korea)
Hyundai Park (Aurrion, USA)
Jin-Hong Park (Sungkyunkwan University, Korea)
Dongjae Shin (Samsung Electronics Co., Ltd., Korea)
Zhiping Zhou (Peking University, China)

Technical Program Committee

T13. Display, Storage, and Applications

Jae-Hyeung Park (Inha University, Korea) Co-chair
Hirotsugu Yamamoto (Utsunomiya University, Japan) Co-chair
Heejin Choi (Sejong University, Korea)
Munekazu Date (NTT, Japan)
Joonku Hahn (Kyungpook National University, Korea)
Yi-Pai Huang (National Chiao Tung University, Taiwan)
Hak-Rin Kim (Kyungpook National University, Korea)
Jung-Ho Kim (Kyunghee University, Korea)
Nam Kim (Chungbuk National University, Korea)
Seung-Cheol Kim (Kwangwoon University, Korea)
Osamu Matoba (Kobe University, Japan)
Daisuke Miyazaki (Osaka City University, Japan)
Yasuhiro Mizutani (University of Tokushima, Japan)
Tatsuhiko Muroi (NHK, Japan)
Tomoyoshi Shimobaba (Chiba University, Japan)
Xiaodi Tan (Beijing Institute of Technology, China)
Yongtian Wang (Beijing Institute of Technology, China)
Masahiro Yamaguchi (Tokyo Institute of Technology, Japan)
Changhe Zhou (SIOM, China)

III. Conference Information

1. General Information

Official Language

English is the official language of the conference and will be used for all the printed materials, presentations, and discussions.

Poster Session

Date: August 26 (Wed) and 27 (Thu), 2015
Time: 13:45 ~ 15:15
Venue: Exhibition Hall, 1F

Post-deadline Paper (PDP) Session

Date: August 27 (Thu), 2015
Time: 18:00 ~ 19:30
Venue: #101 (Room A), 1F
The result of paper selection will be announced on the message board on Tuesday, August 25, 2015.

Insurance

The organizer cannot accept responsibility for accidents that might occur over the course of the conference period. Participants are expected to have purchased suitable form of travel insurance beforehand.

Electricity

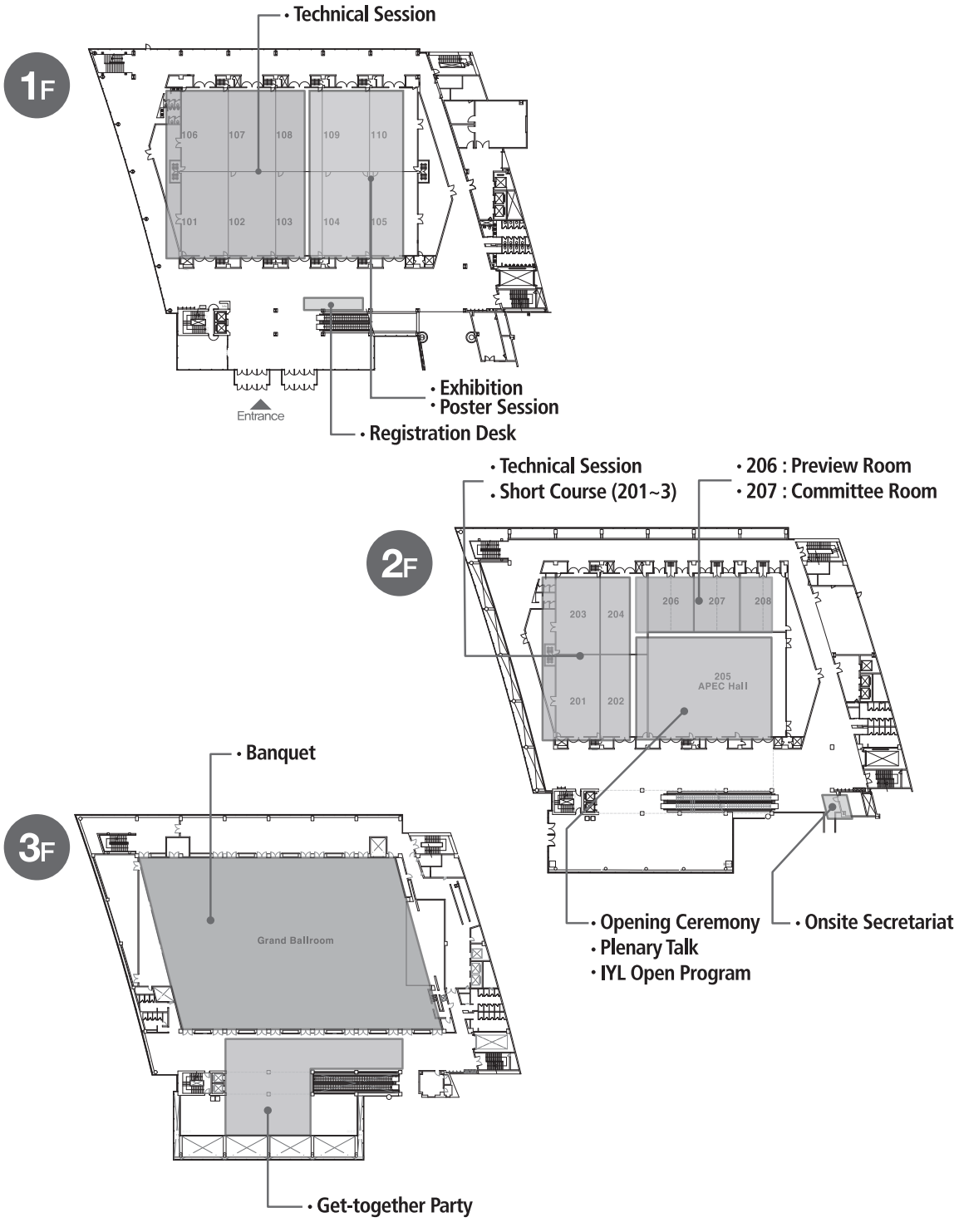
Please be advised that the standard outlet voltage is 220 V in Korea.

Conference Venue “BEXCO”

Address: #55 APEC-ro, Haeundae-gu, Busan
Tel: 82+51-740-7300
Website: **http://www.bexco.co.kr/eng/Main.do**
* You can use Free WiFi . SSID is posted on the Message Board.

2. Floor Plan

Floor Plan



3. Official Program

Get-together Party

Date Monday, August 24, 2015
Time 18:30 ~ 20:00
Place Grand Ballroom Lobby, 3F
All participants are invited. Light snacks and refreshments will be served.
This party is supported by OSA.

Opening Ceremony

Date Tuesday, August 25, 2015
Time 08:40 ~ 09:00
Place #205, 2F

Banquet

Date Wednesday, August 26, 2015
Time 18:00 ~ 20:00
Place Grand Ballroom, 3F
Banquet is included in Regular registration fee.
Extra banquet ticket is KRW 66,000.
It can be purchased at the registration desk.

4. Conference Facilities

On-site Secretariat

Place # C252

The on-site secretariat will be open during the conference as follows.

Date	Aug 24	Aug 25	Aug 26	Aug 27	Aug 28
Time	08:30~19:00	08:30~18:00	08:30~19:00	08:30~18:00	08:30~12:00

Preview Room

Place # 206

Authors and speakers can prepare their presentation in the preview room.
This room is equipped with a laptop computer and wired Internet.
The preview room will be open during the conference as follows.

Date	Aug 25	Aug 26	Aug 27	Aug 28
Time	09:00~17:00	09:00~17:00	09:00~17:00	09:00~11:00

5. Registration Information

If you could not register by July 22, please register at the on-site registration desk.
The registration desk will be located in front of Room #104, #105 (1st floor) at BEXCO. All payments are to be made in KRW, either by cash or credit card.

The registration desk will be open during the conference as follows.

Date	Aug 24	Aug 25	Aug 26	Aug 27	Aug 28
Time	12:00~19:00	08:00~18:00	08:00~18:00	08:00~18:00	08:00~12:00

On-site registration fee

Type	Fee
Regular	KRW 770,000
Student	KRW 385,000
Additional Banquet Ticket	KRW 66,000

(* KRW means Korean Won)

Regular Registration Fee includes;

Access to all technical sessions, admission to Exhibition, IYL Program, Get-Together Party, Banquet, and one copy of USB conference proceedings

Student Registration Fee includes;

Access to all technical sessions, admission to Exhibition, IYL Program, Get-Together Party, and one copy of USB conference proceedings

Registration Receipt

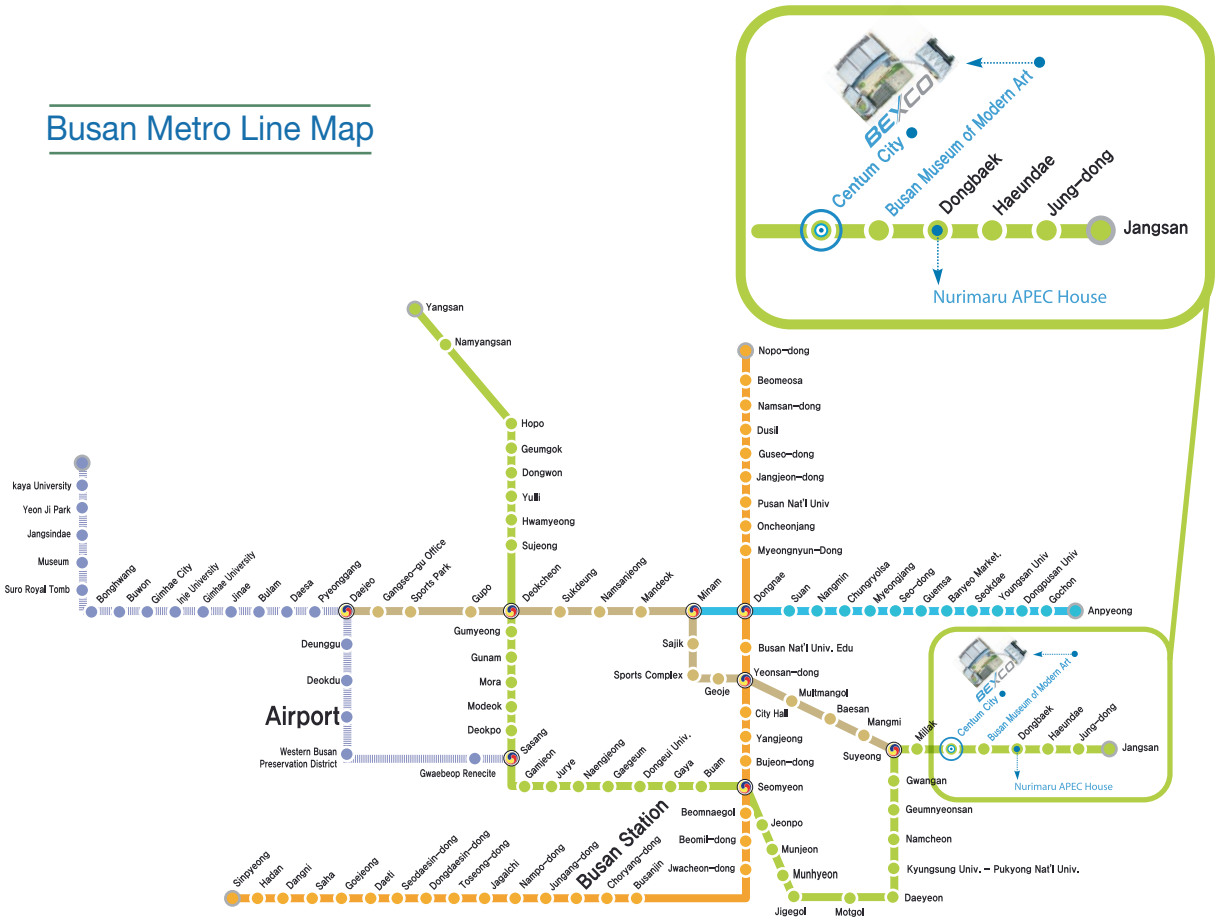
A receipt will be issued at the registration desk together with the name tag packages during the conference.

Registration Bag (Conference KIT)

Registration Bag will be distributed at the registration desk. Each bag will contain a name tag, conference program book, USB conference proceedings and other materials.

6. Transportation

Busan Metro Line Map



IV. Conference Program

1. Plenary Talks
2. Short Courses
3. Tutorial Speakers
4. Invited Speakers
5. Oral and Poster Sessions

1. Plenary Talks

Overview of Plenary Talk

Date & Time	Plenary Speaker	Session Chair
25 August (Tue) 09:00~09:45	**Plenary Talk I** **Optical Antennas; Spontaneous Emission Faster than Stimulated Emission** **Prof. Eli Yablonovitch** *University of California, Berkeley, USA* *Place: Summit Hall (#205), 2nd floor, BEXCO Convention Hall*	**Jung H. Shin** (KAIST)
25 August (Tue) 09:45~10:30	**Plenary Talk II** **FTTH – Past, Present, and Future** **Prof. Yun C. Chung** *Korea Advanced Institute of Science and Technology, Korea* *Place: Summit Hall (#205), 2nd floor, BEXCO Convention Hall*	**Sang Bae Lee** (KIST)
27 August (Thu) 09:00~09:45	**Plenary Talk III** **Coherent Ising Machine Based on Optical Parametric Oscillator Network** **Prof. Yoshihisa Yamamoto** *Stanford University, USA / Japan Science and Technology Agency, Japan* *Place: Summit Hall (#205), 2nd floor, BEXCO Convention Hall*	**Yoon-Ho Kim** (POSTECH)
27 August (Thu) 09:45~10:30	**Plenary Talk IV** **5PW High Gain Large Aperture Ti:sapphire CPA Amplifier** **Prof. Ruxin Li** *Shanghai Institute of Optics and Fine Mechanics, China* *Place: Summit Hall (#205), 2nd floor, BEXCO Convention Hall*	**Dong-Eon Kim** (POSTECH)

Plenary Talk I : Optical Antennas; Spontaneous Emission Faster than Stimulated Emission

Prof. Eli Yablonovitch (University of California, Berkeley, USA)

Date & Time	August 25 (Tue.) 09:00 ~ 09:45
Place	Summit Hall (#205), 2nd floor, BEXCO Convention Hall

Biography

Eli Yablonovitch is Director of the NSF Center for Energy Efficient Electronics Science (E3S), a multi-University Center based at Berkeley.

After a career in industry and in Universities, he is now Professor of Electrical Engineering and Computer Sciences at UC Berkeley, where he holds the James & Katherine Lau Chair in Engineering.

He contributed the 4(n squared) light-trapping factor to solar cells, which is used commercially in most solar panels world-wide. He introduced the benefit of strained lasers, an idea which is employed in almost all Internet telecommunications. He is regarded as a Father of the Photonic BandGap concept, and he coined the term "Photonic Crystal".

Prof. Yablonovitch is a Fellow of the OSA, the IEEE, and the American Physical Society. He was elected as a Member of the National Academy of Engineering, the National Academy of Sciences, the American Academy of Arts & Sciences, and Foreign Member of the Royal Society of London. He has been awarded the Adolf Lomb Medal, the W. Streifer Scientific Achievement Award, the R.W. Wood Prize, the Julius Springer Prize, the IET Mountbatten Medal (UK), the IEEE Photonics Award, the Harvey Prize (Israel), and the Rank Prize (UK). He also has an honorary Ph.D. from the Royal Inst. of Tech., Stockholm Sweden, and the Hong Kong Univ. of Sci. & Technology.

Abstract

Antennas emerged at the dawn of radio for concentrating electromagnetic energy into a small volume $<< \lambda^3$, allowing for nonlinear radio detection. Such coherent detection is essential for radio receivers, and has been used since the time of Hertz.

Conversely, an antenna can efficiently extract radiation from a sub-wavelength source, such as a small cellphone. Likewise, antennas can accelerate spontaneous emission from a small quantum dot or molecule, whose emission rate can become faster than stimulated emission. Antennas interact equally, with real electromagnetic fields, as well as the quantum zero point field fluctuations that are responsible for spontaneous emission.

Regrettably, antenna physics is hardly addressed within the Physics curriculum. Whether from Jackson, the Feynman Lectures, or Yariv, it's hard to learn the true beauty of antenna science.

This talk will commence with a pedagogic description of the three most important parts of antenna physics:

1. The Radiation Resistance;
2. The Electromagnetic Capture Cross-Section;
3. The Wheeler Limit on antenna Q.

These properties are encapsulated in an antenna equivalent circuit that provides us with physical understanding. Since antennas are intended to work at frequencies well below the plasma frequency, plasmonic effects are usually a minor perturbation to antenna physics, only contributing some kinetic inductance to the underlying antenna properties.

Plenary Talk II : FTTH – Past, Present, and Future

Prof. Yun C. Chung (Korea Advanced Institute of Science and Technology, Korea)

Date & Time	August 25 (Tue.) 09:45 ~ 10:30
Place	Summit Hall (#205), 2nd floor, BEXCO Convention Hall

Biography

Yun C. Chung is Dean of KAIST Institute and Professor of Electrical Engineering at Korea Advanced Institute of Science and Technology (KAIST), which he joined in 1994.

From 1987 to 1994, he was with the Lightwave Systems Research Department at AT&T Bell Laboratories. From 1985 to 1987, he was with Los Alamos National Laboratory under AWU-DOE Graduate Fellowship Program.

His current research activities include high-capacity optical transmission systems and networks, optical performance monitoring techniques, WDM passive optical networks, and fiber-optic networks for wireless communications, etc.

He has published over 500 journal and conference papers in these areas and holds over 80 patents. He has been General Co-Chair of OFC, OECC, and APOC, and is currently serving as President of the Optical Society of Korea.

Prof. Chung is a Fellow of IEEE, OSA, Korean Academy of Science and Technology, and National Academy of Engineering of Korea.

Abstract

The first fiber-to-the-home (FTTH) trial started in 1978. However, high cost and uncertain service demand prevented widespread deployment until about 15 years ago.

FTTH is now experiencing fast growth with the number of global FTTH subscribers exceeding 143 million at the end of 2014.

This talk reviews the past history, current status, and future direction of FTTH networks with special emphasis on the results achieved at KAIST.

Plenary Talk III : Coherent Ising Machine Based on Optical Parametric Oscillator Network

Prof. Yoshihisa Yamamoto (Stanford Univ., USA / JST, Japan)

Date & Time	August 27 (Thu.) 09:00 ~ 09:45
Place	Summit Hall (#205), 2nd floor, BEXCO Convention Hall

Biography

Yoshihisa Yamamoto received his B.S. degree from Tokyo Institute of Technology and his Ph.D. degree from the University of Tokyo.

He is a program manager for Impulsive Paradigm Change through Disruptive Technologies Program (ImPACT) of the Council for Science, Technology and Innovation of Cabinet Office of Government of Japan.

He is currently a Professor (emeritus) of Stanford University and National Institute of Informatics, and NTT R&D fellow.

Abstract

Combinatorial optimization problems are ubiquitous in our modern life, but most of them belong to NP-hard or NP-complete class in the complexity theory.

Assuming the widely believed P≠NP conjecture, there is no efficient classical nor quantum algorithm for solving them.

The past 40 years in computer science are thus the history of devising approximation algorithms which return a reasonably accurate solution in polynomial time.

In this talk, we will present a novel optical network machine for solving NP-hard combinatorial optimization problems.

The proposed computing system takes an advantage of criticality at the degenerate optical parametric oscillator (DOPO) phase transition and maps a three-dimensional Ising model onto the loss of the DOPO network.

We will present the principle, performance comparison against standard approaches based on simulated annealing and semi-definite programming, and proof-of-concept experiments.

Plenary Talk IV : 5PW High Gain Large Aperture Ti:sapphire CPA Amplifier

Prof. Ruxin Li (Shanghai Institute of Optics and Fine Mechanics, China)

Date & Time	August 27 (Thu.) 09:45 ~ 10:30
Place	Summit Hall (#205), 2nd floor, BEXCO Convention Hall

Biography

Ruxin Li received his PhD degree in optical physics in 1995 from Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences.

Since 1998 he has been working at SIOM as a full professor.

He is currently the director of SIOM and the director of State Key Laboratory of High Field Laser Physics at SIOM. His research interests include ultra-high-intensity femtosecond lasers, laser acceleration of particles, high order harmonic generation and filamentation nonlinear optics.

He has published more than 120 papers in high quality research journals and delivered more than 50 invited talks in academic conferences. He was elected fellow of OSA in 2014.

He is currently the Vice President of Chinese Optical Society (COS); Chair of Laser Subcommittee of COS; Vice Chair of Division of Quantum Electronics and Optoelectronics, Chinese Society of Electronics. He is a Member of International Committee on High Intensity Lasers; Member of ELI-ALPS Scientific Advisory Committee; associate editor in chief of Chinese Optics Letters and Member of editorial board of Chinese Physics Letters.

Abstract

We reported the latest progress on developing a 10PW ultra-high-intensity laser facility at SIOM. Over 1PW at 800nm central wavelength output from a hybrid CPA-OPCPA laser system was demonstrated, showing the possibility of 10PW 30fs laser pulse output with a large aperture LBO crystal based OPCPA booster amplifier.

In the meantime, a high gain chirped pulse amplifier based on a 150mm in diameter Ti: sapphire crystal was demonstrated, with the highest output pulse energy of 192.3J when pumped with a 312J green laser pulse, corresponding to a pump-laser efficiency of 50.4%.

The amplified chirped pulse has a bandwidth of 50 nm at 800nm central wavelength. With the grating compressor of 72% efficiency and the 27fs long compressed pulse obtained at lower energy level, this Ti:sapphire amplifier could support a compressed laser pulse of 5PW peak power.

2. Short Courses

Overview of Short Course

Date & Time	Speaker	Room
24 August 16:30~18:30	**Short Course I** **Metamaterial : Fundamentals and Applications** **Prof. Namkyoo Park** *Seoul National University, Korea*	#201
	Short Course II **Slow, Stored, and Stationary Light in Cold Atoms** **Prof. Ite A. Yu** *National Tsing Hua University, Taiwan*	#202
	Short Course III **Optical Frequency Comb and its Applications to Metrology** **Prof. Kaoru Minoshima** *University of Electro-Communications, Japan*	#203

Short Course I : Metamaterial : Fundamentals and Applications

Prof. Namkyoo Park (Seoul National University, Korea)

Date & Time	August 24 (Mon.) 16:30 ~ 18:30
Place	#201, 2nd floor, BEXCO Convention Hall

Biography

Prof. Park is currently a professor at the School of EECS at SNU, where he joined in 1997 after a Ph.D. degree from Caltech (Vahala group) and research / industrial experiences in Bell Labs (two years) and Samsung Electronics (one year).

He has authored 130 international journal publications (including Nature, Nature Photonics, Nano Letters, and PRL of 4,900+ total citations), and had worked as an associate editor for IEEE Photonics Technology Letters and OSA Optics Express for over 10 years.

Prof. Park was one of the four recipients of the Young Scientist Award conferred by the president of Korea in 2003.

He is currently leading a nationwide team of Electromagnetic Metamaterials under the larger program of Center for Advanced Meta-Materials (CAMM, Global Frontier Project), which started from 2014 and funded by the Ministry of Science, ICT and Future Planning.

Abstract

The general outcome of the wave propagation is ultimately determined by the properties of its medium, where the wave travels through. In order to achieve an extreme manipulation of the wave propagation, an accessibility to the unusual space of wave parameters are thus obligatory, including regimes not conventionally offered by the natural materials.

Wide variety of artificial, extreme wave parameters and their application have been witnessed for different types of waves and material systems in the name of metamaterials for last 10 years.

In this short course, I will expand the fundamental physics of metamaterial (MM), and list notable achievements / applications made so far, in this exciting field.

Topics to be covered will include: Principles of Electromagnetic MM, Negative index MM, Cloaking & Transformation Optics, Hyperbolic MM, Meta-Surfaces, High index & Zero index MM, Reconfigurable MM, and Acoustic Metamaterials (scope of the course will be adjusted depending on the audiences' previous exposure to Metamaterials).

At the end of the talk, I will also briefly talk about the goals & strategies of Center for Advanced Meta-Materials (CAMM), which started in 2014 as the first nationwide team effort in Korea, dedicated to the development of metamaterial systems.

Short Course II : Slow, Stored, and Stationary Light in Cold Atoms

Prof. Ite A. Yu (National Tsing Hua University, Taiwan)

Date & Time	August 24 (Mon.) 16:30 ~ 18:30
Place	#202, 2nd floor, BEXCO Convention Hall

Biography

Education&Current Employment
Ph.D. in Physics, Massachusetts Institute of Technology (1993).
Professor of Physics, National Tsing Hua University.
Professional Services
Director of the Division of Academy and the Executive Board Member, the Physical Society of R. O. C. Taiwan (2014/1-present).
Editor, Chinese Journal of Physics (2006/1-present).
Convener of the Physics Panel, the Ministry of Science and Technology, Taiwan (2011/1~2013/12).
Physics Panel Member, the Ministry of Science and Technology, Taiwan (2008/1-2010/12).
Director of the Division of International and Continuing Education, National Tsing Hua University (2006/3-2007/8).
Honors and Awards
Fellow of the Physical Society of R. O. C. Taiwan.
Outstanding Scholar Award, Foundation for the Advancement of Outstanding Scholarship (2013).
Ministry of Science and Technology Outstanding Research Award (2012).
National Tsing Hua University Outstanding Mentor Award (2009).
Research Interests
EIT, slow light, light storage, low-light-level nonlinear optics, quantum memory, quantum optics, and quantum information manipulation.
Representative Publications
[1] M. J. Lee, J. Ruseckas, C. Y. Lee, V. Kudriašov, K. F. Chang, H. W. Cho, G. Juzeliūnas, and I. A. Yu,"Experimental demonstration of spinor slow light," Nature Commun. 5, 5542 (2014).
[2] Y. H. Chen, M. J. Lee, I. C. Wang, S. Du, Y. F. Chen, Y. C. Chen, and I. A. Yu, "Coherent Optical Memory with High Storage Efficiency and Large Fractional Delay" Phys. Rev. Lett. 110, 083601 (2013).
[3] Y. H. Chen, M. J. Lee, W. Hung, Y. C. Chen, Y. F. Chen, and I. A. Yu, "Demonstration of the Interaction between Two Stopped Light Pulses," Phys. Rev. Lett. 108, 173603 (2012).
[4] Y. W. Lin, W. T. Liao, T. Peters, H. C. Chou, J. S. Wang, H. W. Cho, P. C. Kuan, and I. A. Yu, "Stationary Light Pulses in Cold Atomic Media and without Bragg Gratings," Phys. Rev. Lett. 102, 213601 (2009).
[5] Y. F. Chen, C. Y. Wang, S. H. Wang, and I. A. Yu, "Low-Light-Level Cross-Phase- Modulation Based on Stored Light Pulses," Phys. Rev. Lett. 96, 043603 (2006).
[6] Y. C. Chen, Y. A. Liao, H. Y. Chiu, J. J. Su, and I. A. Yu, "Observation of the quantum interference phenomenon induced by interacting dark resonances," Phys. Rev. A 64, 053806 (2001).

Abstract

The outline of the short course is listed below:
- Introduction.
- Electromagnetically induced transparency (EIT).
- Slow light and storage of light.
- Theoretical tool and experimental setup for the system of cold atoms.
- Low-light-level nonlinear optics.
- Stationary light.
- Interaction between two motionless light pulses.
- EIT-based quantum memory.
- Two-component or spinor slow light.
- Outlooks.

Short Course III : Optical Frequency Comb and its Applications to Metrology

Prof. Kaoru Minoshima (University of Electro-Communications, Japan)

Date & Time	August 24 (Mon.) 16:30 ~ 18:30
Place	#203, 2nd floor, BEXCO Convention Hall

Biography

Kaoru Minoshima is a Professor at the University of Electro-Communications (UEC), Tokyo, Japan. She is also the research director of Intelligent Optical Synthesizer Project, Exploratory Research for Advanced Technology (ERATO), Japan Science and Technology Agency (JST). She received her Ph.D. degree in science from the University of Tokyo in 1993, and joined the National Research Laboratory of Metrology (NRLM), Japan. She became a senior scientist at NRLM in 1997 and at the National Institute of Advanced Industrial Science and Technology (AIST) in 2001. In 2007, she became group leader of the Length Standards Section at the National Metrology Institute of Japan (NMIJ), AIST. From 2011 to 2013, she served as Bureau Manager at the Innovation School, AIST. In April 2013, she moved to the University of Electro-Communications. Prof. Minoshima also served as a Visiting Professor at the University of Bordeaux I, France (1996), a Visiting Scientist at the Massachusetts Institute of Technology, USA (2000-2001), and a guest professor at the Tokyo University of Science (2007-2013).

Her areas of research are ultrafast optical science and technology and their application to optical metrology, particularly time-resolved imaging, generation of frequency combs, and precision metrology using frequency combs.
She received the Prize for Science and Technology given by the Minister of Education, Culture, Sports, Science and Technology (MEXT), Japan, in 2008, and the first Women Scientists Award from the Japan Society of Applied Physics (JSAP) in 2010, Distinguished Paper Award of Laser Society of Japan, and Nice-Step Award from NISTEP, MEXT, in 2013.

Prof. Minoshima served as the Conference on Lasers and Electro-Optics (CLEO) Technical Subcommittee Chair (2004-2005), where she built a new subcommittee for Optical Metrology, and as Subcommittee member (2006-2008), Program Co-Chair (2009), and General Co-Chair (2011). She has also served on technical and organizing committees for several other international conferences, including CLEO-Pacific Rim, CLEO-Europe, IQEC, Ultrafast Phenomena, and ASSP. She served as a member of the Townes Award selection committee of The Optical Society (OSA) (2012-2013).

Prof. Minoshima is a member of the Science Council of Japan (2011-present). She has served as editor of the Japanese Journal of Applied Physics (JJAP) (2006-2009), Program Chair of Optics Photonics Japan (2011), and she is involved with several other academic and society activities in Japan. She is a Fellow of the JSAP and OSA, and a member of the Physical Society of Japan and Laser Society of Japan.

Abstract

Optical frequency combs have opened up several new application fields not only in frequency metrology as “ultraprecise frequency ruler” but also in broad area such as fundamental science, broadband spectroscopy, communications, signal processing, environmental sensing, biomedical diagnosis, length and distance measurements, industrial measurements, space technology, and astronomy. Since optical frequency comb can be used as a tool for fully controlling the phase, timing, and frequency information of light waves, i.e., “optical synthesizer”, light can be used to its full extent with an extreme precision and wide dynamic range. In this short course, I will give an overview of technologies of optical frequency combs, including its historical background, fundamental technologies for generation and control of combs, types of light sources, key technologies for various applications, and finally some of the examples of applications.

3. Tutorial Speakers

25G1-1 **Quantum Optomechanics**
Warwick Bowen (University of Queensland, Australia)

25I3-1 **Photonic Structures for Information and Energy Applications**
Shanhui Fan (Stanford University, USA)

26B2-1 **Volume Processing of Transparent Materials by Ultrashort Laser Pulses: Potential and Applications**
Stefan Nolte (Friedrich Schiller University Jena, Germany)

4. Invited Speakers

Tuesday, August 25

25A1-1 **Diamond Raman Lasers: Nonlinear Optical Beam Conversion at High Average Powers**
Richard Mildren (Macquarie University, Australia)

25A1-2 **High Power Single Frequency Raman Fiber Amplifiers**
Yan Feng (Chinese Academy of Sciences, China)

25A2-1 **GHz Level Fiber Laser and Frequency Comb**
Zhigang Zhang (Peking University, China)

25B1-1 **fvision: Interactive Glasses-free 3D Images Floating on a Flat Tabletop Surface**
Shunsuke Yoshida (National Institute of Information and Communications Technology, Japan)

25B2-1 **Ultrafast Laser Materials Processing for Manufacturing Innovation**
Jiyeon Choi (KIMM, Korea)

25B3-1 **High-Energy Nonlinear Optics in Fiber**
Siddharth Ramachandran (Boston University, USA)

25B3-2 **Diode-Pumped Alexandrite Laser - a New Prospect for Remote Sensing**
Michael Damzen (Imperial College London, UK)

25C1-1 **Frequency Domain Optical Parametric Amplification**
Francois Legare (Institut National de la Recherche Scientifique, Canada)

25C2-1 **Observation of Attosecond Quantum Wavepackets in Molecules**
Katsumi Midorikawa (RIKEN Center for Advanced Photonics, Japan)

25C2-3 **Ultrahigh-intensity Laser-plasma Interactions Using Structured Light Fields**
Fabien Quere (Commissariat à l'Energie Atomique, France)

25C3-1 **Optical Constants Measurement of Nonlinear Crystals for Terahertz Generation**
Nan El Yu (GIST, Korea)

25D1-1 **Nonlinearity Management: From Fiber Oscillators to Amplifiers**
F. Ömer Ilday (Bilkent University, Turkey)

25D1-2 **Coherent Combination of Ultrafast Laser: A Path towards High Repetition Rate Joule-class fs Pulses**
Arno Klenke (Friedrich-Schiller-Universität Jena, Germany)

25D2-1 **Ultrafast Thin Disk Lasers: towards Intralaser Extreme Nonlinear Optics**
Thomas Südmeyer (Université de Neuchâtel, Switzerland)

25D3-1 **Laser Materials Processing Technologies and the Future**
Martin Richardson (University of Central Florida, USA)

25D3-2 **Laser Doping and Texturing of Silicon for Advanced Optoelectronic Devices**
Eric Mazur (Harvard University, USA)

25E1-1 **Recent Advances on Metasurfaces**
Lei Zhou (Fudan University, China)

25E2-1 **All-Dielectric Metasurfaces**
Jason Valentine (Vanderbilt University, USA)

25E3-1 **Top-down and Bottom-up Fabrication Techniques for Isotropic Metamterials**
Takuo Tanaka (RIKEN, Japan)

25F1-1 **A Flat Spectral Photon Flux Source for Single Photon Detector Quantum Efficiency Calibration**
Haiyong Gan (National Institute of Metrology, China)

25F2-1 **Length Metrology with Ultra-high Precision Using Fiber-based Optical Frequency Combs**
Kaoru Minoshima (University of Electro-Communications, Japan)

25F2-2 **Dimensional Metrology for Smart Devices Using the Optical Comb of Femtosecond Pulse Lasers**
Jonghan Jin (KRISS, Korea)

25G2-1 **New Directions in Optical Quantum Computing**
Tim C. Ralph (University of Queensland, Australia)

25G3-1 **Slow, Stored, and Stationary Light for the Applications in Low-Light-Level Nonlinear Optics and Quantum Memory**
Ite A. YU (National Tsing Hua University, Taiwan)

25G3-2 **Superfluid Optomechanics**
Warwick Bowen (University of Queensland, Australia)

25H1-1 **Growth of Light-Emitting Devices Based on InGaN Quantum Dots by MOVPE**
Lai Wang (Tsinghua University, China)

25H1-2 III-Nitride Quantum Dot Based Light Emitting Diodes for UV Emission
Julien Brault (CNRS-CRHEA, France)

25H2-1 Two-dimensional Mapping of Strain and Piezoelectric Polarization in InGaN/GaN MQWs by Electron Dark-field Holography
Sang Ho Oh (POSTECH, Korea)

25H2-2 Study of Percolation Transport in the InGaN/AlGaN LEDs with Random Alloy Fluctuation
Yuh-Renn Wu (National Taiwan University, Taiwan)

25H3-1 Visible-wavelength Two-photon Excitation Microscopy
Katsumasa Fujita (Osaka University, Japan)

25I2-1 Localized Toroidal Dipole Moment of Spoof Surface Plasmon Polaritons
Sang Soon Oh (Imperial College London, UK)

25J1-1 Silicon-Photonics Devices for Chip to Chip Communications
Ken Morito (Photonics Electronics Technology Research Association, Japan)

25J2-1 Silicon Photonic Integration Platform for Optical Communications and Other Applications
Hiroshi Fukuda (NTT, Japan)

25J3-1 GeSn Optical Gain Media Towards Monolithic 3D Photonic Integration
Jifeng Liu (Dartmouth College, USA)

25J3-2 Heterogeneous Integration of Silicon Photonic Devices and Integrated Circuits
Hyundai Park (Aurrion Inc., USA)

Wednesday, August 26

26A1-1 Development of an Ultrafast Thin-Disk Ring Oscillator with an Intra-Cavity Average Power Higher than 1 kW
A. Amani Eilanlou (RIKEN Center for Advanced Photonics, Japan)

26A2-1 Gate-Controlled All-Fiber Graphene Device and Its Application to Ultrafast Fiber Laser System
Dong-Il Yeom (Ajou University, Korea)

26A3-1 Sub-Fs Hybrid Synchronization between Mode-Locked Fiber Lasers
Yinchieh Lai (National Chiao Tung University, Taiwan)

26B1-1 Low Temperature Laser Processing for the Application in Flexible & Stretchable Electronics
Seung Hwan Ko (Seoul National University, Korea)

26B1-2 Novel Process for Nano-structuring of Conducting Polymer Thin Film
Hyo Jung Kim (Pusan National University, Korea)

26B2-2 Femtosecond Laser Patterning of Plasmonic and Nonlinear Optical Properties in Silver-doped
Lionel Canioni (Universite Bordeaux, France)

26B3-1 Highly Immersive Head-mounted Displays Based on Aspherical and Freeform Optics
Yongtian Wang (Beijing Institute of Technology, China)

26B3-2 Switchable Liquid Crystal Lens for 3D Applications
Hak-Rin Kim (Kyungpook National University, Korea)

26C3-1 Strong-field-ionization Induced Air Lasers
Ya Cheng (Shanghai Institute of Optics and Fine Mechanics ,China)

26D1-1 Precision Performance for Full-scale Operation of LFEX PW Laser
Noriaki Miyanaga (Osaka University, Japan)

26D1-2 Recent Progress and Research Status of Petawatt Femtosecond Lasers in SIOM
Xiaoyan Liang (Shanghai Institute of Optics and Fine Mechanics, China)

26D1-3 Dynamics of Cluster Ionization and Neutral Atom Acceleration
Krishnamurthy Manchikanti (Tata institute of Fundamental Research, India)

26D2-1 0.1 Hz 4.0 PW Ti:Sapphire Laser at CoReLS
Jae Hee Sung (GIST, Korea)

26D2-2 Recent Progress on an Upgrade of the J-KAREN Laser at JAEA
Hiromitsu Kiriyama (Japan Atomic Energy Agency, Japan)

26D2-3 Ultra-high Intensity Laser-Matter Interaction Studies at RRCAT, India
Juzer Ali Chakera (Raja Ramanna Centre for Advanced Technology, India)

26D3-1 High Performance Materials Processing Using Tailored Femtosecond Laser Pulses
Fei He (Shanghai Institute of Optics and Fine Mechanics, China)

26D3-2 Optical Fabrication and Operation of Micronano-Robots
Hong-Bo Sun (Jilin University, China)

26E1-1 Parity-time Optical Metamaterials
Zi Jing Wong (University of California, Berkeley, USA)

26E2-1 Light Emission Enhancement by using Patterned Multilayer Hyperbolic Metamaterials
Zhaowei Liu (University of California, San Diego, USA)

26E2-5 Stimuli Responsive Plasmonic Resonator and Its Sensing Application
Sunghwan Kim (Ajou University, Korea)

26E3-1 Plasmon Lasers: Development, Features and Applications
Ren-Min Ma (Peking University, China)

26F1-1 Extremely Large Freeform Optics Manufacturing and Testing
Dae Wook Kim (University of Arizona, USA)

26F2-1 Quantum Entangled Photon Sources and Their Application to Quantum Metrology
Shigeki Takeuchi (Kyoto University, Japan)

26F2-2 High Efficiency Single Photon Detection with Optimized SNSPD and Compressed Beam
Labao Zhang (Nanjing University, China)

26F3-1 Ultrahigh-Precision Measurement and Optimization of Timing Jitter in Mode-Locked Lasers
Jungwon Kim (KAIST, Korea)

26G1-1 Vortex Pair Creation and Annihilation in a Bose-Einstein Condensate
Yong-Il Shin (Seoul National University, Korea)

26G2-1 Round-robin Differential-phase-shift QKD Protocol
Masato Koashi (The University of Tokyo, Japan)

26G3-1 Storing Single Photons in a Quantum Register
Joerg Wrachtrup (Stuttgart University, Germany)

26H1-1 Nitride-based Light-emitting Diodes Using Conducting Filament Embedded TCO
Tae Geun Kim (Korea University, Korea)

26H1-2 Drastic Enhancement of Eu Emission from Red Light-emitting Eu-doped GaN in a Microcavity
Yasufumi Fujiwara (Osaka University, Japan)

26H2-1 Expanding Imaging Ranges for Spectral Domain Optical Coherence Tomography
Beop-Min Kim (Korea University, Korea)

26H3-1 Extraordinary Light Transmission for Super-resolved Axial Imaging
Donghyun Kim (Yonsei University, Korea)

26I2-1 Hyperbolic Metamaterials
Ishii Satoshi (National Institute for Materials Science, Japan)

26J1-1 Ultrahigh-Q Asymmetric Microcavity Photonics on a Silicon Chip
Yun-Feng Xiao (Peking University, China)

26J2-1 Development of a Versatile InP-Based Photonic Platform Based on Butt-Joint Integration
Francisco M. Soares (Fraunhofer Heinrich-Hertz Institute, Germany)

26J3-1 Nanophotonics for Future Data Communication and Ethernet Networks
James A. Lott (Technische Universität Berlin, Germany)

Thursday, August 27

27A2-1 Solid-State Lasers Directly Pumped by InGaN Blue/Green Diode Lasers
Fumihiko Kannari (Keio University, Japan)

27B1-1 Continuous Wave Terahertz Signal Generator Based on Difference Frequency Generation in Gallium Phosphide Developed for Industrial Applications
Tetsuo Sasaki (Shizuoka University, Japan)

27B2-1 Biomedical Science and Technology Using Terahertz Waves
Joo-Hiuk Son (University of Seoul, Korea)

27B2-2 A Terahertz Technology for Label-free Immune Assay
Toshihiko Kiwa (Okayama University, Japan)

27B2-3 Ultrafast Spin Spectroscopy for Rare-earth Orthoferrites and Orthochromites by THz Pulses
Makoto Nakajima (Osaka University, Japan)

27C1-1 High Harmonics and Attosecond Pulses – Seeing Inside Molecules
David Villeneuve (National Research Council and University of Ottawa, Canada)

27C1-2 Laser-assisted Electron Scattering and Diffraction in Femtosecond Intense Laser Fields
Reika Kanya (the University of Tokyo, Japan)

27C2-1 Measurement and Control of Optical Waveforms
Kyung Taec Kim (GIST, Korea)

27C2-4 Measurement and Synthesis of Ultrafast Scalar and Vectorial Optical Arbitrary Waveforms
Shang-Da Yang (National Tsing Hua University, Taiwan)

27D1-1 Progress on Mid-infrared Intense Laser Aiming at 100 TW Peak Power
Guo Qiang Xie (Shanghai Jiaotong University, China)

27E1-1 Scattering Superlens: Near-field Focusing and Imaging Exploiting Multiple Scattering in Turbid Media
Yong Keun Park (KAIST, Korea)

27E2-1 High Precision Prediction of Thin Film Composition by LIBS
Sungho Jeong (GIST, Korea)

27F1-1 Optical Observation of DNA Translocation Dynamics through Solid-State Nanopores
Toshiharu Saiki (Keio University, Japan)

27G1-1 Monolithic Optical Integration for Scalable Trapped-ion Quantum Information Processing
David Kielpinski (Griffith University, Australia)

27G2-1 Quantum State Estimation and Discrimination
Shigeki Takeuchi (Kyoto University, Japan)

27G2-2 Advances in Photonic Remote Entanglement Sharing
Geoff Pryde (Griffith University, Australia)

27H1-1 ZnO Microcavity Polariton Lasers
Tien-Chang Lu (National Chiao Tung University, Taiwan)

27H1-2 True Green and Yellow Low-Threshold II-VI Laser Heterostructures for II-VI/III-N Laser Diode Converters
Sergey Ivanov (Ioffe Institute, Russia)

27I1-1 Photonics beyond Multiple Light Scattering
Wonshik Choi (Korea University, Korea)

27I2-1 Classical Imaging Seasoned with Quantum Concepts
Tomohiro Shirai (National Institute of Advanced Industrial Science and Technology, Japan)

27I2-2 Intelligent Video Surveillance System based on Distributed Fiber Vibration Sensing Technique
Kun Liu (Tianjin University, China)

27J1-1 Narrow Linewidth Tunable Lasers for Digital Coherent System
Toshikazu Mukaihara (Furukawa Electric, Japan)

27J2-1 High Speed Modulation Characteristics for Semiconductor Microdisk Lasers
Yong-Zhen Huang (Chinese Academy of Sciences, China)

Friday, August 28

28A2-1 Progress in 1-μm Pumped Mid-IR Optical Parametric Oscillators Based on Non-Oxide Nonlinear Crystals
Valentin Petrov (Max Born Institute, Germany)

28B1-1 Efficient Broadband THz Wave Generation Based on Organic Phenolic Electro-Optic Crystals
O-Pil Kwon (Ajou University, Korea)

28B1-2 Novel THz-wave Detection Technique via Interaction between Optical Pumping Waves and THz-wave Generated by Cherenkov Phase Matching
Koji Suizu (Chiba Instutute of Technology, Japan)

28B2-1 THz Spectroscopic Analysis of Transparent Conductive Silver Nanowire Films
Hyeyoung Ahn (National Chiao-Tung University, Taiwan)

28B2-2 Terahertz Response of Electron Charge and Spin Studied by Time-domain Spectroscopy
Takeshi Nagashima (Setsunan University, Japan)

28C2-1 Growth of Semipolar GaN Substrates by Hydride Vapor Phase Epitaxy on Patterned Sapphire Substrate
Kazuyuki Tadatomo (Yamaguchi University, Japan)

28C2-2 Extremely Low-resistivity and High-carrier-concentration Si-doped AlGaN with Low AlN Molar Fraction for Improvement of Wall Plug Efficiency of Nitride-based LED
Motoaki Iwaya (Meijo University, Japan)

28D1-1 Strong Electromagnetic Wave Generation and Electron Guidance on a Metal Wire Interacted with Intense Femtosecond Laser Pulses
Shuji Sakabe (Kyoto University, Japan)

28D2-1 Single-mode Parity-time-symmetric Micro-ring Lasers
Mercedeh Khajavikhan (University of Central Florida, USA)

28F1-1 Si Based Integrated Switchable Mode Convertor
Songnian Fu (Huazhong University of Science and Technology, China)

28G1-1 Novel Lasers in the Visible Spectral Range
Christian Kränkel (Universität Hamburg, Germany)

28H1-1 Superresolution Imaging Based on Nonlinearities of Plasmonic Scattering
Shi-Wei Chu (National Taiwan University, Taiwan)

28H2-1 In Vivo Multiphoton Imaging of Mouse Brain
Chris Xu (Cornell University, USA)

28H2-2 Intravascular Photoacoustic Tomography for Characterization of Atherosclerotic Lipid and Inflammation
Da Xing (South China Normal University, China)

28I1-1 Video-rate Color Holographic Displays Using Doped Liquid Crystals
Yikai Su (Shanghai Jiao Tong University, China)

28I1-2 3D Color Holographic Imaging by Wavefront Printing
Hoonjong Kang (Korea Electronics Technology Institute, Korea)

28I2-1 Encryption and Data Embedding of Error Diffusion Hologram
Peter Tsang (City University of Hong Kong, Hong Kong, China)

28J1-1 Material Platforms for Nonlinear Integrated Microwave Photonics
David Marpaung (University of Sydney, Australia)

28J2-1 A Fully Analog Electronic Dispersion Compensator for 10-Gb/s Directly Modulated Distributed-Feedback Lasers
Hyeon-Min Bae (KAIST, Korea)

5. Oral and Poster Sessions

Instructions for Oral and Poster Presentations

Oral Presentation

1) Presenting Time

The length of an oral presentation should be as follows: Tutorial Papers 45min. / Invited papers 30 min. / Contributed Paper 15 min. We strongly request that you keep to the time limit, with sufficient time left for questions and discussions.

2) Presentation File

Please prepare your presentation files in English using Microsoft PowerPoint. If you use fonts other than the standard Windows Office 2010 fonts, please bring the associated font files. However, it is recommended that you use the standard fonts such as Arial or Times New Roman.
Please bring your presentation file in a USB drive and and give it to the session assistant in the meeting room at least 10 minutes before the start of your session so that the session assistant will be able to upload the files to the laptop PC.

All presenters are also asked to submit a short autobiography to the session chair at least 10 minutes before the start of the session.

3) Audio Visual (A/V) Equipment

Each session room will have the following equipment:

- Laptop computer with a USB port running MS-Office PowerPoint 2010 on Windows 7
- Smart pointer and mouse
- Beam projector (RGB Port)
- Screen

We strongly recommend that you use the A/V equipment provided by the conference. Should you need to use your own laptop computer (especially an Apple laptop), it is your responsibility to ensure that it is compatible with the A/V equipment in the meeting rooms.

Poster Presentation

All poster presenters are asked to prepare posters following guidelines described below. Posters should be displayed on a designated panel for the assigned time and place.

Session Date / Time:

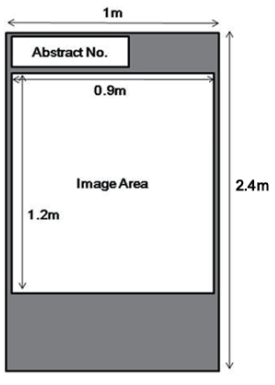
August 26 (WED), 2015. / 9:00am-6:00pm
(Presentation Time: 1:45pm-3:15pm)

August 27 (THU), 2015. / 9:00am-6:00pm
(Presentation Time: 1:45pm-3:15pm)

Session Room:

Exhibition Hall (#103), 1F, Convention Hall, BEXCO

•Poster Size: 0.9m x 1.2m (or 35.4in x 47.2in)
•Poster Panel Size: 1.0m (width) x 2.4m (height)
•Each paper's code will be shown on the panel.
•Scotch tape will be provided for your use. Please do not use double-sided tapes.
•All presenters are required to preside at their poster panel during the session for answers and discussion with participants.
•Each poster should include the paper title, authors, affiliation, abstract number and must fit within the 0.9m x 1.2m poster space.



Room A (101)

Session Title 25A1 / [T01] Raman Lasers
Date & Time Tuesday, 25 August, 11:00 ~ 12:30
Session Chair Valentin Petrov (Max Born Institute, Germany)

[25A1-1] 11:00~11:30 Invited Talk

Diamond Raman Lasers: Nonlinear Optical Beam Conversion at High Average Powers

Richard Mildren

Macquarie University, Australia

Recent advances in high power beam conversion in diamond are reviewed. It is shown that there are excellent prospects for developing high power (kilowatt) devices with diffraction-limited beam quality in bulk and at room temperature.

[25A1-2] 11:30~12:00 Invited Talk

High Power Single Frequency Raman Fiber Amplifiers

Yan Feng

Chinese Academy of Sciences, China

Single frequency Raman fiber amplifiers have been developed for applications of laser guide star and atom physics. Suppression of stimulated Brillouin scattering is the main technical challenge for power scaling.

[25A1-3] 12:00~12:15

Generation of Dissipative Solitons in Normal-Dispersion Raman Fiber Laser

Ugur Tegin[1], Parviz Elahi[1], Cagri Senel[2], E. Emre Ergecen[3], and F. Ömer Ilday[1]

[1]Bilkent University, Turkey, [2]TUBITAK National Metrology Institute, Turkey, [3]METU, Turkey

Dissipative soliton pulses in a synchronously pumped all-normal-dispersion Raman fiber laser is presented theoretically and experimentally. The laser generates 7.1 nJ intra-cavity pulses at 1.12 μm and is compressed to 136 fs.

[25A1-4] 12:15~12:30

Dual-Band Eye-Safe Nd:YAP/KTP Raman Laser

Y. J. Huang[1], Y. F. Chen[1], W. D. Chen[2], and G. Zhang[2]

[1]National Chiao Tung University, Taiwan, [2]Chinese Academy of Science, China

A compact efficient dual-wavelength eye-safe Nd:YAP Raman laser at 1478 and 1503 nm is originally demonstrated based on simultaneous excitations of the cascaded 267 cm^{-1} mode and the 694 cm^{-1} shift in the KTP crystal.

Room B (102)

Session Title 25B1 / [T13] Novel Devices and Systems for Display
Date & Time Tuesday, 25 August, 11:00 ~ 12:30
Session Chairs Yongtian Wang (Beijing Institute of Technology, China)
Hak-Rin Kim (Kyungpook National University, Korea)

[25B1-1] 11:00~11:30 Invited Talk

fvision: Interactive Glasses-free 3D Images Floating on a Flat Tabletop Surface

Shunske Yoshida

National Institute of Information and Communications Technology, Japan

Our proposed glasses-free tabletop 3D display, fvision, employs a hollow conical screen and tiny, circularly arranged projectors installed underneath the table. It floats interactive virtual 3D objects on a flat tabletop surface.

[25B1-2] 11:30~11:45

Evaluation Methods of Retro-Reflector for Polarized Aerial Imaging by Retro-Reflection

Masao Nakajima[1], Yuka Tomiyama[2], Ichiro Amimori[3], and Hirotsugu Yamamoto[1]

[1]Utsunomiya University, Japan, [2]The Tokushima University, Japan, [3]SN Partners, Japan

To improve the brightness of polarized aerial imaging by retro-reflection, we have established evaluation methods of retro-reflector. We found prism type retro-reflectors have higher reflectance and lower polarization maintenance rate than beads type retro-reflectors.

[25B1-3] 11:45~12:00

Blurring Correction for Aerial Image Formed by Dihedral Corner Reflector Array

Daisuke Miyazaki, Shinji Onoda, Yuki Maeda, and Takaaki Mukai

Osaka City University, Japan

A method to improve blurring in an aerial image formed by a novel optical imaging element consisting of micro mirror array is proposed. This method is based on prior inverse filtering with a point-spread function.

[25B1-4] 12:00~12:15

Side-wall Surface Relief Gratings for Micro-structured Liquid Crystal Alignment

Zhichao Ji[1], Xinzheng Zhang[1], Wei Li[1], Irena Drevensek-Olenik[2], and Jingjun Xu[1]

[1]Nankai University, China, [2]J. Stefan Institute, Slovenia

The nematic liquid crystal can be uniformly aligned via its contact to a side-wall of a polymer ribbon fabricated by the TPP-DLW process. The origin of the alignment is analyzed. The surface anchoring energy on the side-wall structures is measured.

[25B1-5] 12:15~12:30

To Enhancement Luminous Efficiency of OLED by Roughness Thin Film Included Microparticles

Chuang-Hung Chiu[1], Chao-Heng Chien[2], Jen-Chi Lee[2], and Wei-Cheng Chien[2]

[1]Chunghwa Picture Tubes, Taiwan, [2]Tatung University Taipei, Taiwan

Including micro-particles and rough surface, an optical thin film was provided to address light extraction efficiency of OLED up to 80%. Two kinds of oxidized metal micro-particles were chosen to dope inside the optical thin film to increase scattering and refraction effect, and to rough surface on the optical thin film can enhance more light extraction efficiency due to the exit angle change on the top of the optical thin film.

Room C (103)

Session Title 25C1 / [T02] Femtosecond Laser
Date & Time Tuesday, 25 August, 11:00 ~ 12:00
Session Chair Fabien Quere (CEA, France)

[25C1-1] 11:00~11:30 Invited Talk

Frequency Domain Optical Parametric Amplification

B. E. Schmidt[1,2], N. Thiré[1], P. Lassonde[1], L. Arissian[3], G. Ernotte[1], F. Poitras[1], T. Ozaki[1], A. Laramée[1], M. Boivin[1], H. Ibrahim[1], and F. Légaré[1]

[1]Institut National de la Recherche Scientifique, Canada, [2]Few-Cycle Inc., Canada, [3]University of New Mexico, USA

General restrictions arising from gain-narrowing and phase-matching are circumvented by employing parametric amplification in the frequency rather than the time domain. Frequency-domain OPA has been used for amplifying few cycle pulses and for high gain amplification.

[25C1-2] 11:30~11:45

Broadband 800nm Pulse Generation with an Optical Parametric Amplifier based on BiB_3O_6

Yanyan Li, Yuxin Leng, Wenkai Li, Xiao Zou, Yi Xu, and Yun Chen

Chinese Academy of Sciences, China

We demonstrated the generation of broadband 800nm laser pulse with a BiB_3O_6 based OPA followed by a SHG process. The achieved pulses are with spectrum of 53.3nm (FWHM) and pulse width of 18.6 fs.

[25C1-3] 11:45~12:00

Ultra-Broadband Femtosecond Optical Gating System Using Transient Kerr Lens Effect

Wenhua Li[1], Zhenhua Wang[1], Xinzheng Zhang[1,2], Yu-E Wu[1], Qiang Wu[1], and Jingjun Xu[1]

[1]Nankai University, China, [2]Collaborative Innovation Center of Chemical Science and Engineering, China

A convenient ultra-broadband femtosecond optical gating system utilizing transient Kerr lens effect is demonstrated with its application on measuring the time-frequency property of some broadband light sources.

Room D (106)

Session Title 25D1 / [T04] High Power, High Energy Lasers
Date & Time Tuesday, 25 August, 11:00 ~ 12:30
Session Chair Changhwan Lim (KAERI, Korea)

[25D1-1] 11:00~11:30 Invited Talk

Nonlinearity Management: From Fiber Oscillators to Amplifiers

F. Ömer Ilday[1], Ç. Şenel[2], R. Hamid[2], T. Teamir[1], I. Pavlov[1], U. Teğin[1], E. Ergeçen[1], P. Elahi[1], and R. Iegorov[1]

[1]Bilkent University, Turkey, [2]TÜBİTAK National Metrology Institute, Turkey

While the standard approach to performance scaling in fiber lasers seeks to reduce nonlinear effects through chirping or mode scaling, I will review recent progress in a complementary approach, whereby the governing dynamics are meticulously exploited towards achieving superior performance.

[25D1-2] 11:30~12:00 Invited Talk

Coherent Combination of Ultrafast Laser: A Path towards High Repetition Rate Joule-class fs Pulses

Jens Limpert

Friedrich-Schiller-Universität Jena, Germany

In recent years intense laser pulses have found applications in various industrial and scientific areas. Significant progress has been made in scaling the energy of the pulses as well as the average power. However, different amplification schemes have been pushed to their specific limits, caused by detrimental nonlinear effects, by damage or by the occurrence of thermo-optical effects. New concepts have to be considered to address these issues and to enable new application fields. In that context, I will review the basics and achievements of coherent combination of amplified femtosecond pulses, a concept which has already out-performed single aperture femtosecond laser systems and which allows for a scaling to unprecedented performance levels, i.e. the combination of highest peak power (Petawatt) and highest average power (Megawatt).

[25D1-3] 12:00~12:15

High Energy Hybrid Fibre Regenerative Amplifier for Nanosecond Laser Pulse

Qiao Zhi, Wang Xiaochao, Fan Wei, and Lin Zunqi

Chinese Academy of Sciences, China

A hybrid fibre-bulk regenerative amplifier with maximum output energy of 600uJ at 1Hz for narrow-linewidth nanoseconds laser is demonstrated. Nearly diffraction limited beam is obtained. The total gain is more than 63dB.

[25D1-4] 12:15~12:30

Kerr Lens Mode-locked $Yb:Lu_2O_3$ Ceramic Oscillator Pumped by a Multimode Laser Diode

Tomohiro Ishikawa[1,2], A. Amani Eilanlou[1], Yasuo Nabekawa[1], Yoshihiko Fujihira[3], Tomohiro Imahoko[1,4], Tetsumi Sumiyoshi[1,4], Fumihiko Kannari[2], Makoto Kuwata-Gonokami[4], and Katsumi Midorikawa[1,4]

[1]RIKEN Center for Advanced Photonics, Japan, [2]Keio University, Japan, [3]Cyber Laser Inc., Japan, [4]The University of Tokyo, Japan

We report a Kerr lens mode-locked $Yb:Lu_2O_3$ ceramic oscillator with a pulse energy of 23.5 nJ, which is the highest value in bulk $Yb:Lu_2O_3$ ceramic oscillators, to the best of our knowledge.

Room E (107)

Session Title 25E1 / [T05] Plasmonics and Metamaterials I
Date & Time Tuesday, 25 August, 11:00 ~ 12:30
Session Chair Takuo Tanaka (RIKEN, Japan)

[25E1-1] 11:00~11:30 Invited Talk

Recent Advances on Metasurfaces

Lei Zhou, Shulin Sun, Qiong He, Ziqi Miao, Weijie Luo, and Wujiong Sun

Fudan University, China

We briefly summarize our recent efforts in employing meta-surfaces to control electromagnetic waves, including realizing high-efficiency photonic spin-hall effect and surface-plasmon couplers, and controlling phases with graphene-based meta-surfaces.

[25E1-2] 11:30~11:45

Point-source Optical Coupling to Electromagnetic Guided Modes of Metasurfaces

Per Lunnemann and A. Femius Koenderink

[1]Technical University of Denmark, Denmark, [2]FOM Institute AMOLF, Netherlands

We present a semi-analytical method for calculating the dispersion-relation and local density of states of a two-dimensional lattice with arbitrary electro-magnetic dipole scatterers. The method is demonstrated on lattices with electric and magnetic plasmonic spheres.

[25E1-3] 11:45~12:00

Vividly-colored Silicon Metasurface Based on Collective Electric and Magnetic Resonances

Wuzhou Song, Shiqiang Li, and Kenneth B. Crozier

University of Melbourne, Australia

We fabricate a silicon nanorod-based metasurface that shows vivid colors. Each nanorod supports electric and magnetic dipole modes whose coupling leads to collective resonances. The reflected field is described by a classical coupled dipole model.

[25E1-4] 12:00~12:15

Metasurface Polarized Beam Splitter and Hologram Based on One-dimensional Metallic Grating

Jun Zheng, Zhi-Cheng Ye, Zheng-Ming Sheng, and Jie Zhang

Shanghai Jiao Tong University, China

Based on the one-dimensional bi-layered metallic nanowire grating with engineered nano-slits, a novel form of metasurface polarizaed beam splitter and holography are proposed and demonstrated. The photon manipulation mechanism is fundamentally different from those in 2-D or 3-D metastructures.

[25E1-5] 12:15~12:30

Superradiant Mode Competition in Silver Slit Array on InGaAsP Structure

Kwang Jun Ahn[1], Seung-Hyun Kim[2], and Ki-Ju Yee[2]

[1]Ajou University, Korea, [2]Chungnam National University, Korea

We studied superradiance at surface plasmon and waveguide mode in a silver silt array / InGaAsP, and showed that although the former has a larger loss, it overwhelmed the latter as the pump energy increases.

Room F (108)

Session Title 25F1 / [T07] Optical Metrology and Sensing I
Date & Time Tuesday, 25 August, 11:00 ~ 12:30
Session Chair Dong-Hoon Lee (KRISS, Korea)

[25F1-1] 11:00~11:30 Invited Talk

A Flat Spectral Photon Flux Source for Single Photon Detector Quantum Efficiency Calibration

Haiyong Gan, Ruoduan Sun, Nan Xu, Jianwei Li, Yanfei Wang, Guojin Feng, Chundi Zheng, Chong Ma, and Yandong Lin

National Institute of Metrology, China

A flat spectral photon flux source is proposed to facilitate the single photon detector quantum efficiency calibration in an extended wavelength range (400-800 nm). The absolute quantum efficiency at certain wavelengths (e.g. 633 nm and 807 nm) of the photon counter under test can be measured via correlated photons method and used to evaluate the photon statistics of the flat spectral photon flux source. A correction factor derived from the photon statistics can then be applied throughout the wavelength range for improved detector quantum efficiency measurement.

[25F1-2] 11:30~11:45

Solar Cell Conversion Efficiency Measurements Based on Electrical Substitution Method

Terubumi Saito, Yamato Abe, Koki Sato, and Minato Takesawa

Tohoku Institute of Technology, Japan

Internal conversion efficiencies of solar cells are measured based on electrical substitution method. The external energy conversion efficiencies and the internal & the external quantum efficiencies are also derived. Agreements validate this technique.

[25F1-3] 11:45~12:00

Test System of 100 GHz Photodetector Time Response at NIM

Jianwei Li, Haiyong Gan, and Nan Xu

National Institute of Metrology, China

Electrooptic sampling has been shown to be a very powerful technique for making time-domain measurements of fast electronic devices and circuits. In this paper, we review the principles of electrooptic sampling technique for electronic waveform probing with applications to characterizing 100 GHz photodetector pulse response.

[25F1-4] 12:00~12:15

Measurement of Relative Spectral Responsivity of Photovoltaic Detectors by Using Single Tunable Pulsed Laser

Kee Suk Hong, Seongchong Park, Dong-Hoon Lee, and Jisoo Hwang

KRISS, Korea

We describe a novel method to measure the relative spectral responsivity of Si and Ge photovoltaic detectors from 250 nm to 1700 nm based on a tunable nano-second pulsed optical parametric oscillator (OPO).

[25F1-5] 12:15~12:30

Detection of Thermal Protrusion at Laser Heating Spot

Chengwu An, Hongzhi Yang, Siang Huei Leong, and Kaidong Ye

Agency for Science, Technology and Research, Singapore

A method based on the detection of the variation of the reflected laser beam's optical divergence was used to detect the temporary thermal protrusion at the laser heating spot.

Room G (201)

Session Title 25G1 / [T08] Quantum Optomechanics
Date & Time Tuesday, 25 August, 11:00 ~ 12:30
Session Chair Yoon Ho Kim (POSTECH, Korea)

[25G1-1] 11:00~11:45 Tutorial

Quantum Optomechanics

Warwick Bowen

University of Queensland, Australia

Quantum optomechanics is a rapidly growing field studying the quantum interaction of light with mechanical devices. This tutorial will review the field, as well as applications in precision sensing, quantum information science, and fundamental physics.

[25G1-2] 11:45~12:00

An Ion Trap of Monolithic 3D Structure for Quantum Information

Dahyun Yum, Ye Wang, Kuan Zhang, Shuoming An, and Kihwan Kim

Tsinghua University, China

We develop a three-dimensional (3D) monolithic ion trap that has advantages of both 3D geometry trap and surface trap. The characteristic properties are measured, i.e. the axial and radial trap frequency and heating rate. We successfully load Yb and Ba ions together in this trap. The hybrid ion trap will be used for quantum information experiment.

[25G1-3] 12:00~12:15

Phonon-Phonon Interaction in a Linear Ion Trap

Shiqian Ding[1], Gleb Maslennikov[1], Roland Hablutzel[1], Huanqian Loh[1,2], and Dzmitry Matsukevich[1,3]

[1]Centre for Quantum Technologies, Singapore, [2]Masssachusets Institute of Technology, USA, [3]National Unversity of Singapore, Singapore

We observe nonlinear coupling of phonons between radial and axial directions in a system of two ions in a linear Paul trap. Anticrossing of phonon modes and adiabatic energy transfer are demonstrated.

[25G1-4] 12:15~12:30

Scalable Trapped-Ion Single-Photon Sources with Monolithically Integrated Optics

Mojtaba Ghadimi[1], Valdis Blūms[1], Ben Norton[1], Zulfiqar Hasan Khan[1], Harley Hayden[2], Jason Amini[2], Curtis Volin[2], Erik Streed[1], and David Kielpinski[1]

[1]Griffith University, Australia, [2]Georgia Tech Research Institute, USA

We demonstrate the first fully integrated and scalable diffractive mirrors for efficient ion light collection. We also generated single photons using an Yb^+ ion and collected them using these mirrors to do a quantum communication protocol.

Room H (202)

Session Title 25H1 / [T09] Nanostructures
Date & Time Tuesday, 25 August, 11:00 ~ 12:30
Session Chairs Yuh-Renn Wu (National Taiwan University, Taiwan)
Sang Ho Oh (POSTECH, Korea)

[25H1-1] 11:00~11:30 Invited Talk

Growth of Light-Emitting Devices Based on InGaN Quantum Dots by MOVPE

Lai Wang, Di Yang, Jiadong Yu, Zhibiao Hao, Yi Luo, Changzheng Sun, Yanjun Han, Bing Xiong, Jian Wang, and Hongtao Li

Tsinghua University, China

In this paper, we reported our recent progresses on growth of InGaN quantum dots and related lightemitting devices by metal organic vapor phase epitaxy.

[25H1-2] 11:30~12:00 Invited Talk

III-Nitride Quantum Dot Based Light Emitting Diodes for UV Emission

Julien Brault[1], Benjamin Damilano[1], Aimeric Courville[1], Mohamed Al Khalfioui[1,2], Mathieu Leroux[1], Sébastien Chenot[1], Philippe Vennéguès[1], Philippe De Mierry[1], Jean Massies[1], Daniel Rosales[3], Thierry Bretagnon[3], and Bernard Gil[3]

[1]CNRS-CRHEA, France, [2]Université de Nice Sophia-Antipolis, France, [3]CNRS-Université Montpellier, France

$Al_yGa_{1-y}N$-based nanostructures have been fabricated by Molecular Beam Epitaxy and their properties as UV emitters investigated. The structure designs leading to shortest wavelength emission are presented. Quantum dot based LED properties are shown and discussed.

[25H1-3] 12:00~12:15

Selective Area Growth of InN Nanocolumns: Effect of Lattice Polarity

Ping Wang, Xin Rong, Xiantong Zheng, and Xinqiang Wang

Peking University, China

A weird effect of lattice polarity on the morphology of InN nanocolumns (NCs) via position- and lattice-polarity-controlled selective area growth (SAG) is demonstrated. In-polar and N-polar InN NCs grown on pillar-patterned GaN template were investigated experimentally and theoretically. Growth behaviors and morphology of InN NCs are analyzed, which exhibit different behaviors for opposite polarities, with pyramid growth front and inverted pyramid growth front for the In- and N-polarities, respectively. Theoretical calculation shows that the diffusion barriers of In and N adatoms on (0001) plane are 0.25 eV and 1.20 eV, respectively, which is about 2-fold larger than that of (000) plane, resulting in opposite growth behaviors. The polarityinversion phenomenon in In-polar InN NCs provides another strong evidence for the polarity driven growth mechanism.

[25H1-4] 12:15~12:30

Green Luminescence of Quasi-Molecular Level in Graphene Quantum Dots Fabricated by Microwave Bottom-up Strategy

Min-Ho Jang[1], Sima Umrao[1,2], Jung-Hwan Jung[1], Anchal Srivastva[2], Il-Kwon Oh[1], and Yong-Hoon Cho[1]

[1]KAIST, Korea, [2]Banaras Hindu University, India

Green photoluminescent graphene quantum dots were synthesized by one step microwave assisted method using organic solvent acetylacetone, which have two different light emissions at 460 and 505 nm irradiated by 370 and 470 nm of monochromatic light from Xenon lamp, respectively.

Room I (203)

Session Title 25I1 / [T10] Plasmonic Devices
Date & Time Tuesday, 25 August, 11:00 ~ 12:00
Session Chair Bumki Min (KAIST, Korea)

[25I1-1] 11:00~11:15

Connecting Deep Sub-Wavelength Plasmonic Waveguide to Si Photonics Waveguides

Masaaki Ono[1,2], Hao Xu[1,2], Masato Tsunekawa[2,3], Eiichi Kuramochi[1,2], Kengo Nozaki[1,2], Hideaki Taniyama[1,2], and Masaya Notomi[1,2,3]

[1]Nanophotonics Center, Japan, [2]NTT Corporation, Japan, [3]Tokyo Institute of Technology, Japan

We achieved three-dimensional mode conversion between a Si-wire waveguide and a deep sub- λ plasmonic slot waveguide (60×50 nm^2) for the first time. The coupling loss was only about 2 dB.

[25I1-2] 11:15~11:30

Tunable Plasmonic Multi-channel Demultiplexer with Graphene Sheets and Ring Resonators

Xiuye Liang, Shinian Qu, Ci Song, Xiushan Xia, Baojie Tang, and Jicheng Wang

Jiangnan University, China

The actively tunable plasmonic multi-channel wavelength demultiplexer (WDM) based on graphene sheets and ring resonators is proposed and numerically investigated by utilizing finite element method (FEM) simulations.

[25I1-3] 11:30~11:45

Phase Characteristics of Broadband Mach-Zehnder Directional Coupler with Quasi-Decoupled Hybrid Plasmon

Shih-Hsiang Hsu, Kuo-Wei Chuang, and Ci-Syu Chen

National Taiwan University of Science and Technology, Taiwan

The phase from quasi-decoupled hybrid plasmon and coupled bending regions of Mach-Zehnder directional couplers was characterized for broadband optical power dividers. The splitting ratios demonstrated within 8% variation across 200-nm bandwidth using400-nm quasidecoupler spacing.

[25I1-4] 11:45~12:00

Nondiffracting Bloch Surface Wave: 2D Quasi-Bessel-Gauss Beam

Myun-Sik Kim, Elsie Barakat, Richa Dubey, Toralf Scharf, and Hans Peter Herzig

Ecole Polytechnique Fédérale de Lausanne, Switzerland

2D Bessel-Gauss beam, which is known as nondiffracting beams in 3D space, is demonstrated in the domain of Bloch surface wave. Its self-healing capacity is verified by using cylindrical obstacles in the diffraction-free beam path.

Room J (204)

Session Title 25J1 / [T12] Silicon Photonics Interconnection
Date & Time Tuesday, 25 August, 11:00 ~ 12:30
Session Chairs Hiroshi Fukuda (NTT, Japan)
Dong Jae Shin (Samsung Electronics Co., Ltd., Korea)

[25J1-1] 11:00~11:30 Invited Talk

Silicon-Photonics Devices for Chip to Chip Communications

Ken Morito, Seok-Hwan Jeong, Shinsuke Tanaka, Takasi Simoyama, Shigekazu Okumura, Yohei Sobu, and Yu Tanaka

Photonics Electronics Technology Research Association, Japan

Recent progress of silicon-photonics devices developed for chip-to-chip communications is presented. WDM MUX/DEMUX filters, multi wavelength light sources, 1D and 2D grating couplers and 25 Gbps interchip transmission experiment with low driving power are detailed.

[25J1-2] 11:30~11:45

Design of Low Loss Crossing of Si Waveguides

Yugao Deng, Kazumi Wada, Naoyuki Kawai, Ziyi Zhang, and Motoki Yako

University of Tokyo, Japan

A novel waveguide crossing structure is proposed, where Si waveguides are tapered off at the crossing. Two-dimensional finite difference time domain simulation indicates that the presented crossing has low insertion loss of 0.01dB/crossing around 1550nm.

[25J1-3] 11:45~12:00

Apodized Amorphous Silicon Grating Coupler with Metal Mirrors for 3D Optical Interconnection

Yuki Kuno, Joonhyun Kang, Kazuto Itoh, Yusuke Hayashi, Junichi Suzuki, Tomohiro Amemiya, Nobuhiko Nishiyama, and Shigehisa Arai

Tokyo Institute of Technology, Japan

Inter-layer coupling between multilayer waveguides was demonstrated using hydrogenated amorphous silicon (aSi:H) grating couplers with metal mirrors. The fabricated device which has the inter-layer distance of 2 μm successfully showed wider bandwidth compared with uniform grating structure.

[25J1-4] 12:00~12:15

Tunable Grating Coupler Based on Thermo-Optic Effect in Silicon

Jong-Hun Kim[1], Sun-Kyu Han[1], Min-Jung Bae[1], Ji-Hwan Park[1], Dong-Eun Yoo[2], Dong-Wook Lee[2], and Hyo-Hoon Park[1]

[1]KAIST, Korea, [2]National Nanofab Center, Korea

We demonstrate an efficient tunable grating coupler using thermo-optic heater in silicon. Tuning of the central wavelength from 1537nm to 1573nm is achieved with an increased 1 dB-bandwidth up to 59nm.

[25J1-5] 12:15~12:30

Non-blocking 8×8 Silicon Electro-optic Switch

Lei Qiao, Weijie Tang, and Tao Chu

Chinese Academy of Sciences, China

A re-arrangeable non-blocking 8×8 silicon electro-optic switch was demonstrated. It had extinction ratios of 18.3~25.5dB on all “Cross” status and 13.3~19dB on all “Bar” status at 1550nm.

Room A (101)

Session Title 25A2 / [T01] Optical Frequency Combs
Date & Time Tuesday, 25 August, 13:45 ~ 15:15
Session Chair Jungwon Kim (KAIST, Korea)

[25A2-1] 13:45~14:15 Invited Talk

GHz Level Fiber Laser and Frequency Comb

Zhigang Zhang, Aimin Wang, Chen Li, and Yuxuan Ma
Peking University, China

The advanced laser technology has led to gigahertz level repetition rate femtosecond fiber laser possible. This laser offers advantages of high average power, chirp-free output pulses and helps the frequency comb made compact and simplified.

[25A2-2] 14:15~14:30

Er Comb Fiber Laser with F_{ceo} Noise below 0.2 rad

N. Kuse[1], J. Jiang[1], C.-C. Lee[2], Y. Yun[1], T. R. Schibli[1,2], and M. E. Fermann[1]
[1]IMRA America Inc., USA, [2]University of Colorado, USA

We demonstrate an all polarization-maintaining Er fiber frequency comb with a record low phase noise for the locked carrier envelope offset frequency of 0.18 rad.

[25A2-3] 14:30~14:45

All-Fiber Soliton Er-Laser Mode-Locked by a Planar Lightwave Circuit (PLC)-Based CNT Saturable Absorber

Yeon Joon Cheong[1], Dohyun Kim[1], Chur Kim[1], Sun Young Choi[2], Hwanseong Jeong[2], Sang Jun Cha[3], Jeong-Woo Lee[4], Dong-Il Yeom[2], Fabian Rotermund[2], and Jungwon Kim[1]
[1]KAIST, Korea, [2]Ajou University, Korea, [3]Fiber Pro Inc., Korea, [4]Core Cross Inc., Korea

We show an all-planar, fiber-connected CNT saturable absorber manufactured by the planar lightwave circuit (PLC) process. The fabricated saturable absorber was successfully employed in an all-fiber soliton mode-locked Er-laser.

[25A2-4] 14:45~15:00

All-Optical Control of Repetition Rate in Mode-Locked Fiber Lasers

Kangwen Yang, Qiang Hao, and Heping Zeng
University of Shanghai for Science and Technology, China

We obtained high precision repetition rate stabilization of an all-fiber laser by modulating the pump power of an additional doping fiber. The standard deviation of the locked repetition rate was 2 mHz.

[25A2-5] 15:00~15:15

Yb-Doped Fiber Comb Based on a Tapered Single-Mode Fiber

Yang Xie[1], Hainian Han[2], Long Zhang[2], Lei Hou[2], Zijiao Yu[2], Zheng Zhu[2], Lihui Pang[2], Wenjun Liu[2], and Zhiyi Wei[2]
[1]Xidian University, China, [2]Chinese Academy of Sciences, China

We present an Yb-doped fiber frequency comb based on a tapered single mode fiber by locking the repetition frequency and the carrier-envelop-offset frequency simultaneously to the microwave frequency reference outside.

Room B (102)

Session Title 25B2 / [T01] Material Processing & Applications
Date & Time Tuesday, 25 August, 13:45 ~ 15:00
Session Chair Richard Mildren (Macquarie University, Australia)

[25B2-1] 13:45~14:15 Invited Talk

Ultrafast Laser Materials Processing for Manufacturing Innovation

Jiyeon Choi, Mirae Lim, Yong Hyeon Kim, and Sangmin Chae
KIMM, Korea

Ultrafast laser based materials processing has shown remarkable success in various area of industrial applications. A few examples of innovative applications in displays, OSCs, and other consumer electronics fabrication are demonstrated.

[25B2-2] 14:15~14:30

Yb-Doped LMA Fiber Fabrication Using Chelate Precursor Doping Technique

Zhen Wang, Cong Gao, Li Ni, Xiaolong Wang, Kun Peng, Yuying Wang, Huan Zhan, Jianjun Wang, Feng Jing, and Aoxiang Lin
Chinese Academy of Sciences, China

We report on the fabrication of a kW-level Yb-doped fiber by using chelate precursor doping technique. Lasing performance was tested up to 1 kW laser output with slope efficiency of 81.8%.

[25B2-3] 14:30~14:45

Characteristics of the Coherent EUV Light Source for EUV Metrology

Yong Soo Kim[1,2], Younghee Kim[1], June Park[1], Hamin Sung[3], Jomsool Kim[3], Ju Han Lee[2], and Young Min Jhon[1]
[1]KIST, Korea, [2]University of Seoul, Korea, [3]Laser Spectronix, Korea

Coherent EUV light at 13.5 nm was generated by high-harmonic generation using a 35-fs pulsed laser at 796 nm in Ne gas, which showed stable operation within 5% deviation over an hour.

[25B2-4] 14:45~15:00

Observation of Rogue Waves in a 980 nm-Laser Diode Subject to Filtered Optical Feedback

Min Won Lee[1], Fadwa Baladi[1,2], Jean-René Burie[2], Mauro A. Bettiati[2], Azzedine Boudrioua[1], and Alexis P. A. Fischer[1]
[1]Université Paris 13, France, [2]3S Photonics Technologies, France

Rogue waves are observed in a 980 nm laser diode subject to filtered optical feedback via an FBG. A rogue wave map is established experimentally as a function of the optical feedback ratio and the laser current.

Room C (103)

Session Title 25C2 / [T02] Attosecond Physics
Date & Time Tuesday, 25 August, 13:45 ~ 15:15
Session Chair Francois Legare (Institut National de la Recherche Scientifique, Canada)

[25C2-1] 13:45~14:15 Invited Talk

Observation of Attosecond Quantum Wavepackets in Molecules

Katsumi Midorikawa, Tomoya Okino, Yasuo Nabekawa, and Yusuka Furukawa

RIKEN Center for Advanced Photonics, Japan

Attosecond Fourier transform spectroscopy with attosecond pulse trains is implemented for observing ultrafast quantum wavepacket dynamics in diatomic molecules. Coupled nuclear-electron motions in the molecules are investigated with an attosecond-pump and attosecond probe method.

[25C2-2] 14:15~14:30

Non-collinear High-order Harmonic Generation in Ionized Media

Kentaro Sato, Takafumi Kuroda, Haruka Ohno, Kyohei Suzuki, and Akira Suda

Tokyo University of Science, Japan

High-harmonic generation by non-collinear wave mixing in ionized media is demonstrated, in which the phase matching is realized in the direction of difference frequency mixing. The emission angle temporally varies depending on the ionization degree.

[25C2-3] 14:30~15:00 Invited Talk

Ultrahigh-intensity Laser-plasma Interactions Using Structured Light Fields

Subhendu Kahaly, Sylvain Monchocé, Gustave Pariente, Adrien Leblanc, and Fabien Quere

Commissariat à l'Energie Atomique, France

We explain how structuring femtosecond laser pulses in space and time leads to new effects in ultrahigh intensity laser plasma interactions, with three examples: ultrafast wavefront rotation, transient plasma gratings, and light springs.

[25C2-4] 15:00~15:15

Frequency-Resolved Optical Gating with Plasma Mirror for VUV Pulse Measurement

Ryuji Itakura, Takayuki Kumada, Motoyoshi Nakano, and Hiroshi Akagi

Japan Atomic Energy Agency, Japan

We demonstrate a new type of frequency-resolved optical gating based on time-resolved reflection measurement with a plasma mirror. A VUV waveform is retrieved with a modified principal component generalized projections algorithm.

Room D (106)

Session Title 25D2 / [T04] High Power, High Energy Lasers
Date & Time Tuesday, 25 August, 13:45 ~ 15:00
Session Chair Arno Klenke (Friedrich Schiller Universität Jena, Germany)

[25D2-1] 13:45~14:15 Invited Talk

Ultrafast Thin Disk Lasers: towards Intralaser Extreme Nonlinear Optics

T. Südmeyer[1], C. J. Saraceno[1,2], C. Schriber[2], A. Diebold[2], F. Emaury[2], M. Golling[2], A. Klenner[2], S. Schilt[1], and U. Keller[2]

[1]Université de Neuchâtel, Switzerland, [2]ETH Zurich, Switzerland

Ultrafast thin disk lasers generate higher power levels than any other femtosecond oscillator technology. We review the current state of the art and give an outlook towards new applications such as intralaser extreme nonlinear optics.

[25D2-2] 14:15~14:30

Scalable Cryogenic Gas Cooled Multi-Slab 10 J and 100 J, 10 Hz DPSSL System

Saumyabrata Banerjee[1], Klaus Ertel[1], Paul Mason[1], Jonathan Phillips[1], Mariastefania De Vido[1], Jodie Smith[1], Thomas Butcher[1], M. Divoky[2], J. Pilar[2], Cristina Hernandez-Gomez[1], Justin Greenhalgh[1], and John Collier[1]

[1]STFC Rutherford Appleton Laboratory, UK, [2]Institute of Physics, Czech Republic

We report the demonstration of a cryogenic gas cooled multi-slab Yb:YAG laser, producing 10.8 J pulses at 10 Hz, and initial results from a scaled-up DPSSL designed to produce 100 J pulses.

[25D2-3] 14:30~14:45

The Output Ability Promotion of the SG Ⅱ-Up Laser Facility

Yanqi Gao[1], Zhaodong Cao[1], Xuedong Yang[1], Weixin Ma[1], Baoqiang Zhu[2], and Zunqi Lin[2]

[1]Shanghai Institute of Laser Plasma, China, [2]Shanghai Institute of Optics and Fine Mechanics, China

The SG-Ⅱ-Up laser facility is one of the most important high power laser facilities in China. The maximum output of this facility is studied, and it is improved to 8000J from the design point 5000J.

[25D2-4] 14:45~15:00

Wavefront Control Systems of the SG Ⅱ Laser Facility and the Multi-Petawatt Laser Facility

Haidong Zhu[1], Ailin Guo[1], Zeping Yang[2], Jianqiang Zhu[1], Zunqi Lin[1], Weixin Ma[1], Xinglong Xie[1], Jian Zhu[3], Xunchun Li[1], and Ping Zhu[1]

[1]Shanghai Institute of Optics and Fine Mechanics, China, [2]The Institute of Optics and Electronics, CAS, China, [3]China Academy of Engineering Physics, China

The Shenguangll laser facility (SGII-LF) is a total output 40 kilojoules laser facility containing a 8-beam Nd glass laser. To meet stringent demands on the delivered energy for the physics experiments research, the SGII-LF utilizes an integrated wavefront control system to significantly improve the ability to tightly focus each laser beam onto a target. Multiple sources of both static and dynamic aberration are corrected. On the other hand, we have designed two adaptive optics systems for the Shenguangll multi-petawatt laser facility (SGII-MPW-LF) to correct the spatial and temporal aberrations introduced by the uncorrected wavefront.

Room E (107)

Session Title 25E2 / [T05] Plasmonics and Metamaterials II
Date & Time Tuesday, 25 August, 13:45 ~ 15:00
Session Chair Lei Zhou (Fudan University, China)

[25E2-1] 13:45~14:15 Invited Talk

All-Dielectric Metasurfaces

Yuanmu Yang[1], Parikshit Moitra[1], Ivan Kravchenko[2], Daryl Briggs[2], and Jason Valentine[1]
[1]Vanderbilt University, USA, [2]Oak Ridge National Laboratory, USA

In this talk, I will discuss our recent efforts to develop purely dielectric metamaterials possessing low absorption loss at optical frequencies. I will discuss implementations ranging from wavefront control to high Q-factor resonances.

[25E2-2] 14:15~14:30

Weak Measurement of Optical Spin Hall Effect in Phase-discontinuity Metasurface

Yeon Ui Lee and Jeong Weon Wu
Ewha Womans University, Korea

Recently it has been demonstrated that a rapid phase change at a phase-discontinuity metasurface (PDM) leads to an additional momentum gradient enabling a direct observation of optical spin Hall (OSH) shift. We show that the helicity-dependent OSH shift depends on incidence and refraction angles at PDM, and construct a weak value measurement to control OSH shift by a variable phase retardance in the post-selection.

[25E2-3] 14:30~14:45

Far-field Measurement of Single Gold Nanorod Scattering using Total-Internal-Reflection Illumination

Donghyeong Kim[1], Kwang-Yong Jeon[2], Ho-Seok Ee[1], Hong-Gyu Park[2], and Min-Kyo Seo[1]
[1]KAIST, Korea, [2]Korea University, Korea

We made a novel method for measuring far-field scattering distribution of single nanostructure with high signal-to-background ratio using total-internal-reflection illumination. We achieved wide measurement range by direct scanning over limit of numerical-aperture in conventional back-focal-imaging.

[25E2-4] 14:45~15:00

An Efficient Method for Analyzing Cylindrical Metallic Nanoparticles

Xun Lu, Hualiang Shi, and Ya Yan Lu
City University of Hong Kong, Hong Kong, China

For the scattering of light by cylindrical metallic nanoparticles on a substrate, we present an efficient numerical method that relies on expanding the field in one-dimensional vertical modes. The method is used to analyze a single cylindrical particle of arbitrary cross section and a pair of circular cylindrical particles.

Room F (108)

Session Title 25F2 / [T07] Optical Metrology and Sensing II
Date & Time Tuesday, 25 August, 13:45 ~ 15:15
Session Chair Atsushi Sato (Tohoku Institute of Technology, Japan)

[25F2-1] 13:45~14:15 Invited Talk

Length Metrology with Ultra-high Precision Using Fiber-based Optical Frequency Combs

Kaoru Minoshima[1,2], Yoshiaki Nakajima[1,2], and Guanhao Wu[3]
[1]University of Electro-Communications, Japan, [2]Japan Science and Technology Agency, Japan, [3]Tsinghua University, China

Ultrahigh-precision length metrology using fiber-based optical frequency combs is presented. By precisely controlling the frequency and phase of the combs, self correction of air refractive index and noise cancellation in fiber path in interferometer are demonstrated.

[25F2-2] 14:15~14:45 Invited Talk

Dimensional Metrology for Smart Devices Using the Optical Comb of Femtosecond Pulse Lasers

Jonghan Jin[1,2], Jungjae Park[1], Jong-Ahn Kim[1], and Jaewan Kim[1,2]
[1]KRISS, Korea, [2]Korea University of Science and Technology, Korea

We have proposed the dimensional metrological methods for smart devices using the optical comb of a femtosecond pulse laser. For precision and high speed measurements, these methods were realized based on spectral-domain interferometry.

[25F2-3] 14:45~15:00

Photonic Chip Based Optical Frequency Comb Using Soliton Induced Cherenkov Radiation

Victor Brasch[1], Michael Geiselmann[1], Tobias Herr[2], Gregoriy Lihachev[3], Martin H. P. Pfeiffer[1], Michael L. Gorodetsky[3], and Tobias J. Kippenberg[1]
[1]École Polytechnique Fédérale de Lausanne, Switzerland, [2]Centre Suisse d'Electronique et Microtechnique SA, Switzerland, [3]M.V. Lomonosov Moscow State University, Russia

We show for the first time a fully coherent frequency comb generated in a SiN photonic chip which spans 2/3 of an octave using solitons and soliton induced Cherenkov radiation. Additionally we stabilize the spectrum.

[25F2-4] 15:00~15:15

An Yb-fiber Laser Comb with Mode Spacing of Higher than 20 GHz by Two Fabry–Pérot Cavities

Lei Hou, Hainian Han, Long Zhang, Lihui Pang, and Zhiyi Wei
Chinese Academy of Sciences, China

We realized an Yb-fiber laser comb with spaced mode-line of larger than 20 GHz, the side-mode was suppressed to 40 dB by two low-finesse Fabry-Pérot cavities. Long term stabilization was demonstrated by locking cavity lengths.

Room G (201)

Session Title 25G2 / [T08] Quantum Information I
Date & Time Tuesday, 25 August, 13:45 ~ 15:15
Session Chair Hyunseok Jeong (Seoul National University, Korea)

[25G2-1] 13:45~14:15 Invited Talk

New Directions in Optical Quantum Computing

Tim C. Ralph

University of Queensland, Australia

We will discuss new sampling algorithms that are hard for classical computers but can be solved with linear optical quantum processors and techniques for implementing universal quantum gates using strong optical non-linearities and Gaussian optics.

[25G2-2] 14:15~14:30

Experimental Implementation of Delayed-Choice Decoherence Suppression

Jong-Chan Lee[1], Hyang-Tag Lim[1], Kang-Hee Hong[1], Youn-Chang Jeong[1], M. S. Kim[2], and Yoon-Ho Kim[1]

[1]POSTECH, Korea, [2]Imperial College London, UK

We propose and experimentally implement the delayedchoice decoherence suppression protocol. Using photonic entanglement, we successfully demonstrated that the choice to suppress decoherence can be delayed after decoherence and even after the detection of a qubit.

[25G2-3] 14:30~14:45

Correlation between Initial and Final Result in a Sequential Quantum Measurement

Masataka Iinuma[1], Yutaro Suzuki[1], Taiki Nii[1], Ryuji Kinoshita[1], and Holger Hofmann[1,2]

[1]Hiroshima university, Japan, [2]JST, Japan

Measurement error can be evaluated using the concepts introduced by Ozawa in 2003. Importantly, this evaluation takes into account the non-classical effects of quantum correlations. We investigate this effect by using a sequence of non-commuting measurements of photon polarization with a variable measurement resolution for the intermediate measurement. It is shown that quantum correlations between the initial and the final measurement outcomes result in a significant reduction of the measurement errors for the target observable, even though the final measurement is not sensitive to the polarization component of interest.

[25G2-4] 14:45~15:00

Generation and Characterization of a Frequency Anti-correlated Entangled Biphoton Source at 1560nm

Feiyan Hou, Ruifang Dong, Xiao Xiang, Runai Quan, Mengmeng Wang, Yiwei Zhai, Shaofeng Wang, Tao Liu, and Shougang Zhang

Chinese Academy of Sciences, China

We report the generation and characterization of a frequency anti-correlated entangled biphoton source at the wavelength of 1560nm via a continuous-wave laser pumped spontaneous parametric down-conversion process. The spectra of the signal and idlerphotons are measured to have their center wavelength being 1559.7nm and 1559.8nm while their 3-dB bandwidths being 3.2nm and 3.15nm respectively. The joint spectrum of the photon pair is observed to be frequency anti-correlated and have a spectral bandwidth of 0.5nm. According to the ratio of the single-photon spectral bandwidth to the joint spectral bandwidth of the photon pairs, the degree of frequency entanglement is quantified to be 6.4. By investigating the relative overlap between the achieved two-photon spectral intensity function and its transpose, the spectral indisinguishablity of the photon pairs is expected to be 90%. Based on a HOM interferometric coincidence measurement setup, a visibility of 89.8% is demonstrated, which shows a good agreement with the expectation.

[25G2-5] 15:00~15:15

Near-Deterministic Bell Measurement for Multiphoton Quantum Information Processing

Seung-Woo Lee[1], Kimin Park[1,2], Timothy C. Ralph[3], and Hyunseok Jeong[1]

[1]Seoul National University, Korea, [2]Palacký University, Czech, [3]The University of Queensland, Australia

We propose a Bell measurement scheme for discriminating logical Bell states with many photons. The logical qubit is in Greenberger-Horne-Zeilinger entanglement with an arbitrary number of photons. Remarkably, its success probability can be made arbitrarily high using only linear optics and photon on-off measurements as the number of photons increases. It is shown that our scheme outperforms all the previously known schemes using single-photon qubits with respect to both the efficiency and feasibility. Our proposal provides an alternative candidate for all-optical quantum information processing.

Room H (202)

Session Title 25H2 / [T09] Material and Device Characterizations
Date & Time Tuesday, 25 August, 13:45 ~ 15:15
Session Chairs Lai Wang (Tsinghua University, China)
Julien Brault (CRHEA-CNRS, France)

[25H2-1] 13:45~14:15 Invited Talk

Two-dimensional Mapping of Strain and Piezoelectric Polarization in InGaN/GaN MQWs by Electron Dark-field Holography

Kyung Song and Sang Ho Oh

POSTECH, Korea

Applying the state-of-the-art inline electron holography to a light emitting diode containing strained InGaN/GaN multiquantum wells, we show fully quantitative maps of 2-D strain and charge density can be obtained and correlated with sub-nanometer resolution.

[25H2-2] 14:15~14:45 Invited Talk

Study of Percolation Transport in the InGaN/AlGaN LEDs with Random Alloy Fluctuation

Yuh-Renn Wu[1], Chen-Kuo Wu[1], Chi-Kang Li[1], David A. Browne[2], and James S. Speck[2]

[1]National Taiwan University, Taiwan [2]University of California, Santa Barbara, USA

3D Numerical modeling for carrier transport in the EBL and InGaN quantum well by considering the random alloy fluctuation have been done. The result shows that percolative transport should be the dominant transport mechanism in the light emitting diode and affects the efficiency droop.

[25H2-3] 14:45~15:00

Strain Relaxation and Quantum Size Effect Studied by Two-Photon Laser Scanning Photoluminescence Microscopy

Hyeong-Yong Hwang[1], Hoonil Jeong[1], Hyun-Jun Baek[2], Gyu-Chul Yi[2], Hyoung-Chan Kim[3], and Young-Dahl Jho[1]

[1]GIST, Korea, [2]Seoul National University, Korea, [3]National Fusion Research Institute, Korea

Nanoscale excitation by the simultaneous absorption of two photons was employed to investigate the spatially resolved role of strain relaxation and quantum size effect (QSE) in affecting luminescence from ZnO nanorods (NRs).

[25H2-4] 15:00~15:15

Radiative and Non-radiative Carrier Lifetime in InGaN-Based Light-Emitting Diodes Investigated by Impedance Analysis

Young Jin Kim, Dong Pyo Han, Gyeong Won Lee, Dong Soo Shin, and Jong In Shim

Hanyang University, Korea

To investigate the efficiency droop in InGaN-based lightemitting diodes, we have measured the differential carrier lifetimes using the electrical method. After separating the radiative and non-radiative carrier lifetimes using the internal quantum efficiency, we discuss their implications.

Room I (203)

Session Title 25I2 / [T10] Plasmonics and Subwavelength Structures
Date & Time Tuesday, 25 August, 13:45 ~ 15:15
Session Chair Hyunyong Choi (Yonsei University, Korea)

[25I2-1] 13:45~14:15 Invited Talk

Localized Toroidal Dipole Moment of Spoof Surface Plasmon Polaritons

Sang Soon Oh[1], John J. Wood[1], Seong-Han Kim[2], Chul-Sik Kee[2], and Ortwin Hess[1]
[1]Imperial College London, UK, [2]GIST, Korea

At infrared wavelengths, we demonstrate subwavelength scale localization of spoof surface plasmon polaritons. Based on an analytical model and numerical simulations, we show that the defect mode has toroidal dipole moment and high Q factor.

[25I2-2] 14:15~14:30

Lossy Plasmonic Resonances in Nanoparticles for Broadband Light Absorption

Satoshi Ishii[1,2], Ramu Sugavaneshwar[1,2], Kai Chen[1,2], Thang Dao[1,2], and Tadaaki Nagao[1,2]
[1]National Institute for Materials Science, Japan, [2]JST, Japan

We show with experiments that localized surface plasmon resonances in conductive nitride nanoparticles result in broadband light absorption covering solar spectrum. The nitride nanoparticle dispersed water was warmed and generated vapor efficiently by sunlight illumination.

[25I2-3] 14:30~14:45

Optical Characterization of a Single Dielectric Nano-antenna Fabricated by Electron Beam-induced Deposition

Eun-Khwang Lee[1], Jung-Hwan Song[1], Kwang-Yong Jeong[2], Ju-Hyung Kang[2], Hong-Gyu Park[2], and Min-Kyo Seo[1]
[1]KAIST, Korea, [2]Korea University, Korea

We investigated the optical properties of a single dielectric nano-antenna fabricated by electron beam induced deposition. Polarization-resolved dark-field spectra showed that both transverse-magnetic and transverse electric resonances are supported and tuned over the visible wavelength range.

[25I2-4] 14:45~15:00

3D Plasmonic Focusing with a Spiral Taper Anchored on a Fiber Tip

Jiafang Li, Zhiguang Liu, Jiajia Mu, Xiaomei Gao, Wuxia Li, Changzhi Gu and Zhi-Yuan Li
Chinese Academy of Sciences, China

Based on a spiral taper that possesses polarization-insensitive three-dimensional (3D) plasmonic focusing properties, here we show that subwavelength 3D plasmonic focusing is readily achieved by integrating this spiral taper on a fiber tip. This portable fiber-integrated taper may find great potentials in near-field optics, high resolution fiber endo-devices, as well as bio-nanophotonic applications.

[25I2-5] 15:00~15:15

Photoluminescence Properties of Carbon-Nanomaterial Doped Solid Films Coupled to Plasmonic Optical Nano-Antennas

Chi-Tsu Yuan
Chung Yuan Christian University, Taiwan

Luminescent carbon based nanomaterials such as carbon dots and graphene quantum dots (GQDs) have attracted much attention owing to some unique properties, including wavelength-dependent emission, better photo-stability and chemical inertness, thus can be severed as efficient nano-scale light sources for promising applications in optoelectronics and bio-photonics. Despite aforementioned advantages, the main challenge is their moderate photoluminescence quantum yields, in particular, when they are brought away from their original solution to form solid films for optoelectronic applications such as light-emitting devices, thus need to be enhanced further for practical uses. Here, the photoluminescence (PL) properties of GQD doped solid films coupled to plasmonic optical nano-antennas are investigated using time-correlated single-photon counting technique, in particular, focusing on the modification of PL emission (including fluorescence, delayed fluorescence, and phosphorescence) by the excitation of surface plasmons and coupled plasmons.

Room J (204)

Session Title 25J2 / [T12] Silicon Photonics Integration
Date & Time Tuesday, 25 August, 13:45 ~ 15:15
Session Chairs Ken Morito (PETRA, Japan)
Hyo-Hoon Park (KAIST, Korea)

[25J2-1] 13:45~14:15 Invited Talk

Silicon Photonic Integration Platform for Optical Communications and Other Applications

Hiroshi Fukuda
NTT, Japan

This paper describes recent progress in silicon photonics integration technology and related developments in optical communications and other applications. A new design concept for integrated photonic circuits and an application for tera-hertz generation are discussed.

[25J2-2] 14:15~14:30

CMOS-compatible Athermal 400GHz-spaced MZI Interleaver

Jong-Moo Lee[1], Min-Su Kim[1], Claudio J. Oton[2,3], Maryse Fournier[4], Pierre Labeye[4], and Francesco Testa[5]
[1]ETRI, Korea, [2]Scuola Superiore Sant'Anna, Italy, [3]Consorzio Nazionale Interuniversitario per le Telecomunicazioni, Italy, [4]CEA Leti, France, [5]Ericsson, Italy

400GHz spaced MZI interleaver is designed and fabricated on a SOI wafer by fully CMOS compatible process. The width and length of the MZI are optimized to reduce the temperature-dependent wavelength shift without using a negative thermo-optic material.

[25J2-3] 14:30~14:45

Wideband Slow Light Effects in 25 Gbps Si Photonic Crystal Mach-Zehnder Modulators

Yosuke Hinakura, Yosuke Terada, Takuya Tamura, and Toshihiko Baba
Yokohama National University, Japan

We evaluated wideband 25 Gbps error-free operation of Si slow light modulators. The fluctuation in extinction ratio was 1 dB over the bandwidth. Larger group indices produce larger extinction ratios and lower bit error rates.

[25J2-4] 14:45~15:00

Avalanche Photodiode Operation of Si Photonic Crystal Modulator

Yosuke Terada, Kenji Miyasaka, Hiroyuki Ito, and Toshihiko Baba
Yokohama National University, Japan

We observed the avalanche photodiode operation through defect levels at telecom band in Si photonic crystal slow light modulator. Maximum responsivity was 0.71 A/W with 350 avalanche gain. The eye opened at 20 Gbps.

[25J2-5] 15:00~15:15

A Nanomembrane-Based Bandgap-Tunable Ge Microdisk for Si-Compatible Optoelectronics

Donguk Nam[1], David Sukhdeo[2], Ju-Hyung Kang[2], Mark Brongersma[2], and Krishna Saraswat[2]
[1]Inha University, Korea, [2]Stanford University, USA

We present a new, CMOS-compatible platform for inducing a large, spatially homogeneous biaxial strain in Ge microdisks. This platform can deliver substantial performance improvements to biaxially strained Ge lasers for silicon-compatible optical interconnects.

Room A (101)

Session Title 25A3 / [T01] Q-switched Lasers
Date & Time Tuesday, 25 August, 15:45 ~ 17:30
Session Chair Takashige Omatsu (Chiba University, Japan)

[25A3-1] 15:45~16:00

Different Interaction Schemes with Carbon Nanotubes in a Pulsed Planar Waveguide Laser

Jun Wan Kim[1], Sun Young Choi[1], Mi Hye Kim[1], Dong-Il Yeom[1], Kwang Jun Ahn[1], Xavier Mateos[2], Madalena Aguiló[2], Francesc Díaz[2], Uwe Griebner[3], Valentin Petrov[3], and Fabian Rotermund[1]

[1]Ajou University, Korea, [2]Universitat Rovira i Virgili, Spain, [3]Max Born Institute for Nonlinear Optics & Short-Pulse Spectroscopy, Germany

We studied operation characteristics of a Gd^{3+} and Lu^{3+} co-doped Yb:KYW planar waveguide laser, Q-switched by carbon nanotube-based saturable absorbers in two direct interaction and one evanescent-field interaction regimes.

[25A3-2] 16:00~16:15

1570 nm Nanosecond Pulse Generation from Er/Yb Co-Doped All-Fiber Dual-Cavity Laser Oscillator with Fiber-Based Passive Q-Switch

Dongchen Jin, Ruoyu Sun, Shouyu Wei, Jiang Liu, and Pu Wang

Beijing University of Technology, China

1570 nm nanosecond all-fiber dual-cavity laser with fiber-based passive Q-switch is demonstrated. Stable pulse trains can be obtained with the repetition rate varying from 14 kHz to 156 kHz, and the maximum average power is 2.2 W.

[25A3-3] 16:15~16:30

Ultrafast Nonlinear Absorption in SWNTs: an Ultra-Broadband Investigation

Frank Wang[1], Shuo Xu[1], Hao Hong[2], Richard Howe[3], Kaihui Liu[2], Tawfique Hasan[3], and Yongbing Xu[1]

[1]Nanjing University, China, [2]Peking University, China, [3]University of Cambridge, UK

Z-scan spectroscopy is used to reveal ultra-broadband nonlinear absorption across different orders of resonant transitions in single-wall carbon nanotube ensembles, demonstrating the potential of nanotubes for nonlinear optics beyond the conventional NIR range.

[25A3-4] 16:30~16:45

Q-Switched Yb-Doped Fiber Laser with WS_2 Saturable Absorber

Guoqing Hu[1], Meng Zhang[1], Lingling Chen[2], Xuekun Zhu[1], Guohua Hu[3], Richard C. T. Howe[3], Xin Zhao[1], Zheng Zheng[1,4], and Tawfique Hasan[3]

[1]Beihang University, China, [2]Shenzhen University, China, [3]University of Cambridge, UK, [4]Collaborative Innovation Center of Geospatial Technology, China

We demonstrate an all-normal dispersion ytterbium doped fiber laser Q-switched by using a solution processed few-layer tungsten disulfide (WS_2)-polymer composite saturable absorber at 1030 nm.

[25A3-5] 16:45~17:00

Mirrorless Graphene Q-Switched Channel Waveguide Laser

Mi Hye Kim[1], Sun Young Choi[1], Thomas Calmano[2], Dong-Il Yeom[1], Christian Kränkel[2], Günter Huber[2], and Fabian Rotermund[1]

[1]Ajou University, Korea, [2]Universität Hamburg, Germany

We propose a Q-switched channel waveguide laser operating near 1 μm in mirrorless resonator configuration. PMMA-assisted monolayer graphene acting as saturable absorber is grown by chemical vapor deposition and transferred onto an end facet of the waveguide.

[25A3-6] 17:00~17:15

Q-Switched Mode-Locked Alexandrite Laser for Picosecond Pulses

Joonmo Ahn, Min Ki Jung, Minah Seo, Seok Lee, and Young Min Jhon

KIST, Korea

Q-switched mode-locked (QML) alexandrite laser with 728 ps pulse width was developed. While the output energy was measured varying the charging voltage, and the profile of the laser beam was monitored confirming single mode operation.

[25A3-7] 17:15~17:30

Improving the Repetition Rate of Tm-Doped Fiber Saturable Absorber Based Passive Q-Switching

Mengmeng Tao[1], Guobin Feng[1], Yanlong Shen[1], Ting Yu[2], and Xisheng Ye[2]

[1]Northwest Institute of Nuclear Technology, China, [2]Chines Academy Sciences, China

Two possible methods for repetition rate improvement of Tm-doped fiber saturable absorber based passively Qswitched Er-doped fiber lasers are reviewed. Simulations show that both methods are effective.

Room B (102)

Session Title 25B3 / [T01] Solid-State & Diode Lasers
Date & Time Tuesday, 25 August, 15:45 ~ 17:30
Session Chair Christian Kränkel (Universität of Hamburg, Germany)

[25B3-1] 15:45~16:15 Invited Talk

High-Energy Nonlinear Optics in Fiber

Siddharth Ramachandran

Boston University, USA

Intermodal nonlinear interactions with higher-order modes circumvent the dispersion-vs-nonlinearity tradeoff of single-mode waveguides. We review advances in this platform to enable nonlinear optics in fibers at energy levels potentially approaching that achievable in bulk crystals.

[25B3-2] 16:15~16:45 Invited Talk

Diode-Pumped Alexandrite Laser - a New Prospect for Remote Sensing

Michael Damzen[1], Gabrielle Thomas[1], Achaya Teppitaksak[1], Emma Arbabzadah[2], William Kerridge-Johns[1], and Ara Minassian[2]

[1]Imperial College London, UK, [2]Unilase Ltd., UK

Tunable-wavelength diode-pumped Alexandrite laser operation includes highest power > 26 W (end-pumped rod); > 12 W (side-pumped slab); and first Q-switched operation with pulse energy ~ 1 mJ at kHz repetition rate, as development for space lidar application.

[25B3-3] 16:45~17:00

Dual-Wavelength Continuous-Wave Operation of Nd,La Co-Doped CaF_2 Laser

Yingnan Peng[1], Wenlong Tian[2], Jiangfeng Zhu[2], Zhaohua Wang[1], Zhiyi Wei[1], Liangbi Su[1], and Jun Xu[1]

[1]Chinese Academy of Sciences, China, [2]Xidian University, China

Stable continuous-wave operation of an Nd, La co-doped CaF_2 laser was realized for the first time. The maximum output power of 534 mW was obtained, corresponding to a slop efficiency of 32.2%.

[25B3-4] 17:00~17:15

A Bulk ZnO-Based Vertical External Cavity Surface-Emitting Laser

Y. P. Lan, Y. C. Wu, Y. H. Chou, Y. Y. Lai, W. F. Hsieh, and Y. C. Chang

National Chiao Tung University, Taiwan

A possible polariton lasing is observed by a vertical-external-cavity surface-emitting laser consisted of a passive Q-switched laser, a semiconductor gain medium with distributed Bragg reflection and external mirror to form a cavity.

[25B3-5] 17:15~17:30

Power Scaling and Q-Switched Operation of a Pr^{3+} Doped YLF Laser Pumped by Four High Power InGaN-Blue-LDs

Kodai Iijima, Ryosuke Kariyama, Hiroki Tanaka, Kenichi Hirosawa, and Fumihiko Kannari

Keio University, Japan

We demonstrate a 2.9-W cw Pr^{3+}:YLF laser at 640 nm by pumping with four InGaN blue LDs. This laser is further extended to passive and active Q-switching operation using Cr^{4+}:YAG saturable absorber and acousto-optic modulator, respectively.

Room C (103)

Session Title 25C3 / [T02] Nonlinear Optics
Date & Time Tuesday, 25 August, 15:45 ~ 17:45
Session Chair Katsumi Midorikawa (RIKEN, Japan)

[25C3-1] 15:45~16:15 Invited Talk

Optical Constants Measurement of Nonlinear Crystals for Terahertz Generation

Nan El Yu[1], kyu-Sup Lee[1], Do-Kyeong Ko[1], Shunji Takekawa[2], and Kenji Kitamura[2]
[1]GIST, Korea, [2]National Institute for Materials Science, Japan

Optical constants of nonlinear crystals for terahertz generation were measured by terahertz time-domain spectroscopy. Congruent and stoichiometric crystals of lithium niobate ($LiNbO_3$) and lithium tantalate ($LiTaO_3$) were compared in the 0.1 – 2 THz range. Stoichiometric lithium tantalate (SLT) was estimated as a most promising single crystal to generate efficient THz source in an ordinary polarization direction. In addition, temperature dependent material dispersion for SLT was derived in the THz range.

[25C3-2] 16:15~16:30

Four Wave Mixing in 5th Order Cascaded CMOS Compatible Ring Resonators

Li Jin[1], Alessia Pasquazi[2], Luigi Di Lauro[2], Marco Peccianti[2], Brent E Little[3], David J Moss[4], Roberto Morandotti[5], and Sai Tak Chu[1]
[1]City University of Hong Kong, Hong Kong, China, [2]University of Sussex, UK, [3]Xi'an Institute of Optics and Precision Mechanics, China, [4]RMIT University, Australia, [5]Matériaux et Télécommunications, Canada

We report wavelength conversion via four wave mixing in a CMOS compatible 5th order cascaded microring resonator.

[25C3-3] 16:30~16:45

Second Harmonic Generation from Suspended Graphene Sheets

Kung-Hsuan Lin[1], Shao-Wei Weng[1], Po-Wei Lyu[1,2], Tsong-Ru Tsai[2], and Wei-Bin Su[1]
[1]Academia Sinica, Taiwan, [2]National Taiwan Ocean University, Taiwan

An ideal freestanding graphene in air is centrosymmetric in three dimensions, and its optical second harmonic generation is inhibited. However, we found strong second harmonic generation from suspended grapheme sheets, and attributed this observation to curved sheet in the long range.

[25C3-4] 16:45~17:00

Third-order Seeded Parametric Down-conversion in Silica Submicro-wire

Kee Hwan Nam, Dae Seok Han, and Myeong Soo Kang
KAIST, Korea

We experimentally demonstrate the 3rd-order seeded parametric down-conversion in a silica submicro-wire. Amplification of a 1597.38 nm seed beam is observed upon co-launching a 532.46 nm pump beam in the HE_{12} mode of the wire.

[25C3-5] 17:00~17:15

Quality Assessment of Quasi-Phase-Matched Gratings by Gaussian Beam Diffraction

Prashant Povel Dwivedi, Pavan Kumar, Heejoo Choi, and Myoungsik Cha
Pusan National University, Korea

Random duty-cycle error is genetic in quasi-phase matched gratings. An estimate of this error is significant to avoid parasitic harmonic generation. This study highlights an advantageous, high resolution method to quantitatively assess the gratings centered on Gaussian beam diffraction.

[25C3-6] 17:15~17:30

Improvement of Frequency-tripling Efficiency through a Walk-off Compensation

Changsoo Jung, Konkuk Kim, Bong-Ahn Yu, Yeung Lak Lee, Woojin Shin, and Young-Chul Noh
GIST, Korea

We experimentally investigated a walk-off-compensation method to improve the ultraviolet output power. We confirmed that the higher output-power improvement can be obtained in the narrower-beam case. The maximum output-power improvement was 3.0 times.

[25C3-7] 17:30~17:45

Control of Optical Rogue Waves in the Femtosecond Supercontinuum Generation Using a Weak Continuous Wave Trigger

Xiaoqi Duan and Qian LI
Peking University, China

We numerically study the characteristics of optical rogue waves in the femtosecond supercontinuum generation. The continuous wave trigger is proved to be an effective way to control optical rogue waves in the femtosecond supercontinuum generation.

Room D (106)

Session Title 25D3 / [T06] Novel Laser Process for Electonic devices
Date & Time Tuesday, 25 August, 15:45 ~ 17:30
Session Chairs Ya Cheng (Shanghai Institute of Optics and Fine Mechanics, China)
Jiyeon Choi (KIMM, Korea)

[25D3-1] 15:45~16:15 Invited Talk

Laser Materials Processing Technologies and the Future

Martin Richardson
University of Central Florida, USA

We present an overview of the advances in the field of laser materials processing, identifying those topics that are new or different, and speculating on their potential for applications in real world scenarios.

[25D3-2] 16:15~16:45 Invited Talk

Laser Doping and Texturing of Silicon for Advanced Optoelectronic Devices

Eric Mazur, Benjamin Franta, David Pastor, Hemi Gandhi, and Alexander Raymond
Harvard University, USA

Irradiating a semiconductor sample with intense laser pulses in the presence of dopants drastically changes the optical, material and electronic properties of the sample. The properties of these processed semiconductors make them useful for photodetectors and, potentially, intermediate band solar cells. This talk discusses the processes that lead to doping and surface texturing, both of which increase the optical absorptance of the material. We will discuss the properties of the resulting material, including the presence of an intermediate band, as well as our work on developing laser-processed silicon photodiodes that are sensitive to sub-bandgap wavelengths. Most recently, we have measured the electron lifetime within the doped material, and we have developed methods to control the dopant profile and the material crystallinity. These findings are expected to be useful in designing laser processed silicon devices.

[25D3-3] 16:45~17:00

Compact, Integrated Femtosecond Lasers for Mobile Display Processing

Eric Mottay[1], Clemens Hoenninger[1], Rainer Kling[2], Jiyeon Choi[3], and Sung-Hak Cho[3]
[1]Amplitude Systemes, France, [2]Alphanov, France, [3]KIMM, Korea

The development of new display technologies, such as organic LEDs and flexible displays, require significant advances in laser sources and manufacturing processes. We report on new laser technologies and optimized processes.

[25D3-4] 17:00~17:15

High Energy and High Average Power Optical Fiber Ultrafast Beam Delivery and Compression

Eric Mottay, Florent Guichard, Guillaume Machinet, Yoann Zaouter, and Clemens Hoenninger
Amplitude Systemes, France

We report on fiber delivery of ultrafast lasers. We demonstrate propagation of 500 fs, 1 mJ pulses over a distance of 10 m. We also report 100 W average power transmission, and sub-50 fs pulse compression.

[25D3-5] 17:30~17:45

Vibration Assisted Femtosecond Laser Hole Drilling on Fine Metal Mask for AMOLED

Wonsuk Choi and Sung Hak Cho
[1]Korea University of Science and Technology, Korea, [2]KIMM, Korea

Using vibration assisted femtosecond laser machining system, we can control hole taper angle directly by adjusting amplitude of vibration.

Room E (107)

Session Title 25E3 / [T05] Plasmonics and Metamaterials III
Date & Time Tuesday, 25 August, 15:45 ~ 17:45
Session Chair Jason Valentine (Vanderbilt University, USA)

[25E3-1] 15:45~16:15 Invited Talk

Top-down and Bottom-up Fabrication Techniques for Isotropic Metamterials

Takuo Tanaka[1,2]
[1]RIKEN, Japan, [2]Tokyo Institute of Technology, Japan

Top-down and bottom-up fabrication techniques are developed and applied for an isotropic infrared metamaterial that consists of fourfold-symmetric 3D SRRs. Mass-productive formation of the 3D SRRs was achieved by metal-stress driven self-folding process.

[25E3-2] 16:15~16:30

Inside-out, 120 nm Diameter Metal Slot Disk Resonator Arrays for Full Access to Air Slot Modes

Jongkook Choi[1], Jaehak Lee[1], Joonyoung Koh[1], Jun-Hyuk Choi[2], and Jung H. Shin[1]
[1]KAIST, Korea, [2]KIMM, Korea

Large-area array of 120 nm diameter plasmonic air-gap disk resonators with 30-nm thick air-gap is fabricated using nanoimprinting. An inside-out structure allows full access to the slot mode, and easy excitation of the plasmon mode.

[25E3-3] 16:30~16:45

Strong Plasmonic Coupling in Rod-dimer/Ring Nanostructure

Jia-Yu Lin, Chia-Yang Tsai, Pin-Tso Lin, Tse-En Hsu, and Po-Tsung Lee
National Chiao Tung University, Taiwan

A rod-dimer/ring (RDR) plasmonic nanostructure with different gap distances is investigated in both experiment and simulation. Compared to rod-dimer and ring, the localized near-field intensity of RDR can be significantly enhanced and further increased in smaller gap distance owing to stronger coupling effect.

[25E3-4] 16:45~17:00

Use DNA Origami as a Scaffold for Self-Assembly of Optical Metamolecules

Yoon Jo Hwang[1], Shelley F. J. Wickham[2], Steven D. Perrault[2], Sanghyun Yoo[1], Sung Ha Park[1], William M. Shih[2], and Seungwoo Lee[1]
[1]Sungkyunkwan University, Korea, [2]Harvard University, USA

A roadmap for assembling optical metamolecule is not yet clear; to address this challenge, herein, we propose to use DNA origami to achieve custom arrangements of metallic nanoparticles for deterministic assembly of optical metamolecules.

[25E3-5] 17:00~17:15

Alloy Plasmonic Materials

Yoshiaki Nishijima[1], Yoshiakizu Hashimoto[1], Seniutinas Gediminas[2,3], Armandas Balčytis[2,3], and Saulius Juodkazis[2,3]
[1]Yokohama National University, Japan, [2]Swinburne University of Technology, Australia, [3]The Australian National Fabrication Facility ANFF, Australia

We focused on the Au, Ag and Cu alloy systems and the experimental determination of their optical permittivity using optical transmission and reflection measurements with thin metal films. The optical constants define the plasmon resonance frequency and the electro-magnetic field intensity localized around the nanoparticles. However it is less known how the alloy metals perform in the field enhancement. Due to the unknown morphology and composition of the alloy, optical properties have to be determined experimentally. We demonstrate experimentally determination of the permittivity and Drude parameters of alloys and discuss the obtained results in comparison with X-ray crystallography measurements.

[25E3-6] 17:15~17:30

Mechanisms of High Refractive Index Properties in Fish-bone Shape Structures

In-Sung Lee[1], Jin-Kyu Yang[2], Chul-Sik Kee[3], and Joong Wook Lee[1]
[1]Chonnam National University, Korea, [2]Kongju National University, Korea, [3]GIST, Korea

We demonstrated the subwavelength metamaterial structures with multiple three-dimensional subwavelength confinement and high effective-refractive-index of terahertz electromagnetic waves. The properties can be explained by the coupling between electric-dipole and magnetic-dipole resonances.

[25E3-7] 17:30~17:45

Aluminum Infrared Plasmonic Perfect Absorbers Fabricated by Colloidal Lithography

Thang Duy Dao[1,2], Kai Chen[1,2], Satoshi Ishii[1,2], Akihiko Ohi[1], Toshihide Nabatame[1,2], Masahiro Kitajima[1,2], and Tadaaki Nagao[1,2]
[1]National Institute for Materials Science, Japan, [2]Japan Science and Technology Agency, Japan

We report on the fabrication of large-area aluminum plasmonic perfect absorber (Al-PA) using colloidal lithography combined with reactive ion etching process. Using the Al-PA, we demonstrate selective thermal emitters and tailor-made molecular vibrational sensing.

Room F (108)

Session Title 25F3 / [T07] Optical Metrology and Sensing III
Date & Time Tuesday, 25 August, 15:45 ~ 17:30
Session Chairs Terubumi Saito (Tohoku Institute of Technology, Japan)
Seung Kwan Kim (KRISS, Korea)

[25F3-1] 15:45~16:00

Single LED-based Flux Addition Method to Measure Linearity of Radiometric Photodiodes

Abdallah M. Karmalawi[1,2,3], Sun Do Lim[1], Bong-Hak Kim[1], Yong-Shim Yoo[1], Dong-Hoon Lee[1], Saber Salim[2], and Ayman Ali[3]
[1]KRISS, Korea, [2]National Institute for Standards, Egypt, [3]Cairo University, Egypt

A measurement method for linearity of photodiodes is proposed and demonstrated, which features a single LED in its setup resulting in better reliability in terms of flux drift than two LEDs' configuration.

[25F3-2] 16:00~16:15

Mid-infrared Difference Frequency Generation Based on Fan-out Grating MgO-doped PPLN

In-Ho Bae and Dong-Hoon Lee
KRISS, Korea

We report on the development of a mid-infrared source based on difference frequency generation in a fan-out MgO-doped PPLN crystal, which can be tuned from 2.5 μm to 3.6 μm by pumping at 1064 nm.

[25F3-3] 16:15~16:30

Temperature Dependence of Lasing Characteristics of a Q-switched Tm,Ho:YLF Laser at Temperatures Lower than 250 K

Atsushi Sato[1,2], Yoshiki Miyake[1], Kazuhiro Asai[1], Shoken Ishii[2], Kohei Mizutani[2], and Satoshi Ochiai[2]
[1]Tohoku Institue of Technology, Japan, [2]National Institute of Information and Communications Technology, Japan

The temperature dependence of Q-switched performance of a Tm,Ho:YLF laser was investigated. Small-signal gains and output energies were measured at 193-246 K. A quasi-four level nature strongly affected the laser performance even in this temperature range.

[25F3-4] 16:30~16:45

Generalized Aberration Reduction of a Concave Grating for Hyperspectral Sensing

Cheng-Hao Ko[1], Chia-Hui Tang[1], Jih-Run Tsai[2], and Bang-Ji Wang[2]
[1]National Taiwan University of Science and Technology, Taiwan, [2]National Space Organization, Taiwan

A generalized optimization process to reduce the aberration of a concave grating is developed. The approach has a dramatic improvement in aberration reduction and spectral resolution. Calculated result is in good agreement with measurement.

[25F3-5] 16:45~17:00

Precise Measurement of Optical Fiber Length Using a Gain-Switched Distributed Feedback Laser with Delayed Optical Feedback

Satoru Matsukura, Amaka Tanaka, Kenji Wada, Tetsuya Matsuyama, and Hiromichi Horinaka
Osaka Prefecture University, Japan

By utilizing the optical feedback induced noise in a gain switched distributed feedback laser, the optical length of a 1 km optical fiber was measured with an accuracy of 3.7×10^{-5} without using fast equipment.

[25F3-6] 17:00~17:15

Tracking of Three-dimensional Speckle Distributions Produced by Fish Otoliths for Fish Stock Identification

Edward Mosso, Guido Plaza, and Darío Pérez
Pontificia Universidad Católica de Valparaíso, Chile

Analyses have been conducted on the three-dimensional speckle distribution produced by fish otoliths. By tracking optical properties of these speckle patterns (autocorrelation areas and contrast), a fish stock identification can be achieved.

[25F3-7] 17:15~17:30

Copper Bromide Laser Monitors for Microstructures Visualization

Fedor A. Gubarev[1,2], Andrei V. Mostovshchikov[1], and Miron S. Klenovskii[1,3]
[1]Tomsk Polytechnic University, Russia, [2]Russian Academy of Sciences, Russia, [3]National Academy of Sciences of Ukraine, Ukraine

A method of observing processes accompanied by intense background light using laser monitor is demonstrated. The visualization results of process of aluminum nitride synthesis occurring by combustion of aluminum nano powder in the air are presented.

Room G (201)

Session Title 25G3 / [T08] Atom-Photon Interaction I
Date & Time Tuesday, 25 August, 15:45 ~ 17:45
Session Chair Jong Chan Lee (POSTECH, Korea)

[25G3-1] 15:45~16:15 Invited Talk

Slow, Stored, and Stationary Light for the Applications in Low-Light-Level Nonlinear Optics and Quantum Memory

Ite A. Yu

National Tsing Hua University, Taiwan

Our recent studies on low-light-level nonlinear optics and quantum memory based on slow, stored, and stationary light, and recent demonstration of two-component or spinor slow light will be presented in this talk.

[25G3-2] 16:15~16:45 Invited Talk

Superfluid Optomechanics

David McAuslan, Glen Harris, Chris Baker, Yauhen Sachkou, and Warwick Bowen

University of Queensland, Australia

Cavity optomechanics allows the first direct observation of superfluid thermodynamical motion. Laser cooling and strong quartic nonlinearities are both observed, enabling prospective applications in quantum engineering, precision sensing, and studiesof emergent quantum phenomena.

[25G3-3] 16:45~17:00

Manipulation of Frequency-Time Quantum Correlation of Narrow-Band Photon Pairs

Young-Wook Cho, Kwang-Kyoon Park, Jong-Chan Lee, and Yoon-Ho Kim

POSTECH, Korea

A specific form of frequency-time quantum correlations is naturally inherent in the nonclassical photon pairs generated via a parametric process. Here, complete manipulation of frequency-time quantum correlations of narrowband biphotons is reported.

[25G3-4] 17:00~17:15

Experimental Generation of Multiple Quantum Correlated Beams from Four-wave Mixing

Jietai Jing

East China Normal University, China

We report on our recent experimental results of generating quadruple quantum correlated beams by using cascaded four-wave mixing processes in hot rubidium vapor. The intensity-difference squeezing of the four beams is about 8.0 dB.

[25G3-5] 17:15~17:30

Characterization of Electromagnetically Induced Transparency in Rydberg State of ^{87}Rb

Hyo Min Kwak[1], Taek Jeong[1], Yoon-Seok Lee[1], No-Weon Kang[2], Seung Kwan Kim[2], and Han Seb Moon[1]

[1]Pusan National University, Korea, [2]KRISS, Korea

We present the direct measurement of highly excited Rydberg state using a ladder-type electromagnetically induced transparency in the $5S_{1/2}$-$5P_{3/2}$ -nL transition of ^{87}Rb atoms in a room-temperature vapor cell.

[25G3-6] 17:30~17:45

Coherence Time Limit of Entangled Paired Photons Generated in a Cold Atom Cloud

Jiefei Chen, Zhiguang Han, Peng Qian, Lu Zhou, and Weiping Zhang

East China Normal University, China

Through electromagnetically-induced transparency (EIT) assisted spontaneous four-wave mixing, we produce the entangled paired photons with a coherence time of 2.34 μs from a cold atom cloud. The EIT dephasing rate is the ultimate limit.

Room H (202)

Session Title 25H3 / [T11] Multiphoton Microscopy
Date & Time Tuesday, 25 August, 15:45 ~ 17:30
Session Chairs Wonshik Choi (Korea University, Korea)
Beop-min Kim (Korea University, Korea)

[25H3-1] 15:45~16:15 Invited Talk

Visible-wavelength Two-photon Excitation Microscopy

Katsumasa Fujita

Osaka University, Japan

We demonstrated two-photon excitation of fluorescent proteins by using visible light. The excitation scheme has been applied to simultaneous multicolor imaging of biological cells with improved spatial resolution.

[25H3-2] 16:15~16:30

Side-view Confocal Endomicroscopy for in Vivo Longitudinal Cellular Imaging of Small Intestine

Jinhyo Ahn[1], Kibaek Choe[1], Taejun Wang[2], Yoonha Hwang[1], Ki Hean Kim[2], and Pilhan Kim[1]

[1]KAIST, Korea, [2]POSTECH, Korea

In vivo longitudinal repetitive cellular level observation of microvasculature and fluorescent cells in a small intestinal tract of single mouse in minimally invasive manner was demonstrated by using GRIN lens based sideview confocal endomicroscopy.

[25H3-3] 16:30~16:45

High-speed, Thermal Damage-free Ablation of Brain Tissue with Femtoecond Pulse Bursts

Can Kerse[1], Seydi Yavaş[1,2], Hamit Kalaycıoğlu[1], Mehmet D. Aşık[3], Önder Akçaalan[1], and F. Ömer Ilday[1]

[1]Bilkent University, Turkey, [2]FiberLAST, Inc., Turkey, [3]Hacettepe University, Turkey

We report a novel ultrafast burst mode fiber laser system and results on ablation of rat brain tissue at rates approaching an order of magnitude improvement over previous reports, with no discernible thermal damage.

[25H3-4] 16:45~17:00

Subtraction Threshold for Fluorescence Difference Microscopy

Nan Wang[1,2] and Takayoshi Kobayashi[1,2,3,4]

[1]University of Electro-Communications, Japan, [2]JST, Japan, [3]National Chiao-Tung University, Taiwan, [4]Osaka University, Japan

The selection criterion of subtraction factors used in subtraction microscopy is numerically investigated. The fluorescence peak intensity after subtraction and resolution derivative are proposed as essential parameters for evaluating the subtractionthreshold.

[25H3-5] 17:00~17:15

Ablation of Targeted Cardiomyocyte in Zebrafish Larvae Utilizing Femtosecond Laser

Kazunori Okano, Chung-Han Wang, and Ian Liau

National Chiao Tung University, Taiwan

An intended death of target cardiomyocyte was induced in zebrafish by femtosecond-laser illumination. Time-lapse imaging revealed that cellular morphology changes accompanied by increase of membrane permeability and generation of cytosolic bubbles enclosed with plasma membranes.

[25H3-6] 17:15~17:30

Dark State Dynamics of Fluorescent Proteins Investigated by Fluorescence Transients

Naoto Kamiyama, Yoshiya Sunairi, Keisuke Toda, Hiroshi Takahashi, and Akira Suda

Tokyo University of Science, Japan

Transient fluorescent variations of enhanced green fluorescent protein and enhanced yellow fluorescent protein indicate the existence of two transient dark states including the lowest triplet state and the other dark state with a longer life time.

Room I (203)

Session Title 25I3 / [T10] Photonic Crystals
Date & Time Tuesday, 25 August, 15:45 ~ 17:30
Session Chair Sang Soon Oh (Imperial College London, U.K.)

[25I3-1] 15:45~16:30 Tutorial

Photonic structures for information and energy applications

Shanhui Fan

Stanford University, USA

We discuss some of our recent works in seeking to develop photonic structures for information processing and for energy applications. In particular, we will discuss our efforts in creating non-reciprocal photonic structures, without using magneto-optical effects, for the control of on-chip propagation of light. We will also discuss the design of photonic structures for energy applications, leading to the demonstration of daytime radiative cooling and radiative cooling of solar absorbers.

[25I3-2] 16:30~16:45

On-chip Operation of Optical Correlator

Shun Kinugasa, Norihiro Ishikura, and Toshihiko Baba

Yokohama National University, Japan

We fabricated a compact on-chip optical correlator using two photonic crystal slow light waveguides, and succeeded in complete on-chip operation. Observed pulse waveform agreed well with the one observed by commercial optical correlator.

[25I3-3] 16:45~17:00

Detection of Endotoxin Using a Photonic Crystal Nanolaser

Daichi Takahashi, Shoji Hachuda, Takumi Watanabe, Yoshiaki Nishijima, and Toshihiko Baba

Yokohama National University, Japan

We demonstrate the sensing of endotoxin using photonic crystal nanolaser and Limulus amebocyte lysate reaction. We detected low concentrations of 0.001 and 0.0001 EU/ml with a twice faster speed of the conventional methods.

[25I3-4] 17:00~17:15

High Group Index Silica-Clad Silicon Photonic Crystal Slow Light Waveguides

Takuya Tamura, Keisuke Kondo, and Toshihiko Baba

Yokohama National University, Japan

We comprehensively investigated practical silica-clad photonic crystal waveguides, and found two lattice shifts optimum for low-dispersion slow light. Fabricated device shows a high group index of >50, which ensures twice higher performance than conventional ones.

[25I3-5] 17:15~17:30

Optically-Induced Doppler Shift in Photonic Crystal Slow Light Waveguides

Keisuke Kondo and Toshihiko Baba

Yokohama National University, Japan

Doppler shift of signal light is obtainable by moving photonic bandgap mirror, which is dynamically formed by slow light pulse. Large wavelength shift from several 10 nm to a few 100 nm are numerically demonstrated.

Room J (204)

Session Title 25J3 / [T12] Silicon Photonics Hybrid Integration
Date & Time Tuesday, 25 August, 15:45 ~ 17:45
Session Chairs Kazumi Wada (University of Tokyo, Japan)
Donghwan Ahn (Kookmin University, Korea)

[25J3-1] 15:45~16:15 Invited Talk

GeSn Optical Gain Media Towards Monolithic 3D Photonic Integration

Jifeng Liu, Haofeng Li, and Xiaoxin Wang

Dartmouth College, USA

We present pseudo-single-crystal, direct band gap GeSn gain media fabricated at <450 °C on dielectric layers towards monolithic 3D photonic integration. A high transient optical gain ~5000 cm^{-1} has been at μ=2100-2200nm at 300K.

[25J3-2] 16:15~16:45 Invited Talk

Heterogeneous Integration of Silicon Photonic Devices and Integrated Circuits

Hyundai Park, Brian R. Koch, Erik J. Norberg, Jonathon E. Roth, Byungchae Kim, Anand Ramaswamy, John Hutchinson, Jae-Hyuk Shin, and Gregory Fish

Aurrion Inc., USA

Aurrion's heterogeneous integration platform enables simultaneous integration of active and passive photonic components on a silicon substrate. The platform provides photonic device library where each component is tailored to deliver maximum functionality for large scale photonic integrated circuits.

[25J3-3] 16:45~17:00

Characteristics of Film InP Layer and Si Substrate Bonded Interface Bonded by Wafer Direct Bonding

Keiichi Matsumoto, Yoshinori Kanaya, Junya Kishikawa, and Kazuhiko Shimomura

Sophia University, Japan

We demonstrated bonding of thin film InP and Si using wafer direct bonding technique and compared with bulk InP/Si bonded sample in terms of bonding strength and defect formation. Electrical conduction through the interface was also investigated.

[25J3-4] 17:00~17:15

Enhanced Photoluminescence from n^+-Ge Epitaxial Layers on Si: effect of Growth/Annealing Temperature

Naoki Higashitarumizu, Kazumi Wada, and Yasuhiko Ishikawa

University of Tokyo, Japan

Photoluminescence intensity is studied for n-type Ge layers (~1×10^{19} cm^{-3}) grown on Si. The growth and post-growth annealing temperatures are important factors to enhance the light emission together with the concentration of n-type doping.

[25J3-5] 17:15~17:30

Raman Analysis of in-plane Biaxial Strain for Ge-on-Si Lasers

Bugeun Ki[1], Jiwoong Baek[1], Chulwon Lee[2], Yong-Hoon Cho[2], and Jungwoo Oh[1]

[1]Yonsei University, Korea, [2]KAIST, Korea

Tensile strain of Ge-on-Si with post-growth annealing was analyzed using micro-Raman for optical sources in interconnection system. Tensile Stain in epi-Ge distributed non-linearly with SiGe alloy formation at the interface after annealing.

[25J3-6] 17:30~17:45

Controlling Optical Properties of Ge-on-Si by Thermal Annealing and Etching Process

Chulwon Lee[1], Yong-Hoon Cho[2], Yang-Seok Yoo[1], Min-Ho Jang[1], Bugeun Ki[2], and Jungwoo Oh[1]

[1]KAIST, Korea, [2]Yonsei University, Korea

We studied optical properties of thermally annealed Ge-on-Si. From Raman experiments, tensile strain as well as SiGe intermixing were investigated. Significant Γ'-band transition peak-shift was confirmed by photoluminescence depending on the thermal annealing conditions.

Room A (101)

Session Title 26A1 / [T01] High-Power Solid-State Lasers
Date & Time Wednesday, 26 August, 09:00 ~ 10:30
Session Chair Thomas Südmeyer (University of Neuchatel, Switzerland)

[26A1-1] 09:00~09:30 Invited Talk

Development of an Ultrafast Thin-Disk Ring Oscillator with an Intra-Cavity Average Power Higher than 1 kW

A. Amani Eilanlou[1], Yasuo Nabekawa[1], Makoto Kuwata-Gonokami[2], and Katsumi Midorikawa[1,2]

[1]RIKEN Center for Advanced Photonics, Japan, [2]The University of Tokyo, Japan

We report intra-cavity average power upscaling of a Kerr lens mode-locked ring oscillator to 1060 W. Obtained pulse energy of 68 μJ is the highest inside a ring-type oscillator, to the best of our knowledge.

[26A1-2] 09:30~09:45

Dual-Wavelength Operation of a Diode-Pumped Yb:KGW Laser

R. Akbari, H. Zhao, and A. Major

University of Manitoba, Canada

A high power continuous-wave dual-wavelength Yb:KGW laser using a birefringent plate was demonstrated. Stable operation at 1014.6 nm and 1046.3 nm with 3.4 W of average output power was obtained with diffraction-limited beam profile.

[26A1-3] 09:45~10:00

Yb:YAG Thin-Disk CPA Laser System for Intense THz Pulse Generation at 1 kHz Repetition Rate

Y. Ochi, K. Nagashima, M. Maruyama, M. Tsubouchi, F. Yoshida, N. Kono, and A. Sugiyama

Japan Atomic Energy Agency, Japan

We have developed a high average power picosecond laser system dedicated to intense terahertz (THz) pulse generation. The system is a chirped pulse amplification laser equipping with a Yb:YAG thin-disk amplifier. The Yb:YAG thin-disk regenerative amplifier at room temperature provides pulses with energy over 10 mJ and spectral bandwidth of 1.2 nm at a repetition rate of 1 kHz. In a pulse compressor, the laser pulse is compressed to be 1.3 ps. By employing this picosecond pulse as a pump source,THz pulses at the center frequency of 0.3 THz with energy over a few microjoules have been generated at 1 kHz repetition rate by the optical rectification in Mg-$LiNbO_3$ crystal.

[26A1-4] 10:00~10:15

Monoclinic 20at.% Tb^{3+}-Doped β-$BaLu_2F_8$ Single Crystals: Growth and Efficient Green Laser Operation

Philip Werner Metz, Daniel-Timo Marzahl, Ahmad Majid, and Christian Kränkel

Universität Hamburg, Germany

We report on the Czochralski growth of monoclinic β-$BaLu_2F_8$ single crystals. The solid-state phase transition was quenched by substituting 20% of the Lu^{3+}-ions with Tb^{3+}. An efficient green emitting Tb^{3+}:$BaLu_2F_8$-laser could be demonstrated as well.

[26A1-5] 10:15~10:30

High Average Power Picosecond Sapphire Face-Cooled Nd:YVO_4 Bounce Laser System

Maya Kowa[1], Masashi Abe[1], Katsuhiko Miyamoto[1], and Takashige Omatsu[1,2]

[1]Chiba University, Japan, [2]CREST Japan Science and Technology Agency, Japan

We developed a high average power, diffraction-limited (M2~1.1) picosecond laser system formed of a sapphire face-cooled Nd:YVO_4 slab amplifier with a multi-pass geometry. Average output power of 46.4 W was obtained at an optical-optical efficiency of 56%.

Room B (102)

Session Title 26B1 / [T06] Laser Processing for Flexible Electronics
Date & Time Wednesday, 26 August, 09:00 ~ 10:30
Session Chairs Sang Hoon Ahn (KIMM, Korea)
Jiyeon Choi (KIMM, Korea)

[26B1-1] 09:00~09:30 Invited Talk

Low Temperature Laser Processing for the Application in Flexible & Stretchable Electronics

Habeom Lee, Sukjoon Hong, Young Duk Suh, and Seung Hwan Ko

Seoul National University, Korea

Nanomaterials show various interesting unique thermal characteristics such as size dependent melting temperature drop, which can be used to develop plastic compatible low temperature metal patterning process. Focused laser as a local heat source can further reduce the processing temperature or induced localized thermochemical reaction. In this talk, recent research development and trend in nanomaterial based low temperature laser thermal engineering as well as applications will be discussed.

[26B1-2] 09:30~10:00 Invited Talk

Novel Process for Nano-structuring of Conducting Polymer Thin Film

Sang Min Chae[1], See Woo Lee[1], Kuk Hyun Jo[1], Ji Yeon Choi[2], Hyun Hwi Lee[3], and Hyo Jung Kim[1]

[1]Pusan National University, Korea, [2]KIMM, Korea, [3]POSTECH, Korea

We present new technique for nano-structuring of conducting polymers using femto-second (fs) laser in P3HT:PCBM films with special chain alignment. In an optimized condition of fs laser (1030 nm) irradiation on P3HT:PCBM films, the surface changed into a photoexpanded structure. The crystalline order of edge-on P3HT decreased, while the crystalline order of face-on P3HT increased in the photoexpanded area. The chain alignment of face-on P3HT was affected by the polarization direction of irradiated laser. The PCBM amount also increased in the photoexpanded area in comparison with the pristine area. The results of micro RAMAN measurement confirmed the stability of P3HT chains under the laser irradiation, i.e. the main P3TH chains were kept chain configuration and bonds after laser in photoexpanded areas. These results imply that orientation of P3HT crystals can be selectively controlled into face-on configuration by the fs-laser irradiation.

[26B1-3] 10:00~10:15

Numerical Analysis of Plasmonic Heating of Silver Nanowires under Femtosecond Laser Irradiation

Jeonghong Ha and Dongsik Kim

POSTECH, Korea

This work analyzes the electromagnetic and thermal phenomena occurring in welding of silver nanowires by femtosecond laser irradiation. We suggest that the nanowires can be joined by a non-thermal mechanism, substantially below the melting point.

[26B1-4] 10:15~10:30

Direct Ultrafast Laser Patterning of Transparent Conducting Layers for Flexible Electronics Fabrication

Mirae Lim[1], Yonghyeon Kim[1], Hyojoong Kim[2], Hanki Kim[2], and Jiyeon Choi[1]

[1]KIMM, Korea, [2]Kyung Hee University, Korea

An ultrafast laser was used to ablate transparent conducting layers deposited either by multilayered silver and ITO or silver web. Performance of the devices using them as electrodes was examined to confirm the process' efficiency.

Room C (103)

Session Title 26C1 / [T02] Fiber Laser
Date & Time Wednesday, 26 August, 09:00 ~ 10:30
Session Chair Myeong Soo Kang (KAIST, Korea)

[26C1-1] 09:00~09:15

Passively Mode-Locked Erbium-Doped Fiber Laser Using Gold-Nanosphere Based on Double Cladding Fiber as Saturable Absorber

Jun Yuan, Xunkun Bai, Dengfeng Fan, Jie Gu, Shaofei Wang, and Xianglong Zeng

Shanghai University, China

We have obtained a serial of mode-locked pulses at 1530 nm with a repetition rate of 8.47 MHz by using a double cladding fiber coated with gold-nanosphere as saturable absorber.

[26C1-2] 09:15~09:30

Femtosecond Erbium-doped Fiber Oscillator with Pulse Energy up to 58 nJ

Hao-Yuan Jiang, Chia-Lun Tsai, and Shang-Da Yang

National Tsing Hua University, Taiwan

Mode-locked Erbium fiber oscillator with pulse energy up to 58 nJ is experimentally demonstrated, the highest value to our best knowledge. The broadest spectrum corresponds to a transform-limited pulse of 93 fs duration.

[26C1-3] 09:30~09:45

A 359 fs Er-doped Fiber Laser Based on Topological Insulator: Bi_2Se_3

Kexuan LI, Yansong Song, Zhenhua Yu, and Jinrong Tian

Beijing University of Technology, China

A 359 fs erbium-doped fiber laser using topological insulator Bi_2Se_3/Polyvinyl alcohol (PVA) composite film as a saturable absorber was demonstrated. When changing the length of the erbium-doped fiber, a mode-locking pulse ranging from 1557 nm to 1600 nm could be generated.

[26C1-4] 09:45~10:00

Passively Q-switching of Erbium-doped Fiber Laser Using Ferrite as Saturable Absorber

Xuekun Bai[1], Jun Yuan[1], Shaofei Wang[1], Dengfeng Fan[1], Jie Gu[1], Yi Huang[1], Yunhe Zhao[1], Qianwu Zhang[1], Shengli Pu[2], and Xianglong Zeng[1]

[1]Shanghai University, China, [2]University of Shanghai for Science and Technology, China

We report on passive Q-switching of an erbium-doped fiber laser with ferrite saturable absorber achieving for the first time short (~3.2 μs) pulse durations with a low threshold pump power (~15 mW).

[26C1-5] 10:00~10:15

Dissipative-soliton-resonance in All-normaldispersion Fiber Lasers

Daojing Li[1], Luming Zhao[2], Dingyuan Tang[2], and Deyuan Shen[1]

[1]Fudan University, China, [2]Nanyang Technological University, Singapore

Multiple dissipative soliton operation is numerically found to be caused by the spectral filtering effect. Strong peak-power-clamping effect is required for the dissipativesoliton-resonance generation. The peak power is controlled by the cavity peak-power-clamping effect.

[26C1-6] 10:15~10:30

Ultra Low Threshold Optical Power Limiter Based on a Silicon Photonic Crystal Cavity

Zheng Wu, Mengxi Ji, and Yi Wang

Huazhong University of Science and Technology, China

Limiting high intensity light transmission and passing through the low in a L3-type nanocavity was proposed. This thermo-optic-effect-based power limiter realized a threshold power 19 μw. The threshold as a function of detuned wavelength is given.

Room D (106)

Session Title 26D1 / [T04] Ultrahigh Intensity Lasers I
Date & Time Wednesday, 26 August, 09:00 ~ 10:30
Session Chair Guoqiang Xie (Shanghai Jiao Tong University, China)

[26D1-1] 09:00~09:30 Invited Talk

Precision Performance for Full-scale Operation of LFEX PW Laser

Noriaki Miyanaga, Junji Kawanaka, Shigeki Tokita, Takahisa Jitsuno, Yoshiki Nakata, Hiroyuki Shiraga, and Shinsuke Fujioka

Osaka University, Japan

LFEX is a four-beam, picosecond Nd: glass laser system based on the chirped pulse amplification. The current operation level of amplifier is ~400 J/beam with a chirping of ~2 ns/3 nm. The compressor output is ~1.4 kJ at a pulse width of ~1.5 ps with a pulse contrast better than 109.

[26D1-2] 09:30~10:00 Invited Talk

Recent Progress and Research Status of Petawatt Femtosecond Lasers in SIOM

Xiaoyan Liang, Yuxi Chu, Zebiao Gan, Lianghong Yu, Lu Xu, Cheng Wang, Xiaoming Lu, Yuxin Leng, Ruxin Li, and Zhizhan Xu

Shanghai Institute of Optics and Fine Mechanics, China

The latest progress towards a 10PW ultra-intense femtosecond laser at SIOM was reported. The energy of 192.3J was achieved with Ti:sapphire amplifiers, which could support a peak power of 5.13PW.

[26D1-3] 10:00~10:30 Invited Talk

Dynamics of Cluster Ionization and Neutral Atom Acceleration

Krishnamurthy Manchikanti

Tata institute of Fundamental Research, India

Nanoclusters are simpler systems that engulf most of the complexity of the intense laser matter interactions. While the intra-cluster density is solid-like, the bulk density is orders of magnitude smaller. Inter-cluster plasma dynamics offer a rich variety of parameters to tweak the plasma for unusual effects like neutral atom and negative ion acceleration. Rydberg excited states generated in these systems have a decisive effects on the ion charge states and their angular distributions. In this talk I present a review of the dynamics of the intra-cluster and intercluster effects in nano-plasmas.

Room E (107)

Session Title 26E1 / [T05] Plasmonics and Metamaterials Ⅳ
Date & Time Wednesday, 26 August, 09:00 ~ 10:30
Session Chair Zhaowei Liu (University of California, San Diego, USA)

[26E1-1] 09:00~09:30 Invited Talk

Parity-time Optical Metamaterials

Zi Jing Wong, Liang Feng, Ren-Min Ma, Yuan Wang, and Xiang Zhang

University of California, Berkeley, USA

Exploration of the interplay between gain and loss in optical materials can lead to novel device functionalities. Here we demonstrated a single-mode laser based on paritytime symmetry breaking.

[26E1-2] 09:30~09:45

Chiral light-matter Interactions in Resonant Metamaterials

Seok Jae Yoo and Q-Han Park

Korea University, Korea

We present a theory of the chiral Purcell effect to describe the cavity-modified differential decay rate of chiral molecules to left and right circular-polarized modes. We also show negative-index metamaterials support the chiral Purcell effect.

[26E1-3] 09:45~10:00

Dual-band Optical Response Based on Plasmonic Metamaterial

Wudeng Wang, Yudong Li, Mingsi Zhang, Jingjun Xu, and Qian Sun

Nankai University, China

We investigated transmission of metematerial composed of stacked double semicircular-arcs structures with an angular offset. Optical response is observed simultaneously at visible and near-infrared band. Circular dichroism of ~0.47 within the near-infrared band is achieved.

[26E1-4] 10:00~10:15

Quantum Dot Nano Gap Metamaterial Terahertz Resonators

Laxmi Narayan Tripathi, Taehee Kang, Young-Mi Bahk, Sanghoon Han, Geunchang Choi, Jiyeah Rhie, Jeeyoon Jeong, and Dai-Sik Kim

Seoul National University, Korea

We present CdSe quantum dots nanogap metamaterial fabrication over large scale, resonant funneling of terahertz waves across 10 nm gap with giant terahertz intensity enhancements and quenching of photoluminescence of QDs inside the gap.

[26E1-5] 10:15~10:30

Microscopic Origin of Metal-to-Insulator Transition in Tightly-Coupled Metamaterials

Ji-Hun Kang[1,2], Seo-Joo Lee[2], and Q-Han Park[2]

[1]University of California, Berkeley, USA, [2]Korea University, Korea

We present a microscopic origin of metal-to-insulator transition (MIT) in tightly-coupled metamaterials. Like Mott transition in crystal solid, MIT in metamaterial is shown to arise when the distance between unit resonators passes the critical gap-size.

Room F (108)

Session Title 26F1 / [T07] Optical Metrology and Sensing Ⅳ
Date & Time Wednesday, 26 August, 09:00 ~ 10:15
Session Chair Hyug-Gyo Rhee (KRISS, Korea)

[26F1-1] 09:00~09:30 Invited Talk

Extremely Large Freeform Optics Manufacturing and Testing

Dae Wook Kim, Peng Su, Chang Jin Oh, and James H. Burge

University of Arizona, USA

The 4.2 m Daniel K. Inouye Solar Telescope (DKIST) primary mirror has about 9 mm freeform aspheric departure. Actively controlled stressed lap and infrared deflectometry system have been developed to manufacture the extremely large freeform optics.

[26F1-2] 09:30~09:45

The Study of High Precision MIR Lens Back Focal Length Measurement System

Feng-Ming Yeh[1], Der-Chin Chen[2], Siak-Lim Lee[2], Shih-Chieh Lee[1], and Wen-Te Hsieh[2]

[1]Da Yeh University, Taiwan, [2]Feng Chia University, Taiwan

This paper presents a new method of measuring the back focal length of middle infrared (MIR) lens that uses MIR pulse collimated beam and thermopile sensor. The experiment results state that the measurement accuracy of the back focal length of MIR lens is up to 2% at 5~25 mm range EFL. The advantages of this testing system are low costs, fast measurement speed, high precision, less complicated system and replacements of light source and detector of different IR spectrum for measuring BFL of lens.

[26F1-3] 09:45~10:00

The Study for Gigapixel Image Utilizing Robot Panoramic Head and Image Stitching Technique

Seung-Jo Noh, Yeon-Chan Choi, Hee-Joon Moon, Ho-Kwan Kang, and Cheon-Seog Rim

Hannam University, Korea

Currently, while the technology related to gigapixel image might not be well known to the general masses of people, leading edge enterprises like Google and BAE Systems are successively reporting for achieving the progress of gigapixel application and camera system. Even though conventional camera technology is limited to the class of megapixel image, we can obtain gigapixel image readily by means of robot panoramic head and image stitching technique. In this paper, we investigate the total process of creating gigapixel image which will be expected to make the chance of a multibillion dollar business in the industrial area related to vision technology and surveillance. From the experience of this research, we can also utilize the knowledge to devise and develop new types of gigapixel camera system such as AWARE camera of Duke University and ARGUS IS camera of BAE Systems. Meanwhile, we try to report very important issue realized from the process of creating gigapixel images, that is, visibility problem and how to correct.

[26F1-4] 10:00~10:15

Snapshot Spectroscopic Polarimeter Based on Polarized Dual Spectra

Daesuk Kim[1], Yonghee Yoon[1], Yoonho Seo[1], Hyunsuk Kim[1], and Robert Magnusson[2]

[1]Chonbuk National University, Korea, [2]University of Texas at Arlington, USA

This paper describes a snapshot spectroscopic polarimeter which can measure an accurate spectral Stokes vector of a transmissive object in a wide spectral domain within tens of msec.

Room G (201)

Session Title 26G1 / [T08] Atomic Physics
Date & Time Wednesday, 26 August, 09:00 ~ 10:30
Session Chair Han Seb Moon (Pusan National University, Korea)

[26G1-1] 09:00~09:30 Invited Talk

Vortex Pair Creation and Annihilation in a Bose-Einstein Condensate

Woo Jin Kwon, Geol Moon, and Yong-Il Shin

Seoul National University, Korea

We describe our recent experiments where we studied creation and annihilation of vortex pairs in a highly oblate Bose-Einstein condensate. We measured the critical velocity for vortex shedding and investigated the thermal relaxation of two-dimensional superfluid turbulence.

[26G1-2] 09:30~09:45

Atomic Fountain for Atom Interferometry

Nan Li, Zhouxiang Xu, Hao Ying, Kaikai Huang, and Xuanhui Lu

Zhejiang University, China

We demonstrated a highly controlled atomic fountain which is realized by simultaneous detuning of the upward beams versus the downward beams. A fountain height of 90cm is achieved after fine adjustment.

[26G1-3] 09:45~10:00

Progress Towards a Strontium Optical Lattice Clock at NTSC

Wang Yebing[1,2], Liu Hui[1,2], Lu Benquan[1,2], Ren Jie[1], Xu Qinfang[1], Yin Mojuan[1], Kong Dehuang[1], Ma Jie[1], and Chang Hong[1]

[1]National Time Service Center, China, [2]University of Chinese Academy of Sciences, China

Stable narrow line lasers are built up and some precision measurements are performed. Based on the cold 88Sr atoms loaded in to one dimension optical lattice, a sideband resolved clock transition spectrum is obtained.

[26G1-4] 10:00~10:15

Stark and Zeeman Effects as Tools for Magnetic Diagnostics in Toroidal Plasmas

Jinseok Ko[1], Jinil Chung[1], and Maximilian Messmer[2]

[1]National Fusion Research Institute, Korea, [2]Eindhoven University of Technology, Netherlands

Doppler-shifted Stark and Zeeman effects are applied to the measurement of the magnetic structure that confines toroidal plasmas for nuclear fusion. Progress on these applications to the Korean tokamak is presented.

[26G1-5] 10:15~10:30

Ultrafast Laser-Driven Rabi Oscillation of Morris-Shore Transformed Multi-Level Atoms

Hyosub Kim, Yunheung Song, Han-Gyeol Lee, and Jaewook Ahn

KAIST, Korea

We show that the 24 energy levels involved in the D1 transition of atomic Rb^{85} are reduced to independent 12 two-level systems of a single Rabi frequency by MorrisShore transformation. Experiment performed with ultrafast laser interacting with cold atoms in a MOT confirms the prediction.

Room H (202)

Session Title 26H1 / [T09] Growth and Fabrications
Date & Time Wednesday, 26 August, 09:00 ~ 10:30
Session Chairs Yong-Hoon Cho (KAIST, Korea)
Tae Geun Kim (Korea University, Korea)

[26H1-1] 09:00~09:30 Invited Talk

Nitride-based Light-emitting Diodes Using Conducting Filament Embedded TCO

B. R. Lee, K. H. Kim, T. H. Lee, and Tae Geun Kim

Korea University, Korea

We present an electroforming transparent conductive electrode that enables current injection from metal to semiconductor, by forming conducting filaments (CFs) in wide-bandgap materials such as silicon nitride, and employ it as an n-type electrode for GaN-based vertical light emitting diodes to investigate the effect of the CF densities on the electrical and optical characteristics in VLEDs.

[26H1-2] 09:30~10:00 Invited Talk

Drastic Enhancement of Eu Emission from Red Light-emitting Eu-doped GaN in a Microcavity

Yasufumi Fujiwara, Tomohiro Inaba, Takanori Kojima, and Atsushi Koizumi

Osaka University, Japan

Eu-doped GaN (GaN:Eu) has been identified as a promising red emitter. A GaN:Eu layer was confined in a microcavity consisting of a Ag mirror and an AlGaN/GaN distributed Bragg reflector (DBR), resulting in drastic enhancement of Eu emission intensity.

[26H1-3] 10:00~10:15

Reflection Properties of Nano Textured Distributed Bragg Mirrors

Yoon-Jong Moon[1], Han-Kyeol Lee[1], Jin-Young Na[1], Sang-Woon Lee[2], and Sun-Kyung Kim[1]

[1]Kyung Hee University, Korea, [2]Ajou University, Korea

We designed nano-textured distributed Bragg reflectors and investigated their reflectance properties by conducting finite-difference-time-domain, mostly focusing on the effect of surface roughness.

[26H1-4] 10:15~10:30

Direct Growth of Thick AlN Template on Micro-circle Patterned-Si Substrate

Tinh Binh Tran, Hideki Hirayama, Noritoshi Maeda, Masafumi Jo, and Shiro Toyoda

RIKEN, Japan

A 8-μm-thick AlN template has been successfully directly grown on micro-circle patterned-Si substrate. Low surface roughness of 3.5 nm and both screw and edge dislocation densities are in the order of 10^8 /cm^2 have been obtained.

Room I (203)

Session Title 26I1 / [T10] Waveguides
Date & Time Wednesday, 26 August, 09:00 ~ 10:15
Session Chair Seungwoo Lee (Sungkyunkwan University, Korea)

[26I1-1] 09:00~09:15

Waveguide Side-wall Angle Dependant Resonance of a Si Micro Ring-resonator

Mohammad Rakib Uddin[1], Nur'Azmina Lingas[1], Bikash Nakarmi[2], and Yong Hyub Won[2]
[1]Institut Teknologi Brunei, Brunei, [2]KAIST, Korea

Si waveguide side-wall angle dependant resonance characteristic of a micro ring-resonator is presented. The peak resonant wavelength and the modulation depth have changed significantly due to the changes of side-wall angle.

[26I1-2] 09:15~09:30

Broadband Guidance and Control of Polarization Vector Beams in Small-core Ultrahigh-NA Optical Waveguides

Eunmi Kim, Ki Sang Lee, and Myeong Soo Kang
KAIST, Korea

We demonstrate direct excitation and broadband guidance of polarization vector beams (PVBs) in commercially stock-available small-core ultrahigh-NA optical fibers. A simple numerical analysis supports the experimental results and provides criteria for stable guidance of PVBs.

[26I1-3] 09:30~09:45

Grating Based MEMS Tunable Filter for WDM Optical Network

U. Poornalakshmi, Somya Agarwal, M. Balasubramanian and Prasant Kumar Pattnaik
BITS-Pilani, India

A simulation model of in-plane MEMS tunable optical filter based on grating located on a silicon micro-machined cantilever beam is presented. Upon actuation a shift in filtered frequency varies linearly in C-band has been observed.

[26I1-4] 09:45~10:00

Theoretical Investigation of Graphene-Based Inverted Rib-type Silicon Waveguides

Yonghan Kim and Min-Suk Kwon
UNIST, Korea

We demonstrate that graphene-based inverted rib-type silicon waveguides can be used as absorption modulators. Simulation shows that the modulation depth of such a modulator is larger than those of previous graphene-based silicon waveguide modulators.

[26I1-5] 10:00~10:15

Fabrication of 0.7μm^2 Ridge Waveguide in Ion-Sliced $LiNbO_3$ by Proton-Exchange Accelerated Etching

Keisuke Tanaka and Toshiaki Suhara
Osaka University, Japan

We fabricated ridge waveguides in ion-sliced $LiNbO_3$ by accelerated chemical etching in the proton-exchanged region. We obtained the low-loss waveguides of 0.7 μm^2 cross-sectional area. Strongly confined guided modes were obtained at 1.55 μm wavelength.

Room J (204)

Session Title 26J1 / [T12] Micro Cavity Devices
Date & Time Wednesday, 26 August, 09:00 ~ 10:15
Session Chairs Jifeng Liu (Dartmouth College, USA)
Kyong Hon Kim (Inha University, Korea)

[26J1-1] 09:00~09:30 Invited Talk

Ultrahigh-Q Asymmetric Microcavity Photonics on a Silicon Chip

Yun-Feng Xiao, Xue-Feng Jiang, Linbo Shao, Li Wang, and Qihuang Gong
Peking University, China

We experimentally realized on-chip deformed microcavities supporting both highly unidirectional emission and ultrahigh Q factors exceeding 108. This type of microcavity holds potential in ultralow-threshold laser and sensitive nanoparticle detection.

[26J1-2] 09:30~09:45

High-Frequency Self-Modulation in Short-External-Cavity VCSEL with Semi-Spherical Mirror

Tao Liu, Takeo Katayama, and Hitoshi Kawaguchi
Nara Institute of Science and Technology, Japan

Optical output modulation of over 15 GHz frequency was achieved in a short-external-cavity VCSEL by using a semispherical mirror for the cavity. The modulation was caused by the beat note between two external cavity modes.

[26J1-3] 09:45~10:00

Electro-Optic Polymer/TiO_2 Vertical Slot Waveguide Modulators

Yasufumi Enami[1], Youssef Jouane[1], Jingdong Luo[2], and Alex Jen[2]
[1]Kochi University of Technology, Japan, [2]University of Washington, USA

We report the efficient poling of electro-optic (EO) polymer in a hybrid EO polymer/TiO_2 vertical slot waveguide modulators based on enhanced conductivity of sol-gel silica under-cladding. The electrical volume conductivity of sol-gel silica cladding increases approximately 30 times when the calcining time of the cladding layer is critically reduced to 45 minutes, which increases the in-device EO coefficient of the 600-nm-thick EO polymer film in modulators and reduces the lower halfwave voltage (V_π) of the modulators. The lowest driving voltage (V_π) of the TiO_2 slot waveguide modulator is 2.0 V for an electrode length (Le) of 10 mm and wavelength of 1550 nm ($V_\pi L_e$ = 2.0 V·cm) for the low-index guest–host EO polymer SEO125. The optical propagation loss is reduced to 7 dB/cm.

[26J1-4] 10:00~10:15

High Sensitivity, Ultra-Broadband SWNT-Graphene Hybrid Photodetector

Frank Wang[1], Yuanda Liu[1], Xiaomu Wang[2], Yao Li[1], Xizhang Wang[1], Xinran Wang[1], Yongbing Xu[1], Yi Shi[1], and Rong Zhang[1]
[1]Nanjing University, China, [2]Yale University, USA

A photodetector based on SWNT-graphene hybrid films and facile fabrication steps is demonstrated, which exhibits a remarkably high photoresponsivity of ~ 100 A/W, across visible (400 nm) to the telecommunication wavelengths (1550 nm).

Room A (101)

Session Title 26A2 / [T01] Mode-Locked Lasers I
Date & Time Wednesday, 26 August, 11:00 ~ 12:30
Session Chair Zhigang Zhang (Peking University , China)

[26A2-1] 11:00~11:30 Invited Talk

Gate-Controlled All-Fiber Graphene Device and Its Application to Ultrafast Fiber Laser System

Dong-Il Yeom

Ajou University, Korea

Actively controlled all-fiber graphene device exhibiting strong graphene-light interaction is demonstrated through electrical gating of graphene layer, and its application as a tunable nonlinear saturable absorber in ultrafast fiber laser system is discussed.

[26A2-2] 11:30~11:45

High Frequency 60 fs Mode-Locked Fiber Laser

Yanrong Song, Zhiyuan Dou, and Jinrong Tian

Beijing Univerisity of Technology, China

An Er-doped all fiber laser with high-repetition-rate of 224-MHz is demonstrated. The mode locking mechanism is nonlinear polarization rotation mode-locking. The fiber laser is compact and simple with pulse-width of 60-fs and spectral-width of 60-nm.

[26A2-3] 11:45~12:00

All-Polarization Maintaining FemtoSecond Fiber Laser Based on Evanescent Field Interaction with SWCNT Saturable Absorber

H. Jeong[1,2], S. Y. Choi[1], F. Rotermund[1], S. B. Lee[2], K. Lee[2], and D.-I. Yeom[1]

[1]Ajou University, Korea, [2]KIST, Korea

We demonstrate an all-polarization maintaining Er-doped soliton fiber laser using evanescent field interaction with carbon nanotube saturable absorber. Fabricated fiber laser stably generates linearly polarized 510-fs soliton pulses with polarization extinction ratio of 18 dB.

[26A2-4] 12:00~12:15

Demonstration of Femtosecond Ti:Sapphire Laser Oscillation Pumped by InGaN Diode Lasers

Ryota Sawada, Hiroki Tanaka, Ryosuke Kariyama, Kenichi Hirosawa, and Fumihiko Kannari

Keio University, Japan

We demonstrate a mode-locked Ti:sapphire laser pumped by green InGaN laser diodes from both sides of the crystal. An output power of 45 mW is achived in modelocking with a SESAM (semiconductor saturable absorber mirror).

[26A2-5] 12:15~12:30

Laser Diode Pumped Kerr-Lens Mode-Locking Nd,Y-Codoped CaF_2 Laser

Jiangfeng Zhu[1], Lijuan Zhang[1], Juting Zhang[1], Ziye Gao[1], Junli Wang[1], Zhiyi Wei[2], Liangbi Su[2], and Jun Xu[2]

[1]Xidian University, China, [2]Chinese Academy of Sciences, China

We realized a diode-pumped Kerr-lens modelocking operation in a Nd,Y-codoped CaF_2 laser. Pulses with 357 fs duration at 1063 nm were obtained. The average power was 210 mW under 5 W pump.

Room B (102)

Session Title 26B2 / [T06] Ultrashort Pulsed Laser 3D Processing
Date & Time Wednesday, 26 August, 11:00 ~ 12:30
Session Chair Sung Hak Cho (KIMM, Korea)
Jiyeon Choi (KIMM, Korea)

[26B2-1] 11:00~11:45 Tutorial

Volume Processing of Transparent Materials by Ultrashort Laser Pulses: Potential and Applications

Stefan Nolte[1,2], Klaus Bergner[1], Ria Krämer[1], Daniel Richter[1], Sören Richter[1], Christian Voigtländer[1], and Felix Zimmermann[1]

[1]Friedrich Schiller University Jena, Germany, [2]Fraunhofer Institute for Applied Optics and Precision Engineering, Germany

Internal structuring of transparent materials using ultrashort laser pulses enables a plethora of applications. This includes precise cutting, welding but also the realization of various photonic components like waveguides, artificial birefringent devices or Bragg gratings.

[26B2-2] 11:45~12:15 Invited Talk

Femtosecond Laser Patterning of Plasmonic and Nonlinear Optical Properties in Silver-doped

Y. Petit[1,2], M. Vangheluwe[1], N. Marquestaut[1], T. Cardinal[2] and Lionel Canioni[1]

[1]Universite Bordeaux, France, [2]Institut de Chimie de la Matière Condensée de Bordeaux, France

Nowadays the optical properties and structural arrangements of several inorganic materials can be modified using ultrafast and intense laser sources. Among several lithographic techniques, Direct Laser Writing (DLW) considered as a maskless patterning process, presents numerous advantages over usual techniques. DLW offers rapid patterning at sub-micrometer resolutions, with flexibility and scalability. At last, true three-dimensional structuration is allowed thanks to non-linear interaction in optical transparent materials. In this context, DLW of materials containing photosensitive agents can initiate photochemical processes, opening routes toward the design of nanocomposites. DLW techniques can modify the size, the shape, and the arrangement of the metal clusters. It is a powerful and flexible tool to control and optimize the linear and nonlinear properties of metallo-dielectric composites. Many groups have shown interest in patterning metals in three dimensions in transparent media such as glasses or polymers. This becomes particularly challenging when structures much smaller than the diffraction limit need to be patterned for infrared or optical applications.

[26B2-3] 12:15~12:30

Extraordinary Characteristics of Spatiotemporally Focused Laser Pulses and Their Roles in Precision Materials Processing

Fei He[1], Zhaohui Wang[1], Bin Zeng[1], Jielei Ni[1], Ya Cheng[1], and Koji Sugioka[2]

[1]Shanghai Institute of Optics and Fine Mechanics, China, [2]RIKEN Center for Advanced Photonics, Japan

We report on the observation of novel spatiotemporal effects of a spatiotemporally focused beam, which play important roles in many applications of femtosecond laser processing of materials.

Room C (103)

Session Title 26C2 / [T02] Novel Materials
Date & Time Wednesday, 26 August, 11:00 ~ 12:30
Session Chair Nan Ei Yu (APRI/GIST, Korea)

[26C2-1] 11:00~11:15

Heat-Spreading Role of Graphene Studied by Coherent Phononic Propagations

Hoonil Jeong[1], A. J. Minnich[2], Soon-Young Park[1], Hyeong-Yong Hwang[1], Sung-Yong Yoon[1], and Young-Dahl Jho[1,2]

[1]GIST, Korea, [2]California Institute of Technology, USA

We have experimentally explored the role of graphene transferred on top of a GaN-based light-emitting diode (LED) as a heat spreading layer by monitoring the propagations of coherent acoustic phonons (CAPs).

[26C2-2] 11:15~11:30

Ultrafast Mid-infrared Investigations on the Surface Dirac Fermions with Topological Phase Transition

Jun Park[1], Sangwan Sim[1], Nikesh Koirala[2], Matthew Brahlek[2], Seongshik Oh[2], and Hyunyong Choi[1]

[1]Yonsei University, Korea, [2]Rutgers the State University of New Jersey, USA

We present ultrafast optical studies of the Dirac surface dynamics in a topological insulator Bi_2Se_3 via optical pump mid-infrared probe spectroscopy. We observed largely enhanced carrier relaxation when the topological-phase transition takes place.

[26C2-3] 11:30~11:45

Electrically Controllable Detection of Transverse Acoustic Phonons

Young-Dahl Jho[1], Hoonil Jeong[1], S. Y. Yoon[1], and C. J. Stanton[2]

[1]GIST, Korea, [2]University of Florida, USA

In this work, we report on the electrical manipulation of photoelastic properties in wurtzite semiconductors for allowing transverse acoustic (TA) phonon detection.

[26C2-4] 11:45~12:00

Coherent Phonon Dynamics in Single-Layer and Multilayer Graphene

Taeyoung Jeong[1,2], Suyong Jung[2], and Kiju Yee[1]

[1]Chungnam National University, Korea, [2]KRISS, Korea

Coherent phonon dynamics of single-layer graphene (SLG) and multi-layer graphene (MLG) on sapphire substrate were investigated using femtosecond pump-probe techniques. The center peak of G-mode phonon redshift with the number of graphene layer and the temperature increases in the temperature range between 300 K and 900 K. Also, the dephasing time upshift from 0.82 ps to 1.14 ps as the number of graphene layer increases. The results reflect thermal expansion and damping constant of SLG and MLG.

[26C2-5] 12:00~12:15

Observation of the Mid-infrared 1s Intraexcitonic Dynamics in Monolayer MoS_2

Soonyoung Cha[1], Ji Ho Sung[2], Sangwan Sim[1], Jun Park[1], Moon-Ho Jo[2], and Hyunyong Choi[1]

[1]Yonsei University, Korea, [2]POSTECH, Korea

We report the first measurement of ultrafast mid-infrared (IR) spectroscopy in monolayer MoS_2. The observed mid-IR dynamics shows large photo-excited absorption, indicating the predominant intraexcitonic transition from the ground to the higher-lyingexcitonic states.

[26C2-6] 12:15~12:30

Ultrafast Mid-IR Carrier Dynamics in Three-Dimensional Dirac Semimetal Cd_3As_2

Chunhui Zhu[1], Xiang Yuan[2], Yongbing Xu[1], Faxian Xiu[2], and Fengqiu Wang[1]

[1]Nanjing University, China, [2]Fudan University, China

We investigated ultrafast carrier dynamics in Cd_3As_2 at 2.6 μm. Single-exponential decay and saturable absorption features are observed. The ultrafast optical nonlinearity suggests that Cd_3As_2 is useful for mode-locking lasers in the mid-IR range.

Room D (106)

Session Title 26D2 / [T04] Ultrahigh Intensity Lasers II
Date & Time Wednesday, 26 August, 11:00 ~ 12:30
Session Chair Noriaki Miyanaga (Osaka University, Japan)

[26D2-1] 11:00~11:30 Invited Talk

0.1 Hz 4.0 PW Ti:Sapphire Laser at CoReLS

Jae Hee Sung[1,2], Seong Ku Lee[1,2], Hwang Woon Lee[1], Je Yoon Yoo[1], Tae Moon Jeong[1,2], and Chang Hee Nam[1]

[1]IBS, Korea, [2]GIST, Korea

0.1-Hz 4.0-PW laser is being developed for research on relativistic laser-matter interactions. The upgrade will be achieved by increasing the laser energy of the current 1.5- PW laser to 80 J and decreasing the pulse duration to 20 fs.

[26D2-2] 11:30~12:00 Invited Talk

Recent Progress on an Upgrade of the J-KAREN Laser at JAEA

H. Kiriyama[1], M. Mori[1], A. S. Pirozhkov[1], K. Ogura[1], M. Nishiuchi[1], M. Kando[1], H. Sakaki[1], A. Kon[1], M. Kanasaki[1], H. Tanaka[2], Y. Fukuda[1,2], J. Koga[1], A. Sagisaka[1], T. Zh. Esirkepov[1], Y. Hayashi[1], H.Kotaki[1], S. V. Bulanov[1], K. Kondo[1], Y. Mashiba[1,3], M. R. Asak[3], O. Slezak[4], D. Vojna[4], M. Sawica-Chyla[4], V. Jambunathan[4], A. Lucianetti[4], and T. Mocek[4]

[1]Japan Atomic Energy Agency, Japan, [2]Kyushu University, Japan, [3]Kansai University, Japan, [4]Institute of Physics, Czech Republic

We describe recent advances on the J-KAREN laser upgrade to provide an intensity capacity surpassing 10^{22} W/cm^2 at 0.1 Hz. The present high-spatiotemporal quality pulses of 20 J will be amplified in an additional amplifier.

[26D2-3] 12:00~12:30 Invited Talk

Ultra-high Intensity Laser-Matter Interaction Studies at RRCAT, India

Juzer Ali Chakera, Anand Moorti, Himanshu Singhal, Bobilli Sanyasi Rao, Vipul Arora, Suman Bagchi, Muhammad Tayyab, Mukund Kumar, Ranjana Rathore, Tirtha Mandal, Prasad Anant Naik, and Parshotam Dass Gupta

Raja Ramanna Centre for Advanced Technology, India

This article presents some of the recent experimental studies in ultra-high intensity laser-matter interaction, carried out at Raja Ramanna Centre for Advanced Technology, India, at laser intensities of ~$3x10^{18}$ and ~$5x10^{19}$ W/cm^2, using 0TW and 150 TWTi:sapphire laser systems.

Room E (107)

Session Title 26E2 / [T05] Plasmonics and Metamaterials V
Date & Time Wednesday, 26 August, 11:00 ~ 12:45
Session Chair Junsuk Rho (POSTECH, Korea)

[26E2-1] 11:00~11:30 Invited Talk

Light Emission Enhancement by Using Patterned Multilayer Hyperbolic Metamaterials

Dylan Lu, Haoliang Qian, Kangwei Wang, Jimmy Kan, Eric Fullerton, Paul Yu, and Zhaowei Liu

University of California, San Diego, USA

We study nanopatterned multilayer hyperbolic metamaterials with tunable plasmonic properties for enhancing fluorescent molecules and LEDs at different working wavelengths. About two order of magnitude of spontaneous emission rate enhancement was demonstrated.

[26E2-2] 11:30~11:45

Low-Scattering Hyperbolic Nanotube

Kyoung-Ho Kim, You-Shin No, Sehwan Chang, Jae-Hyuck Choi, and Hong-Gyu Park

Korea University, Korea

We present a low-scattering radial anisotropic hyperbolic metamaterial nanotube of which angular permittivity is near zero. As a realization of the hyperbolic nanotube, we propose a metal/dielectric layered nanotube in the visible wavelength regime.

[26E2-3] 11:45~12:00

Angle-dependent Phase Reversal through Deep-subwavelength Dislocation in Hyperbolic Metamaterials

Jiho Hong, Sunkyu Yu, and Namkyoo Park

Seoul National University, Korea

In this communication, we show that phase-shifted transmission can be achieved through the deep subwavelength dislocation in hyperbolic metamaterials. Based on the analysis using Fourier modal method, we show that the regime of 'phase reversal' exists for the oblique incidence which has the tangential wavevector anti-parallel to the direction of dislocation.

[26E2-4] 12:00~12:15

Reconfigurable Designs for EIT in Solid State Plasma Metamaterials with Multiple Transmission Windows

Xiangkun Kong[1], Shaobin Liu[1], Guowen Ding[1], and Bingxiang Li[1,2]

[1]Nanjing University, China, [2]Kent State University, USA

A reconfigurable metamaterial analog electromagnettically induced transparency like (EIT-like) effect is theoretically and numerically demonstrated in this paper. The unit cell is composed of a stimulated circular loop element and an unstimulated arc slot element, which are both constructed by semiconductor. The proposed designs can realize a continuously tunable EIT-like effect in a broad frequency range, while the number of EIT-like transmission windows can be configured by increasing the number of arc slots.

[26E2-5] 12:15~12:45 Invited Talk

Stimuli Responsive Plasmonic Resonator and Its Sensing Application

Myungjae Lee[1], Heonsu Jeon[1], and Sunghwan Kim[2]

[1]Seoul National University, Korea, [2]Ajou University, Korea

A fully biocompatible and tunable plasmonic resonator consisting of silk protein and gold nanostructure is demonstrated. The silk plasmonic absorber sensor is based on the metal-insulator-metal resonator exhibits stimuli responsive optical properties.

Room F (108)

Session Title 26F2 / [T07] Optical Metrology and Sensing V
Date & Time Wednesday, 26 August, 11:00 ~ 12:30
Session Chair Dong-Hoon Lee (KRISS, Korea)

[26F2-1] 11:00~11:30 Invited Talk

Quantum Entangled Photon Sources and Their Application to Quantum Metrology

Shigeki Takeuchi

Kyoto University, Japan

Quantum information science has been attracting significant attention recently. It harnesses the intrinsic nature of quantum mechanics such as quantum superposition, the uncertainty principle, and quantum entanglement to realize novel functions. Recently, quantum metrology is emerging as another appealing application of quantum information science. In this talk, we will report our recent progresses on the development of novel quantum entangled-photon sources and application to quantum measurements.

[26F2-2] 11:30~12:00 Invited Talk

High Efficiency Single Photon Detection with Optimized SNSPD and Compressed Beam

Labao Zhang, Lin Kang, Jian Chen, and Peiheng Wu

Nanjing University, China

The efficiency is one of the most important parameter of single photon detector (SPD). The ideal SPD is expected to have 100% efficiency without false counts (always called dark counts). Improving the efficiency and reducing dark counts are interesting work for both scientific research and practical applications. Superconducting nanowire single photon detector (SNSPD) was intensively developed for its merit of low dark count, less than 1 count per second. However, its efficiency was limited by the optical absorption of superconductor nanowire. In this work, we analyzed the optical absorption of superconductor nanowire of SNSPD in theory. Then, we designed a SNSPD considering film growth and microfabrication process by optimizing the device structure, including the filling factor, films thickness, substrate index and cavity. With the SNSPD, a high absorption of 97% was calculated by FDTD method and a detector efficiency of 90% was achieved in experiments assisted by beam compressing settings.

[26F2-3] 12:00~12:15

Intensity-based Pointwise Processing in Dynamic Laser Speckle Analysis

Elena Stoykova[1], Natalia Berberova[2], Dimana Nazarova[2], and Atanas Gotchev[3]

[1]KETI, Korea, [2]Bulgarian Academy of Sciences, Bulgaria, [3]Tampere University of Technology, Finland

Intensity-based pointwise algorithms for 2D evaluation of activity in optical metrology with dynamic speckle analysis are studied. They are applied to a temporal sequence of correlated speckle patterns formed at laser illumination of the object surface. A new algorithm is proposed that provides the same quality of the 2D activity map but at less computational effort.

[26F2-4] 12:15~12:30

Actinic EUV Mask Inspection Using Coherent EUV Source Based on High-order Harmonic Generation

Yong Soo Kim[1,2], June Park[1], Han Yong Park[1,2], Hamin Sung[3], Jomsool Kim[3], Seung Beom Lee[3], Hyun Woo Cho[4], Ju Han Lee[2], Min-Chul Park[1], and Young Min Jhon[1]

[1]KIST, Korea, [2]University of Seoul, Korea, [3]Laser Spectronix, Korea, [4]Uvisions, Korea

We developed a coherent scattering microscope (CSM) for actinic EUV mask inspection. The CSM system was designed to measure critical dimensions down to 88 nm, and 200 nm l/s patterns were experimentally inspected.

Room G (201)

Session Title 26G2 / [T08] Quantum Information II
Date & Time Wednesday, 26 August, 11:00 ~ 12:30
Session Chair Geoff Pryde (Griffith University, Australia)

[26G2-1] 11:00~11:30 Invited Talk

Round-robin Differential-phase-shift QKD Protocol

Masato Koashi

The University of Tokyo, Japan

Conventional quantum key distribution (QKD) schemes determine the amount of leaked information through estimation of signal disturbance. Here we present a QKD protocol based on an entirely different principle, which works without monitoring the disturbance.

[26G2-2] 11:30~11:45

Adaptive Polarization-State Monitoring and Stabilization Scheme for One-Way Polarization-Encoded Quantum Key Distribution Systems

Shengrong Timothy Yu[1], Jiun Yan Yap[2], Mao Tong Liu[1], Wenhan Wang[2], and Han Chuen Lim[1,2]

[1]Nanyang Technological University, Singapore, [2]DSO National Laboratories, Singapore

We demonstrate an adaptive polarization-state monitoring and stabilization scheme for one-way polarization-encoded QKD. Polarization references are sent at a repetition rate that is adapted to the polarization drift condition to maintain a low QBER.

[26G2-3] 11:45~12:00

Measurement of Arbitrary Superpositions of Core Modes in a Multi-core Fiber

Hee Jung Lee[1,2], Han Seb Moon[2], Sang-Kyung Choi[1], and Hee Su Park[1]

[1]KIRSS, Korea, [2]Pusan National University, Korea

We propose and demonstrate an experimental technique that generates and measures arbitrary superpositions of the core modes in a multi-core fiber. This technique is potentially useful for transmission of high-dimensional quantum states through optical fiber.

[26G2-4] 12:00~12:15

Demonstration of Quantum Permutation Algorithm with a Single Photon Ququart

Pei Zhang, Feiran Wang, Yunlong Wang, Ruifeng Liu, and Fuli Li

Xi'an Jiaotong University, China

We report an experiment to demonstrate a quantum permutation determining algorithm by employing photon polarization and spatial modes. This work displays the remarkable speedup of quantum algorithm and strong universality in quantum computation.

[26G2-5] 12:15~12:30

Experimental Observation of Decoherence-induced Symmetry Breaking in Entangled Photons

Hyang-Tag Lim, Jong-Chan Lee, Kang-Hee Hong, and Yoon-Ho Kim

POSTECH, Korea

Quantum states can exhibit exchange symmetry; local quantum operations on the subsystems are exchangeable without affecting the quantum state. Here, we report that the exchange symmetry is broken once decoherence is introduced, even though the photons still share non-zero entanglement.

Room H (202)

Session Title 26H2 / [T11] Optical Coherence Tomography
Date & Time Wednesday, 26 August, 11:00 ~ 12:30
Session Chair Donghyun Kim (Yonsei University, Korea)

[26H2-1] 11:00~11:30 Invited Talk

Expanding Imaging Ranges for Spectral Domain Optical Coherence Tomography

Hyung-Jin Kim[1], Pil Un Kim[2], Min Gyu Hyeon[1], Jee-Hyun Kim[3], and Beop-Min Kim[1]

[1]Korea University, Korea, [2]Oz-tec Co., Korea, [3]Kyungpook National University, Korea

Applicability of optical coherence tomography (OCT) has been expanding in various areas of medicine. Imaging larger areas using OCT while maintaining reasonable spatial resolution is one of the directions people pursue to enable new diagnosis. We have employed an ultrafast optical switch along with several new techniques to fully expand the spectral domain OCT imaging range in ophthalmology.

[26H2-2] 11:30~11:45

Deep-tissue Imaging with Collective Accumulation of Single Scattering Microscopy

Seungwon Jeong[1], Sungsam Kang[1], Wonjun Choi[1], Hakseok Ko[1], Taeseok D. Yang[1], Jungho Moon[1], Yonghyeon Jo[1], Jang Ho Joo[1], Jae-Seung Lee[1], Yong-Sik Lim[2], Q-Han Park[1], and Wonshik Choi[1]

[1]Korea University, Korea, [2]Konkuk University, Korea

We present an approach that maintains full optical resolution in imaging deep within scattering media. Imaging depth of 11.5 times the scattering mean free path was achieved with near-diffraction-limit resolution of 1.5 μm.

[26H2-3] 11:45~12:00

Fiber-based Dual Modal System for Noncontact Photoacoustic and Optical Coherence Tomography

Jonghyun Eom[1], Seong Jun Park[2], Jae Hwi Lee[1], Soongho Park[1], and Byeong Ha Lee[1]

[1]GIST, Korea, [2]UNIST, Korea

We present a dual modal system combining noncontact photoacoustic tomography and optical coherence tomography. The proposed system, composed of fiber-optic networks, uses one probing beam path, which provides the noncontact measurements. Multimodal images of phantoms were acquired to demonstrate the capability of the proposed system.

[26H2-4] 12:00~12:15

Visualization of Prostatic Nerves Using Polarization-sensitive Optical Coherence Tomography

Yeoreum Yoon[1], Yong Hyun Park[2], Seung Hwan Jeon[2], Won Hyuk Jang[1], Ji Youl Lee[2], and Ki Hean Kim[1]

[1]POSTECH, Korea, [2]Catholic University of Korea, Korea

We demonstrate that polarization-sensitive optical coherence tomography (PS-OCT) can identify the cavernous nerve in the human and rat prostate ex vivo based on its birefringence. PS-OCT may be useful for nerve preservation during radical prostatectomy.

[26H2-5] 12:15~12:30

All-Fiber Burst Mode Laser System Integrated with OCT for Cataract Surgery

Denizhan Koray Kesim, Hamit Kalaycıoğlu, Can Kerse, and F. Ömer Ilday

Bilkent University, Turkey

We demonstrate a burst-mode Yb all-fiber femtosecond laser system integrated with OCT for cataract surgery and aim to enhance further the procedure with lower collateral tissue damage, cleaner, efficient cuts with compact and robust structure.

Room I (203)

Session Title 26I2 / [T10] Advances in Metamaterials
Date & Time Wednesday, 26 August, 11:00 ~ 12:15
Session Chairs Masaaki Ono (NTT, Japan)
Young Chul Jun (UNIST, Korea)

[26I2-1] 11:00~11:30 Invited Talk

Hyperbolic Metamaterials

Evgenii Narimanov[1] and Ishii Satoshi[2]

[1]Purdue University, USA, [2]National Institute for Materials Science, Japan

Photonic hyper-crystals represent a new class of artificial optical media. These composites, which are hyperbolic metamaterials with periodic spatial variation of dielectric permittivity on a subwavelength scale, combine the features of optical metamaterials and photonic crystals.

[26I2-2] 11:30~11:45

Tunable and Broadband Perfect Absorption in Epsilon-Near-Zero Indium Tin Oxide Thin Films at Near Infrared Wavelengths

Junho Yoon[1], Md. Alamgir Badsha[1], Tae Young Kim[1], Young Chul Jun[2], and Chang Kwon Hwangbo[1]

[1]Inha University, Korea, [2]UNIST, Korea

In this study we demonstrate tunable and broadband perfect absorption in epsilon-near-zero ITO thin films and multilayers at near infrared wavelengths and investigate their optical, electrical, and structural properties.

[26I2-3] 11:45~12:00

Hollow Core Negative Curvature Fiber with Layers of Photoaligned SD1 Azo Dye

Denis Bogdanovich[1], Abhishek Shristava[2], Vladimir Chigrinov[2], Alexander Biriukov[3], and Andrey Pryamikov[3]

[1]Irkutsk State Technical University, Russia, [2]Hong Kong University of Science and Technology, Hong Kong, China, [3]Russian Academy of Sciences, Russia

Microstructured hollow core negative curvature fiber containing layers of SD1 azo dye exhibits spectral shift of photonic bandgaps and change of guided light amplitude under the influence of external linearly polarized UV radiation.

[26I2-4] 12:00~12:15

Full-field Sub-wavelength Imaging with a Multiple Scattering

Chunghyun Park[1], Jung-Hoon park[1], Christophe Rodriguez[1], Hyeon Seung Yu[1], Minkwan Kim[1], Kyoungsuk Jin[2], Seungyong Han[2], Jonghwa Shin[1], Seung Hwan Ko[2], Ki Tae Nam[2], Yong Hee Lee[1], Y. Cho[1], and Yong Keun Park[1]

[1]KAIST, Korea, [2]Seoul National University, Korea

We demonstrate the scattering superlens using elastic scattering to obtain sub-diffraction resolution. Scattering from disordered nanoparticles enables to reconstruct the sub-wavelength image of the target through time-reversal and transmission matrix.

Room J (204)

Session Title 26J2 / [T12] Ⅲ-Ⅴ Integrated Photonics
Date & Time Wednesday, 26 August, 11:00 ~ 12:00
Session Chairs James A. Lott (Technische Universität Berlin, Germany)
Yongsoon Baek (ETRI, Korea)

[26J2-1] 11:00~11:30 Invited Talk

Development of a Versatile InP-Based Photonic Platform Based on Butt-Joint Integration

Francisco M. Soares, Francisco M. Soares, Tom Gaertner, Dieter Franke, Martin Moehrle, and Norbert Grote

Fraunhofer Heinrich-Hertz Institute, Germany

This paper describes the development of a very-versatile InP-Based Photonic-Integration platform by Butt-Joint integration of the passive waveguides to active waveguides across a relatively high mesa of 3-4μm. The Butt-Joint losses are currently around 1dB.

[26J2-2] 11:30~11:45

Dynamic Behavior of 1.3-μm npn-AlGaInAs/InP Transistor Lasers under Collector-Base Voltage Loss-modulation

Takaaki Kaneko, Takumi Yoshida, Tadano Shotaro, Nobuhiko Nishiyama, and Shigehisa Arai

Tokyo Institute of Technology, Japan

An intensity modulation of 1.3-μm wavelength npn AlGaInAs/InP transistor laser was demonstrated by collector-base voltage loss-modulation at 1 GHz. A 150-ps wide pulse operation was observed with the peak intensity enhanced by approximately 6 times the CW intensity level.

[26J2-3] 11:45~12:00

Experimental and Numerical Investigation of Slow Carrier Relaxation in an InGaAs/GaAs Quantum Dot Laser Diode

Jong Min Lee[1], Bong Hwan Jun[1], Donghan Lee[1], and Jungho Kim[2]

[1]Chungnam National University, Korea, [2]Kyung Hee University, Korea

Spontaneous emission from InGaAs/GaAs quantum dots was investigated above the lasing threshold through windows structure on a laser diode. We found a clear evidence of slow carrier relaxation from the excited state to the ground state in a lasing condition.

Room A (101)

Session Title 26A3 / [T01] Mode-Locked Lasers II
Date & Time Wednesday, 26 August, 15:45 ~ 17:45
Session Chair Fengqiu Wang (Nanjing University, China)

[26A3-1] 15:45~16:15 Invited Talk

Sub-fs Hybrid Synchronization between Mode-Locked Fiber Lasers

Y. Lai[1], W.-W. Hsiang[2], and S.-Y. Wu[1]

[1]National Chiao Tung University, Taiwan, [2]Fu Jen Catholic University, Taiwan

Sub-fs timing synchronization between a 1030 nm Yb doped and a 1560 nm Er-doped mode-locked fiber laser is successfully demonstrated by utilizing a hybrid passive/active approach. The physical mechanisms for determining the relative timing jitter are clarified.

[26A3-2] 16:15~16:30

Dispersion Management in Nanotube Mode-Locked, Compact Linear-Cavity Fiber Laser

Tomoyasu Honda, Yu Wang, and Shinji Yamashita

The University of Tokyo, Japan

By managing the intracaivty dispersion in nanotube mode-locked linear-cavity fiber laser, we achieved dissipative soliton operation at repetition rate of 62.5 MHz, which is the highest repetition rate for dissipative soliton.

[26A3-3] 16:30~16:45

Efficient Diode-Pumped High Power Femtosecond Yb:LYSO Laser

Wenlong Tian[1], Zhaohua Wang[2], Zhiyi Wei[2], Jiangfeng Zhu[1], Lihe Zheng[2], Xiaodong Xu[2], and Jun Xu[2]

[1]Xidian University, China, [2]Chinese Academy of Sciences, China

We report on a diode-pumped high power femtosecond Yb:LYSO laser. More than 3 W average power with pulse duration of 215 fs at 1042 nm and 297 fs at 1035 nm, respectively, were obtained.

[26A3-4] 16:45~17:00

Diode-Pumped Kerr-Lens Mode-Locked Yb:GSO Laser Generating 72 fs Pulses

Wenlong Tian[1], Zhaohua Wang[2], Zhiyi Wei[2], Jiangfeng Zhu[1], Lihe Zheng[2], Xiaodong Xu[2], and Jun Xu[2]

[1]Xidian University, China, [2]Chinese Academy of Sciences, China

We demonstrated a diode-pumped Kerr-lens mode-locked Yb:GSO laser starting with SESAM. Stable mode-locking operation with average power of 85 mW and pulse duration of 72 fs was realized at repetition rate of 113 MHz.

[26A3-5] 17:00~17:15

Dissipative Soliton Generation in All Fiber Mode Locked Thulium Laser

Fangzhou Tan, Jiang Liu, Huihui Li, and Pu Wang

Beijing University of Technology, China

We demonstrate an all fiber dispersion managed mode locked thulium laser generating sub-200 fs pluses with 168 mW output power at repetition rate of 30 MHz.

[26A3-6] 17:15~17:30

Dissipative Soliton Yb-Doped Fiber Laser Using a Bulk-Structured Bi_2Te_3 Topological Insulator

Junsu Lee, Cheolhwan Chi, Joonhoi Koo, and Ju Han Lee

University of Seoul, Korea

We experimentally demonstrate mode-locking of an ytterbium-doped fiber laser using a bulk-structured Bi_2Te_3 topological insulator. The stable mode-locked pulses with temporal width of ~230 ps and repetition rate of 1.44 MHz were obtained.

[26A3-7] 17:30~17:45

Multiwavelength, Subpicosecond Pulse Generation from a SWNT-SA Mode-Locked Ring Birefringent Fiber Laser

Guoqing Hu[1], Xin Zhao[1], Ya Liu[1], Zijun Yao[1], Meng Zhang[1], and Zheng Zheng[1,2]

[1]Beihang University, China, [2]Collaborative Innovation Center of Geospatial Technology, China

By leveraging the polarization interference filtering and the gain profile tilting based on polarization dependent loss tuning, ultrashort pulses at up to four wavelengths are generated covering both 1530 and 1560 nm windows of the C-band.

Room B (102)

Session Title 26B3 / [T13] 3D Display
Date & Time Wednesday, 26 August, 15:45 ~ 17:45
Session Chairs Kun Liu (Tianjin University, China)
Hee-Jin Choi (Sejong University, Korea)

[26B3-1] 15:45~16:15 Invited Talk

Highly Immersive Head-mounted Displays Based on Aspherical and Freeform Optics

Dewen Cheng and Yongtian Wang

Beijing Institute of Technology, China

Field of view (FOV) and resolution are two key parameters for head-mounted displays (HMDs), which determine the user's experience including immersion and comfort. We present four different designs for large FOV and high resolution HMDs developed at Beijing Institute of Technology. Each of them provides an FOV greater than 80 degrees and an angular resolution better than 4 arcminutes. Two of the designs are immersive for virtual reality applications, and the other two are optical see-through foraugmented reality applications. The designs can be divided into another two categories according to the size of the display devices employed. Design methods and experimental results are discussed in detail.

[26B3-2] 16:15~16:45 Invited Talk

Switchable Liquid Crystal Lens for 3D Applications

Ki-Beom Son, Min-Kyu Park, Mugeon Kim, Heewon Park, and Hak-Rin Kim

Kyungpook National University, Korea

We developed a polarization dependent reactive mesogen lens array by using both bottom-up and top-down alignment method for 2D/3D switchable 3D device systems like autostereoscopic display and light field camera.

[26B3-3] 16:45~17:00

Full-color Table-top Display with Rotating Transmissive Screen

Kwang-Soo Kim[1], Hosung Jeon[1], Hwi Kim[2], and Joonku Hahn[1]

[1]Kyungpook National University, Korea, [2]Korea University, Korea

We already suggested a 360-degree table top display system using transmissive screen. We improve our system as a full-color table-top display using RGB LEDs and cross dichroic prism.

[26B3-4] 17:00~17:15

Time-Multiplexed Two-Directional Sequential Projections for Integral Imaging 3D Display

Md. Ashraful Alam[1], Seok-Hee Jeon[2], and Nam Kim[1]

[1]Chungbuk National University, Korea, [2]Incheon National University, Korea

A time-multiplexed two-directional sequential projection scheme (TTSP) is proposed and demonstrated to implement a viewing-angle-enhanced integral imaging display system. The main idea behind the method is sharing of the same image screen to display two sets of directional elemental images (DEIs) in a time-multiplexed sequential projection manner.

[26B3-5] 17:15~17:30

Comparison of Perceived Depth Resolution between Different Image Generation Methods for Lenticular 3D Display

Minyoung Park and Hee-Jin Choi

Sejong University, Korea

The shape of the displayed image of the lenticular lens array method is changed with the sampling methods. In this paper, we try to compare the perceived depth resolution between different sampling methods.

[26B3-6] 17:30~17:45

Luminance Profile Control Method Using Gradation Iris for Autostereoscopic 3D Displays

Munekazu Date[1], Tohru Kawakami[2], Mutsumi Sasai[2], and Hideaki Takada[1]

[1]Nippon Telegraph and Telephone Corporation, Japan, [2]Tohoku University, Japan

A precise control method of angular luminance distribution of viewing zone using a filter with gradation in transmittance in an iris of a projector is proposed for autostereoscopic 3D display with smooth motion parallax.

Room C (103)

Session Title 26C3 / [T02] Supercontinuum Generation
Date & Time Wednesday, 26 August, 15:45 ~ 17:45
Session Chair Kyung Taec Kim (IBS/GIST, Korea)

[26C3-1] 15:45~16:15 Invited Talk

Strong-field-ionization Induced Air Lasers

Bin Zeng[1], Jinping Yao[1], Wei Chu[1], Hongqiang Xie[1], Ziting Li[1], Jielei Ni[1], Guihua Li[1], Chenrui Jing[1], Huailiang Xu[2], and Ya Cheng[1]

[1]Shanghai Institute of Optics and Fine Mechanics ,China, [2]Jilin University, China

We report on generation of strong-field-ionization induced free-space air lasers and explore their applications in remote sensing and molecular physics.

[26C3-2] 16:15~16:30

Interaction between a Single Water Droplet and a Laser Filament

Cheonha Jeon, Danielle Harper, Khan Lim, Magali Durand, Michael Chini, Matthieu Baudelet, and Martin Richardson

University of Central Florida, USA

The analysis of the destruction and reformation of a single laser filament interacting with a single micro-sized water droplet allows a better understanding of filament propagation through atmospheric aerosols.

[26C3-3] 16:30~16:45

Optical Guiding Using Femtosecond Laser Filamentation

Xiao-Long Liu[1], Xin Lu[1], Zhi Gui Du[1], and Jie Zhang[1,2]

[1]Chinese Academy of Sciences, China, [2]Shanghai Jiao Tong University, China

Optical guiding of the laser pulse using filamentation is investigated experimentally. Guiding effect as a function of temporal delay shows that it is the most effective when pump beam goes 8ps before signal beam.

[26C3-4] 16:45~17:00

Highly Coherent Supercontinuum Pumped by Picosecond Pulse with a PCF Taper

Feng Li[1], Qian Li[2], Jinhui Yuan[1], and P. K. A. Wai[1]

[1]Hong Kong Polytechnic University, Hong Kong, China, [2]Peking University, China

We propose to directly generate highly coherent supercontinuum with single noisy picosecond pump pulses by self-similarly pre-compress them down to ~50 fs with negligible pedestal in a nonlinearity engineered large mode area photonic crystal fiber taper.

[26C3-5] 17:00~17:15

High-order Modes Supercontinuum Generation in a Large-core Photonic Crystal Fiber

Stanislav Leonov[1], Vladimir Lazarev[1], Mikhail Tarabrin[1], Dmitriy Dvoretskiy[1], Valeriy Karasik[1], and Andrey Pryamikov[2]

[1]Bauman Moscow State Technical University, Russia, [2]Russian Academy of Sciences, Russia

We report on experimental investigation spectral properties of high-order modes SC generation in a large-core photonic crystal fiber with high air-filling fraction. Optical properties of large-core photonic crystal fiber were analysed. The SC generation in high-order modes LP_{11}, LP_{21} and LP_{02} were observed under different input conditions.

[26C3-6] 17:15~17:30

Supercontinuum Generation in Suspended Core Photonic Crystal Fibers Doped with Silver Nanoparticle

Surajit Bose[1], Rik Chattopadhyay[1], Samudra Roy[2], and Shyamal K. Bhadra[1]

[1]CSIR-Central Glass and Ceramic Research Institute, India, [2]Indian Institute of Technology, India

We study optical properties of silver nanoparticle doped highly nonlinear silica suspended core photonic crystal fiber. We numerically obtained a nearly octave-spanning supercontinuum in few centimeters of such doped fiber with very low input power.

[26C3-7] 17:30~17:45

Supercontinuum Notch Shaping via Fiber Bragg Grating for the Excitation Source in Coherent Anti-Stokes Raman Spectroscopy

Seung Ryeol Oh, Daewon Kang, Jindoo Choi, Jin Hwan Kim, Hyub Lee, Kyung-Soo Kim, and Soohyun Kim

KAIST, Korea

We show the feasibility of an all-fiber based single-pulse coherent anti-Stokes Raman spectroscopy. The system consists of a supercontinuum source from erbium-doped fiber amplifier and fiber Bragg grating for notch filtering.

Room D (106)

Session Title 26D3 / [T06] Novel Laser and Optical Technologies in Manufacturing
Date & Time Wednesday, 26 August, 15:45 ~ 17:30
Session Chair Sung Ho Jeong (GIST, Korea)

[26D3-1] 15:45~16:15 Invited Talk

High Performance Materials Processing Using Tailored Femtosecond Laser Pulses

Koji Sugioka[1], Katsumi Midorikawa[1], Fei He[2], and Ya Cheng[2]

[1]RIKEN Center for Advanced Photonics, Japan, [2]Shanghai Institute of Optics and Fine Mechanics, China

Tailored femtosecond laser pulses can enhance the performance for materials processing. Temporarily tailored femtosecond laser pulses are employed for high efficiency glass welding, while the spatially one, for formation of taper-free through Si vias.

[26D3-2] 16:15~16:45 Invited Talk

Optical Fabrication and Operation of Micronano-Robots

Hong-Bo Sun

Jilin University, China

Femtosecond laser direct writing (FsLDW) was utilized to create micronano-robots, which were then demonstrated to be optically, electronically, magnetically or chemically manipulated. An appropriate operation mechanism is considered as essential for functionalizing the robots.

[26D3-3] 16:45~17:00

Physical Model for Subsurface Silicon Writing

Onur Tokel, Ahmet Turnali, Ihor Pavlov, and F. Ömer Ilday

Bilkent University, Turkey

We have recently reported a direct laser writing method enabling buried structures deep inside silicon. Here we study the formation of these subsurface structures. We take advantage of Nonlinearity Engineering to understand this new phenomenon.

[26D3-4] 17:00~17:15

Material Response of Semiconductors Irradiated with IR Ultrashort Laser Pulses

Ilya Mingareev, Mark Ramme, and Martin Richardson

University of Central Florida, USA

We utilize near- and mid-IR ultrafast laser radiation to investigate the processing of crystalline silicon with different dopants. A numerical model is adopted to simulate the material response depending on the wavelength and the dopant concentration.

[26D3-5] 17:15~17:30

Experimental and Numerical Investigation of Laser-based Short Wavelength Plasma Sources

Homaira Parchamy, John Szilagyi, Majid Masnavi, and Martin Richardson

University of Central Florida, USA

Laser-based plasma lamps are of particular interest in the semiconductor industry. This study examines the optimum regions of laser-plasma operational space for a number of intense laser-irradiated mass-limited droplet source scenarios.

Room E (107)

Session Title 26E3 / [T05] Plasmonics and Metamaterials VI
Date & Time Wednesday, 26 August, 15:45 ~ 17:45
Session Chair Q-Han Park (Korea University, Korea)

[26E3-1] 15:45~16:15 Invited Talk

Plasmon Lasers: Development, Features and Applications

Ren-Min Ma

Peking University, China

Plasmon lasers are a new class of lasers that surpassed the diffraction limit of light which stimulates the exploration of nanometer-scale laser science and the development of high performance devices.

[26E3-2] 16:15~16:30

Effective Engineering of Sub-wavelength-scale Plasmonic Cavities

Myung-Ki Kim, Hongchul Sim, and Yong Hee Lee

KAIST, Korea

We suggest cladding and geometric engineering methods for effective field engineering of sub-wavelength-scale plasmonic cavities, which enable 90% coupling to the integrated waveguide and extreme 3D field confinement in a volume of ~10^{-7} λ^3 (~5×10×10nm^3).

[26E3-3] 16:30~16:45

The Measurement of Surface Plasmonic Transport on Silver Nanowires Arrays

Sean Sung-Yen Juang, Ming-Hui Lin, and Hsiang-Chen Chui

National Cheng Kung University, Taiwan

We measured the scattering intensity of the anodic aluminum oxide embedded the silver nanoparticles (Ag/AAO) to observe signals transport on silver nanowires arrays and calculate out the propagation surface plasmons length is about 2 μm.

[26E3-4] 16:45~17:00

Surface Plasmon Absorption Characteristics of Gold Deposited on Optical Fibers

Shuji Taue, Yuya Utsunomiya, and Hideki Fukano

Okayama University, Japan

We deposited gold films on optical fiber surfaces and annealed them to analyze the absorbance in the visible and near infrared wavelength range. The corresponding relations between the absorption spectra and the structural images of the deposited gold were identified.

[26E3-5] 17:00~17:15

Giant Modulation Depth in the Photoexcited Topological Surface Plasmons Exceeding 2,400%

Sangwan Sim[1], Houk Jang[1], Nikesh Koirala[2], Matthew Brahlek[2], Ji Ho Sung[3], Jun Park[1], Soonyoung Cha[1], Seongshik Oh[2], Jong-Hyun Ahn[1], Moon-Ho Jo[2,3], and Hyunyong Choi[1]

[1]Yonsei University, Korea, [2]Rutgers the State University of New Jersey, USA, [3]POSTECH, Korea

We present ultrafast optical modulation of plasmons in a topological insulator Bi_2Se_3 micro-ribbon array. Unprecedented giant modulation depth up to 2,400 % is obtained with very low fluence of optical control pulse.

[26E3-6] 17:15~17:30

Propagation of Quantum Signal in Plasmonic Waveguides

Xifeng Ren, Yongjing Cai, Ming Li, Changling Zou, Xiao Xiong, Hualin Lei, Biheng Liu, Guoping Guo, and Guangcan Guo

University of Science and Technology of China, China

Here we introduce two works on quantum plasmonics: high-visibility on-chip quantum interference of single surface plasmons and transmission of quantum polarization entanglement in a nanoscale hybrid plasmonic waveguide. Our works can bridge nanophotonics and quantum optics.

[26E3-7] 17:30~17:45

Non-polarizing Subtractive Structural Color Filters Based on Aluminum Plasmonics

Vivek Raj Shrestha[1], Sang-Shin Lee[1], Eun-Soo Kim[1], and Duk-Yong Choi[2]

[1]Kwangwoon University, Korea, [2]The Australian National University, Australia

We report non-polarizing subtractive structural color filters based on surface plasmon-induced suppressed transmission via two-dimensional array of aluminum nanopatches over a glass substrate. Three subtractive primary colors i.e. cyan, magenta and yellow are demonstrated with high transmission efficiencies reaching 75 %.

Room F (108)

Session Title 26F3 / [T07] Optical Metrology and Sensing VI
Date & Time Wednesday, 26 August, 15:45 ~ 17:45
Session Chairs Kaoru Minoshima (Univ. of Electro-Communications, Japan)
Jungwon Kim (KAIST, Korea)

[26F3-1] 15:45~16:15 Invited Talk

Ultrahigh-Precision Measurement and Optimization of Timing Jitter in Mode-Locked Lasers

Jungwon Kim

KAIST, Korea

I introduce novel attosecond-resolution measurement methods of timing jitter spectra in mode-locked lasers. Based on the accurate measurements, the jitter of various types of fiber lasers could be optimized to the unprecedented sub-femtosecond regime.

[26F3-2] 16:15~16:30

High-precision 3-D Surface Measurement of Step-structures Using Femtosecond Lasers

Young-Jin Kim[1,2], Minah Choi[2], Jiyong Park[2], Sangwon Hyun[2], Woodeok Joo[2], and Seung-Woo Kim[2]

[1]Nanyang Technological University, Singapore, [2]KAIST, Korea

Femtosecond pulse lasers provide novel possibilities to high-precision optical profilometry for quality assurance of step-structures on 3D microelectronic products based on its time and frequency domain characteristics.

[26F3-3] 16:30~16:45

Carrier-envelope Phase Stabilized Octave-spanning Laser with Monolithic Scheme

Zijiao Yu, Hainian Han, Lei Hou, and Zhiyi Wei

Chinese Academy of Sciences, China

We first demonstrated a carrier-envelope phase (CEP) stabilized octave-spanning oscillator based on the monolithic scheme. Nearly-60 dB CEP offset beat note (RBW=100 kHz) was achieved. The locked CEP residual phase noise is 55 mrad, corresponding to timing jitter of only 23 as.

[26F3-4] 16:45~17:00

Reducing the Linewidth of a Diode Laser at 243 nm by Frequency Stabilization

Lei Hou, Hainian Han, Long Zhang, Dehua Li, and Zhiyi Wei

Chinese Academy of Sciences, China

We have realized locking of external cavity diode laser to a vibration-insensitive high finesse Fabry–Perot cavity using PDH technique. Linewidth to 1 MHz was obtained at 243 nm by enhanced frequency-doubled second harmonic of diode laser.

[26F3-5] 17:00~17:15

Measurement of Specular Surfaces by One-Shot and Closed Form Solutions

Zhenzhou Wang

Chinese Academy of Sciences, China

This paper describes a method of measuring the shapes of specular surfaces with one-shot-projection of structured laser patterns. The closed form solution are achieved for both incident rays, reflected rays and their intersections (samples of surface points).

[26F3-6] 17:15~17:30

Displacement Measurement by Single-grating Heterodyne Interferometry

Shuhua Yan, Guochao Wang, Cunbao Lin, and Yukun Luo

National University of Defense Technology, China

We presented a displacement measurement system based on single-grating heterodyne interferometry. Our prototype system was demonstrated to achieve a relative measurement accuracy of better than 69 nm with standard deviations of less than 28 nm.

[26F3-7] 17:30~17:45

Simultaneous Microwave Frequency Transfer and Time Synchronization Based Mode-locked Pulse Train over 120 km Fiber

Xing Chen[1], Jinlong Lu[1], Jian Zhang[1], Yifan Cui[1], Xing Lu[1], Xusheng Tian[2], Cheng Ci[2], Bo Liu[2], Hong Wu[2], Tingsong Tang[3], Kebin Shi[1], and Zhigang Zhang[1]

[1]Peking University, China, [2]Nankai University, China, [3]Beijing Satellite Navigation Center, China

We demonstrate feed-forward digital compensation technique applied in both precise frequency transfer and time synchronization. The fractional frequency instability was 6.18x10^{-20} at 2000 s and RMS variation of time synchronization was sub-40 ps.

Room G (201)

Session Title 26G3 / [T08] Atom-Photon Interaction II
Date & Time Wednesday, 26 August, 15:45 ~ 17:15
Session Chair Yong-Il Shin (Seoul National University, Korea)

[26G3-1] 15:45~16:15 Invited Talk

Storing Single Photons in a Quantum Register

Joerg Wrachtrup

Stuttgart University, Germany

The efficient transfer of photons from a light field to a solid state quantum register is key to distributed quantum computing and quantum repeater architectures.

[26G3-2] 16:15~16:30

Experimental Investigation of Transverse Spatial Coherence of an Optical Pulse in Atomic Vapor Quantum Memory

Jong-Chan Lee, Kwang-Kyoon Park, Young-Wook Cho, and Yoon-Ho Kim

POSTECH, Korea

We experimentally investigate the transverse spatial coherence of an optical pulse stored in atomic vapor quantum memory. Using Young-type spatial interference, it is demonstrated that the atomic vapor quantum memory preserves transverse spatial coherence.

[26G3-3] 16:30~16:45

Saturated Absorption Spectroscopy of Helium 2^3S-3^3P Transitions

Chia-Wei Chen[1], Jain-You Chen[1], Pei-Ling Luo[2], Jow-Tsong Shy[2], Li-Bang Wang[2], and Hsiang-Chen Chui[1]

[1]National Cheng Kung University, Taiwan, [2]National Tsing Hua University, Taiwan

We have observed the saturated absorption spectrum of the He-4 2^3S^1-$3^3P_{0,1,2}$ hyperfine transitions in a RFdischarged helium cell using a 6-mW 389-nm laser. The linewidth broadening due to power was investigated.

[26G3-4] 16:45~17:00

The Effects of Two Photon Coherence on the Four-wave Mixing Spectrum in a Ladder-type Atomic system

Yoon-Seok Lee and Han Seb Moon

Pusan National Univiersity, Korea

We report the analysis of four-wave mixing spectrum in terms of two-photon coherence in a ladder-type atomic system of the $5S_{1/2}$ - $5P_{3/2}$ - $5D_{5/2}$ transition of ^{87}Rb atom. This spectroscopy is potentially useful for the effective way to generate a correlated photon pair from an atomic ensemble.

[26G3-5] 17:00~17:15

Resonant Four-wave Mixing with Co-propagating Scheme in Rubidium Vapor Cell

Taek Jeong and Han Seb Moon

Pusan National Univiersity, Korea

We have observed four-wave mixing (FWM) of weak pumping in a resonance double-Λ system for the $5S_{1/2}$ – $5P_{1/2}$ transition of ^{87}Rb atoms. When three beams (CPT1, CPT2 and pump) were co-propagated in the double-Λ configuration composed of the common excited state $5P_{1/2}$ (F_e=2) and the two ground state $5S_{1/2}$ (F_g=1 and 2), we directly measured the generated FWM signal filtering the three beams using polarizer and etalon filters. The spectral width of FWM signal was measured to be ~10 kHz under the condition of coherent population trapping (CPT). Dependence of FWM signals on the intensities of the two beams related CPT and pump beam was investigated in detail.

Room H (202)

Session Title 26H3 / [T11] Tissue Imaging
Date & Time Wednesday, 26 August, 15:45 ~ 17:45
Session Chair Hyuk-Sang Kwon (GIST, Korea)

[26H3-1] 15:45~16:15 Invited Talk

Extraordinary Light Transmission for Super-resolved Axial Imaging

Wonju Lee[1], Jong-Ryul Choi[2], Kyujung Kim[3], Youngjin Oh[1], and Donghyun Kim[1]

[1]Yonsei University, Korea, [2]Daegu-Gyeongbuk Medical Innovation Foundation, Korea, [3]Pusan National University, Korea

In this paper, the feasibility of super-resolved axial imaging is explored by extraordinary light transmission using graded nanohole arrays. Intracellular axial sectioning was performed with an effective resolution as small as 20-nm.

[26H3-2] 16:15~16:30

Monte Carlo Model of Laser Doppler Perfusion Imaging in Skin Cancer Detection

Alireza Mowla, Thomas Taimre, Yah Leng Lim, and Aleksandar D. Rakic

The University of Queensland, Australia

We present a laser Doppler perfusion imaging model to map the perfusion in melanoma and non-melanoma skin cancers. We numerically investigate the use of neovascularization as an early detection method using Monte Carlo method to simulate the interactions of photons and skin tissue.

[26H3-3] 16:30~16:45

Optical Coherence Gating with Stimulated Emission

Fu-Jen Kao, Chun-Hui Yu, Shen-Shou Chung, and Wen-Chuan Kuo

National Yang-Ming University, Taiwan

Stimulated emission based optical coherence gating is established for feasibility study in tomography, which shows a depth resolution of approximately 66 μm.

[26H3-4] 16:45~17:00

Endoscopic Probe for Optical Coherence Tomography with Magnet Driving Device

Ziwei Pang[1] and Jigang Wu[1,2]

[1]Shanghai Jiao Tong University, China, [2]Tsinghua University, China

We proposed and implemented a magnetic-driven side imaging endoscopic probe for optical coherence tomography. The probe can achieve 360-degree unobstructed circumferential imaging with a 1.4-mm outer diameter, and thus suitable for many endoscopic applications.

[26H3-5] 17:00~17:15

In Situ Visualization of Collagen Fiber Produced by Cultured Osteoblasts Using Sensitive Second-harmonic-generation Microscopy Equipped with a 10-fs Mode-locked Ti:sapphire Laser

Eiji Hase[1], Katsuya Sato[1], and Takeshi Yasui[1,2]

[1]The Tokushima University, Japan, [2]Osaka University, Japan

In this paper, we constructed sensitive second-harmonic generation (SHG) microscopy equipped with a 10-fs Ti:Sapphire laser and succeeded to visualize collagen fibers produced by the cultured osteoblasts in situ.

[26H3-6] 17:15~17:30

Photonic Crystal Enhanced Fluorescence through Extraction of Dual Polarization Modes

Cheng-Sheng Huang, Yu-An Wu, and Po-Tsung Wu

National Chiao Tung University, Taiwan

In this paper, we demonstrate that the fluorescence collection efficiency of surface-bound fluorophores can be enhanced through coupling of fluorescence emission into both TE and TM resonant modes of a photonic crystal substrate.

[26H3-7] 17:30~17:45

Optically-tunable Multiple Switching Effects of Biopolymer Memory Devices

Yu-Chueh Hung, Yi-Tzu Lin, Chao-You Hung, and Waan-Ting Tu

National Tsing Hua University, Taiwan

We present optically-tunable switching effects based on biopolymer nanocomposite. Without the need of external doping, the nanocomposites can be manipulated by light to exhibit multiple switching behaviors, showing promises for memory device applications.

Room I (203)

Session Title 26I3 / [T10] Micro/Nano Lasers
Date & Time Wednesday, 26 August, 15:45 ~ 17:15
Session Chair Muhan Choi (Kyungpook National University, Korea)

[26I3-1] 15:45~16:00

Unidirectional Emission in Asymmetric Reuleaux Triangle 2-D Microcavity Laser

Chil-Min Kim[1], Jin-Hyeok Ryu[2], Ji-Won Lee[2], Changhwan Yi[1], Ji-Hwan Kim[1], Sung-Min Go[1], In-Goo Lee[3], Kwang Ryong Oh[3], and Sung-Bock Kim[2]

[1]Sogang University, Korea, [2]DGIST, Korea, [3]ETRI, Korea

In an asymmetric Reuleaux triangle microcavity laser, we experimentally confirm that the laser unidirectionally emits at a single window. In this shape, because the quality factor of the clockwise traveling wave is higher than that of the counter clockwise one, the clockwise traveling wave emits at a single window.

[26I3-2] 16:00~16:15

Dual-Mode Multi-Section Lasers with Nanoscale Surface Gratings

Mihail Dumitrescu, Topi Uusitalo, Heikki Virtanen, Jukka Viheriälä, Joel Salmi, and Antti Aho

Tampere University of Technology, Finland

Dual-mode multi-section distributed-feedback lasers with surface gratings have been fabricated using UV nanoimprint lithography. Frequency differences from 14GHz to 1.3THz for different longitudinal structures and frequency difference modulation speed up to 500MHz have been measured.

[26I3-3] 16:15~16:30

A Printed Nanobeam Laser on Silicon

Indra Karnadi[1], Jaehyeon Son[1], Ju-Young Kim[1], Hoon Jang[1], Putu Eka Pramudita[1], Seungwoo Lee[2], Bumki Min[1], and Yong Hee Lee[1]

[1]KAIST, Korea, [2]Sungkyunkwan University, Korea

A nanobeam laser made of InGaAsP material is printed on a SiO_2 /Si substrate via transfer-printing process. From this structure, single mode lasing near 1550 nm with continuous-wave (CW) operation at room-temperature is achieved.

[26I3-4] 16:30~16:45

Optimized Aperiodic Nanobeam Lasers

Suel-Ki Moon[1], Kwang-Yong Jeong[2], and Jin-Kyu Yang[1]

[1]Kongju National University, Korea, [2]KAIST, Korea

We demonstrated lasing action at aperiodic nanobeam cavities composed of two different air holes at room temperature. As the size ratio of two holes is changed, different type of optical modes is selected for lasing.

[26I3-5] 16:45~17:00

Room Temperature Continuous Operation of Sub-μW Threshold Nano-Island Lasers

Hoon Jang, Indra Karnadi, Putu Pramudita, and Yong Hee Lee

KAIST, Korea

Nanobeam laser with nano-island quantum well (QW) is demonstrated. Continuous operation with 210 nW threshold is achieved at room-temperature. We remove the absorptive QW surrounding the central cavity, leaving the gain only inside $0.7\times0.25\times0.02$ μm^3.

[26I3-6] 17:00~17:15

Self-Aligned InGaAsP Nano-Emitters Near Telecom-Wavelength

Putu Eka Pramudita, Hoon Jang, Chang-Min Lee, Indra Karnadi, Jungmin Lee, Myung-Ki Kim, and Yong Hee Lee

KAIST, Korea

We study selective wet-etching systems for realizing selfaligned nano-emitters. Controllability of the nano-emitters' shapes, sizes and positions are the major advantages of this method. Emission of nano-emitters at telecom-wavelength is characterized from the photoluminescence measurement.

Room J (204)

Session Title 26J3 / [T12] Nanophotonics Applications
Date & Time Wednesday, 26 August, 15:45 ~ 17:45
Session Chairs Francisco M. Soares (Fraunhofer HHI, Germany)
Kyoungsik Yu (KAIST, Korea)

[26J3-1] 15:45~16:15 Invited Talk

Nanophotonics for Future Data Communication and Ethernet Networks

Dieter Bimberg[1,2] and James A. Lott[1]

[1]Technische Universität Berlin, Germany, [2]King Abdulaziz University, Saudi Arabia

We present the design, physics, and performance of our novel nanophotonic lasers for present and visionary emerging applications in optical data communications and integrated photonic systems at on-chip through mega data center distances.

[26J3-2] 16:15~16:30

Design of a Current-Driven Optical Gate Switch Using a Si Waveguide and Phase-Change Material

Kentaro Kato and Hiroyuki Tsuda

Keio University, Japan

We have proposed and designed a current-driven optical gate switch using a Si waveguide and phase-change material. The ON-state loss and the power consumption of the optimized structure are 0.63 dB and 60 mW, respectively.

[26J3-3] 16:30~16:45

Near-infrared Silicon Sub-bandgap Photo-detectors for on-chip Integrated Optical Links

Jong-Bum You and Kyoungsik Yu

KAIST, Korea

We report near-infrared and high-speed silicon photodetectors capable of sub-bandgap light absorption based on the optically-assisted tunneling induced by a large electric field.

[26J3-4] 16:45~17:00

Si Photonic Crystal Compact Multilevel Modulators

Keiko Hojo, Yosuke Terada, Yosuke Hinakura, Naoya Yazawa, Tomohiko Watanabe, and Toshihiko Baba

Yokohama National University, Japan

We fabricated Si QPSK and PAM modulators with photonic crystal slow light waveguides and interleaved p/n junction, both of which have footprints less than 1 mm^2. 30-35 Gbps operation were observed in 300-450 μm devices.

[26J3-5] 17:00~17:15

Precise Wavelength Tuning of MEMS VCSELs Enabling 110-ch Operations

Masanori Nakahama, Takahiro Sakaguchi, Akihiro Matsutani, and Fumio Koyama

Tokyo Institute of Technology, Japan

We demonstrate the precise wavelength tuning of MEMS VCSELs with thermally-actuated cantilever for athermal operations. 110-channel operations with 100 GHz spacing were realized with SMSR of over 30 dB and output variation of below 2.5 dB.

[26J3-6] 17:15~17:30

Sub-wavelength Grating Assisted 3-dB Colorless Directional Coupler for TM Mode

Yaguang Qin, Yu Yu, Chaotan Sima, and Xinliang Zhang

Huazhong University of Science and Technology, China

We propose and theoretically demonstrate a colorless 3-dB directional coupler for TM mode. The fluctuation of insertion loss at the output port in the range of wavelength from 1.5 um to 1.6 um (100 nm bandwidth) is 3.1 dB.

[26J3-7] 17:30~17:45

Real-Time Spectrally-Resolved Imaging of the Transverse Modes in Broad Area Diode Lasers

Grant Brodnik[1], Stephen Misak[1], Daniel Dugmore[2], Evan Hale[3], Kirsten Middleton[4], and Paul Leisher[1]

[1]Rose-Hulman Institute of Technology, USA, [2]Teradiode Inc., USA, [3]University of Central Florida, USA, [4]L3 Communications SSG, USA

We demonstrate a simple system which is capable of resolving and imaging, in real time, the lateral modes of a multimode broad area diode laser. This technique enables direct characterization of the intensity distribution of each mode of the laser and differs from prior work in that it provides both high spectral resolution (< 3 pm) and real-time imaging. This will allow for the first time direct observation of the dynamics of closely spaced lateral modes of in high power broad area diode lasers.

Room A (101)

Session Title 27A1 / [T01] Tm Fiber Lasers
Date & Time Thursday, 27 August, 11:00 ~ 12:30
Session Chair Ju Han Lee (University of Seoul, Korea)

[27A1-1] 11:00~11:15

Resonantly Pumped Amplification in a Thulium-Doped Photonic Crystal Fiber

Alex Sincore[1], Lawrence Shah[1], Mateusz Wysmolek[2], Robert Ryan[1], Ali Abdulfattah[1], and Martin Richardson[1]

[1]University of Central Florida, USA, [2]Laser Zentrum Hannover, Germany

Efficiencies <50% are typical in large mode area, thulium-doped photonic crystal fibers when pumped at 790 nm. These large thermal loads limit power scaling. In this work, we investigate resonant pumping and demonstrate slope efficiencies >64%.

[27A1-2] 11:15~11:30

Dissipative Soliton Generation at 2μm from a Mode-Locked Fiber Laser Using CNT

Yu Wang[1], Alam Shaif-ul[2], Elena D. Obraztsova[3], Anatolii S. Pozharov[3], and Shinji Yamashita[1]

[1]The University of Tokyo, Japan, [2]University of Southampton, UK, [3]A.M. Prokhorov General Physics Institute, Russia

We report for the first time, generation of dissipative soliton from a ring-cavity thulium fiber laser mode-locked with the use of a carbon nanotubes saturable absorber and a length of DCF producing 416 pJ pulse energy.

[27A1-3] 11:30~11:45

High-Power Narrow-Linewidth Thulium-Doped All-Fiber MOPA

Jiang Liu, Hongxing Shi, Chen Liu, and Pu Wang

Beijing University of Technology, China

We demonstrated a high-power narrow-linewidth thulium-doped all-fiber laser based on master-oscillator power amplifier. The amplifier yielded 342 W of narrow-linewidth laser output at central wavelength of 2000.3 nm with 3 dB spectral bandwidth of 90pm.

[27A1-4] 11:45~12:00

Linearly Polarized Thulium Doped All-Fiber Laser

Jiachen Wang[1,2], Sang Bae Lee[1], and Kwanil Lee[1]

[1]KIST, Korea, [2]University of Science and Technology, Korea

We report an all-fiber, linearly polarized Thulium doped fiber laser operating at 1950 nm. In the experiment, as high as 14.2 Watts power is generated from the laser with slope efficiency of 48.4%.

[27A1-5] 12:00~12:15

Long-Cavity Nanosecond Thulium Fiber Laser: A Compact Source of Energetic Mid-IR Pulses

Yao Li[1], Xing Bi[1], Yafei Meng[1], Xiaokang Cao[1], Yongbing Xu[1], Edmund Kelleher[2], and Fengqiu Wang[1]

[1]Nanjing University, China, [2]Imperial College London, UK

We demonstrate nanosecond operation in an elongated cavity thulium fiber laser: a simple scheme for pulse energy scaling and repetition rate reduction. 7.5 nJ pulses with a repetition rate of 330 kHz are achieved.

[27A1-6] 12:15~12:30

Optical Properties of Er^{3+}-doped K-Ca-Al Fluorophosphate Glasses

K. Linganna[1], K. Suresh[2], S. Ju[1], W.-T. Han[1], C. K. Jayasankar[2], and V. Venkatramu[3]

[1]GIST, Korea, [2]Sri Venkateswara University, India, [3]Yogi Vemana University, India

Optical absorption and emission properties of the Er^{3+}-doped K-Ca-Al fluorophosphate glasses were investigated and compared with other reported glasses for optical amplification application at 1.534 μm.

Room B (102)

Session Title 27B1 / [T03] Terahertz Technologies and Applications I
Date & Time Thursday, 27 August, 11:00 ~ 12:30
Session Chair Il-Min Lee (ETRI, Korea)

[27B1-1] 11:00~11:30 Invited Talk

Continuous Wave Terahertz Signal Generator Based on Difference Frequency Generation in Gallium Phosphide Developed for Industrial Applications

Tetsuo Sasaki[1], Tadao Tanabe[2], Tomoaki Sakamoto[3], and Jun-ichi Nishizawa[2]

[1]Shizuoka University, Japan, [2]Tohoku University, Japan, [3]National Institute of Health Sciences, Japan

We have developed a CW THz signal generator on the principle of DFG in a GaP crystal and constructed THz spectrometers. Simple and easy operation/maintenance of the device would be suitable for industrial applications.

[27B1-2] 11:30~11:45

Enhanced Terahertz Emission from SI-GaAs with a Sub-wavelength 1D Metal Array

Maria Angela Faustino, Lorenzo Jr. Lopez, Jessica Afalla, Joselito Muldera, Mark Jayson Felix, Arnel Salvador, Armando Somintac, and Elmer Estacio

University of the Philippines, Philippines

Terahertz emission enhancement in SI-GaAs, having a deposited periodic 1D metal array, is reported. The one order enhancement is currently attributed to the localization of the terahertz electromagnetic field at the GaAs apertures.

[27B1-3] 11:45~12:00

Stoichiometry Controlled Liquid Phase Growth of GaSe Crystals for the Efficient THz Generation

Yohei Sato, Kohei Suzuki, Kensaku Maeda, and Yutaka Oyama

Tohoku University, Japan

THz generation efficiency from GaSe crystals were deteriorated by thermal equilibrium point defects and deviation from stoichiometry. Low temperature solution grown GaSe crystals were evaluated in comparison with commercially available Bridgman-grownc rystals.

[27B1-4] 12:00~12:15

Progress on Terahertz in-line Digital Holography Based on 3THz QCL

Qinghua Deng, Weihua Li, Xuemin Wang, Changle Shen, and Tao Jiang

China Academy of Engineering Physics, China

By shaping the output from 3THz QCL, Gaussian-distributed THz source with very small divergence was obtained. With this good-quality QCL source, a Terahertz in-line digital holography set was built up. Resolution of this Terahertz in-line digital holography set is as small as 200μm, which is the smallest resolution reported up to now.

[27B1-5] 12:15~12:30

Real-Time Absolute Frequency Measurement of CW THz Radiation Based on a Free-Running THz Comb

Takashi Ogura[1], Kenta Hayashi[1], Kosuke Nagai[1], Yoshiaki Nakajima[2,3], Hajime Inaba[2,4], Kaoru Minoshima[2,3], and Takeshi Yasui[1,2]

[1]Tokushima University, Japan, [2]JST, Japan, [3]The University of Electro-Communications, Japan, [4]National Institute of Advanced Industrial Science and Technology, Japan

Absolute frequency of continuous-wave terahertz radiation was determined at an acuracy of 10^{-11} in real time by modulating a frequency spacing of photocarrier terahertz comb induced by a free-running femtosecond laser.

Room C (103)

Session Title 27C1 / [T02] Strong Field Physics
Date & Time Thursday, 27 August, 11:00 ~ 12:15
Session Chair Ryuji Itakura (Japan Atomic Energy Agency, Japan)

[27C1-1] 11:00~11:30 Invited Talk

High Harmonics and Attosecond Pulses – Seeing Inside Molecules

David M Villeneuve

National Research Council and University of Ottawa, Canada

High harmonic spectroscopy is a window into the valence electron structure of molecules. The femtosecond timescale allows us to see changes in molecular structure and the attosecond timescale allows us to see re-arrangement of electrons.

[27C1-2] 11:30~12:00 Invited Talk

Laser-assisted Electron Scattering and Diffraction in Femtosecond Intense Laser Fields

Yuya Morimoto, Reika Kanya, and Kaoru Yamanouchi

the University of Tokyo, Japan

We have developed a method called laser-assisted electron diffraction through which geometrical structures of molecules can be determined with high precision (~0.01 Å) and with high temporal resolution (<10 fs), and applied it to CCl4.

[27C1-3] 12:00~12:15

Strong Field Nanoplasmonic Photoemission in the Mid-IR at <1 GW/cm^2 Intensity

Péter Rácz[1], Stephan Teichmann[2], Marcelo Ciappina[3], José Antonio Pérez Hernández[4], Alexandre Thai[2], Júlia Fekete[1], Abdulhakem Elezzabi[5], László Veisz[3], Jens Biegert[2], and Péter Dombi[1]

[1]Wigner Research Centre for Physics, Hungary, [2]ICFO–Institut de Cičncies Fotňniques, Spain, [3]Max-Planck-Institut für Quantenoptik, Germany, [4]Centro de Láseres Pulsados, Spain, [5]University of Alberta, Canada

Strong-field ultrafast photoemission was studied by propagating surface plasmons generated on gold metal layer in Kretschmann configuration at 3.1 microns wavelength. Tunneling photoemission and electron acceleration was demonstrated at an unprecedently low laser intensity (1-5 GW/cm^2).

Room D (106)

Session Title 27D1 / [T04] High Power, High Energy Lasers I
Date & Time Thursday, 27 August, 11:00 ~ 12:30
Session Chair Jae Hee Sung (IBS/GIST, Korea)

[27D1-1] 11:00~11:30 Invited Talk

Progress on Mid-infrared Intense Laser Aiming at 100 TW Peak Power

Guo Qiang Xie, Fu Yong Wang, Peng Yuan, and Lie Jia Qian

Shanghai Jiaotong University, China

We have accomplished designing of a 100-TW level midinfrared laser based on two-stage optical parametric chirped pulse amplification (OPCPA) scheme. At present, we have experimentally demonstrated 120-GW midinfrared pulse generation with single-stage OPCPA.

[27D1-2] 11:30~11:45

Design and Progress of SG-II Multi Petawatt Laser Facility

Jianqiang Zhu, Xinglong Xie, Qingwei Yang, Jun Kang, Haidong Zhu, Ailin Guo, Ping Zhu, Qi Gao, Zhigang Liu, Quantang Fan, Daizhong Liu, Xiaoping Ouyang, Hui Wei, and Xiaochao Wang

Shanghai Institute of Optics and Fine Mechanics, China

Shenguang-II multi petawatt laser is designed to deliver a 5PW laser pulse. It is expected to be finished in the year of 2015. Details of the design and the progresses will be presented in this paper.

[27D1-3] 11:45~12:00

Final EDP Ti: Sapphire Amplifiers for ELI –Project

Vladimir Chvykov[1], Mikhail Kalashnikov[1,2], and Karoly Osvay[1]

[1]ELI-ALPS, Hungary, [2]Max Born Institute, Germany

We studied the concept of EDP amplification for the 10-100 PW level of the three ELI-pillars laser systems. The design of EDP – duty amplifiers required to achieve these parameters was done and will be reported.

[27D1-4] 12:00~12:15

1.02 Petawatt Hybrid-scheme Laser System Based on LBO-OPCPA Near 800 nm

Lianghong YU[1], Xiaoyan Liang[1], Zhanggui Hu[2], Yuxin Leng[1], Ruxin Li[1], and Zhizhan Xu[1]

[1]Shanghai Institute of Optics and Fine Mechanics, China, [2]Technical Institute of Physics and Chemistry, China

We report a hybrid laser system with peak power of 1.02 PW based on LBO-OPCPA near 800 nm. The amplified energy of 45.3 J centered at 800 nm was generated with a conversion efficiency of 26.3%. After compression, the pulse duration was 32 fs.

[27D1-5] 12:15~12:30

Optical Parametric Chirped Pulse Amplifier for a 4 PW Laser Front-end

Hwang Woon Lee[1], Je Yoon Yoo[1], Jae Hee Sung[1,2], Seong Ku Lee[1,2], Tae Moon Jeong[1,2], Jeong Moon Yang[1], Yeon Joo Son[1], and Chang Hee Nam[1]

[1]IBS, Korea, [2]GIST, Korea

A two-stage non-collinear optical parametric chirped pulse amplifier (OPCPA), using type-I BBO nonlinear crystal, has been developed as a pre-amplifier of the 4 PW laser at CoReLS.

Room E (107)

Session Title 27E1 / [T05] Plasmonics and Metamaterials VII
Date & Time Thursday, 27 August, 11:00 ~ 12:30
Session Chair Renmin Ma (Peking University , China)

[27E1-1] 11:00~11:30 Invited Talk

Scattering Superlens: Near-field Focusing and Imaging Exploiting Multiple Scattering in Turbid Media

Yong Keun Park

KAIST, Korea

We demonstrate that multiple scattering can be controlled via wavefront shaping in order to obtain a subdiffraction limited focus at an arbitrary position and the full-field dynamic sub-wavelength imaging. Due to the random structure of the highly scattering media there are no restrictions on the physical position of the focus giving the system a high degree of freedom. We also present that the full-field dynamic sub-wavelength imaging can be obtained by transferring the optical near-field intopropagating far-field components by multiple light scattering from disordered nanoparticles, which was previously demonstrated in microwave regime.

[27E1-2] 11:30~11:45

Numerical Demonstration of Deterministic Spatiotemporal Control of Localized Plasmon Pulses at Metallic Nanostructures by Light Wave Shaping

Yasuhiro Kojima, Yuta Masaki, Kazunori Toma, Kenichi Hirosawa, and Fumihiko Kannari

Keio University, Japan

We numerically demonstrate spatiotemporal control of ultrafast localized plasmon pulses at metallic nanostructures. This results confirm that more flexible spatiotemporal control can be achieved by femtosecond laser pulses combined with wave front and pulse shaping.

[27E1-3] 11:45~12:00

Focusing Surface Plasmon Polaritons through a Disordered Nanohole Structure

Eunsung Seo[1], Joonmo Ahn[2], Wonjun Choi[1], Hakjoon Lee[1], Young Min Jhon[2], Sanghoon Lee[1], and Wonshik Choi[1]

[1]Korea University, Korea, [2]KIST, Korea

Control of near-field waves is the key to going beyond the diffraction limit. Here we present the focusing of plasmonic waves, a type of near-field waves, by the wavefront shaping of far-field waves. We coupled far-field illumination to a disordered nanoholes on a thin gold film to generate speckled plasmonic waves. By controlling the phase pattern of the incident waves at the excitation wavelength of 637 nm, we demonstrated the focusing of surface plasmon polaritons (SPPs) down to 170 nm at arbitrary positions. Our study shows the possibility of using disordered nanoholes as a plasmonic lens with high flexibility in the far-field control.

[27E1-4] 12:00~12:15

Tunable Tamm Plasmon Modes at Metal-Photonic Crystal Interface

Che-Yuan Chang, Yi-Hsun Chen, Mong-Yin Lin, and Kuo-Ping Chen

National Chiao-Tung University, Taiwan

Tamm plasmon (TP) modes happening at photonic crystals with different metals are studied using admittance loci. At visible wavelength, silver TP provides ultra-sharp resonance with FHWM = 1.5 nm, which is tunable by using different photonic crystals.

[27E1-5] 12:15~12:30

Resonant Absorption and Amplification of EM Waves in Stratified Chiral Media

Seulong Kim and Kihong Kim

Ajou University, Korea

The mode conversion and the resonant absorption and amplification phenomena occurring in inhomogeneous chiral media are theoretically studied. Mode conversion is found to occur when the medium contains regions where at least one of the effective refractive indices corresponding to two circular polarizations vanishes. Resonant absorption and enhancement phenomena are useful for designing efficient absorbers and nonlinear photonic devices.

Room F (108)

Session Title 27F1 / [T07] Optical Metrology and Sensing VII
Date & Time Thursday, 27 August, 11:00 ~ 12:30
Session Chairs Labao Zhang (Nanjing University, China)
Kwang Jo Lee (Kyunghee University, Korea)

[27F1-1] 11:00~11:30 Invited Talk

Optical Observation of DNA Translocation Dynamics through Solid-State Nanopores

Hirohito Yamazaki, Shintaro Itoh, Keiko Esashika, and Toshiharu Saiki

Keio University, Japan

We report an optical nanopore detection system for investigating DNA translocation dynamics through a nanopore at sub-millisecond and sub-100-nm resolutions. The proposed optical nanopore detection scheme enables the observation of both the translocation process and the escape process. We found different correlation between the translocation time and the escape time, depending on whether the translocation occurs in a folded or unfolded configuration.

[27F1-2] 11:30~11:45

Wide-field Heterodyne En-face OCT System for Vibration Measurement of Internal Surfaces

Samuel Choi, Fumiaki Nin, Takamasa Suzuki, and Hiroshi Hibino

Niigata University, Japan

Multi-frequency-swept OCT adopting the wide field heterodyne detection technique is demonstrated for high-speed 3D Vibration measurements. The axial resolution and the accuracy of vibration amplitude measurement were estimated to be 2.5 μm and 1.3 nm, respectively.

[27F1-3] 11:45~12:00

Design and Simulation of Light Source Integrated Photonic Crystal Nanobeam Biosensor

Gyeyoung Kim and Jung H. Shin

KAIST, Korea

We report on design and simulation results of a SiN photonic crystal waveguide integrated with silicon quantum dot lights source for low-cost, high-performance biosensor on a chip.

[27F1-4] 12:00~12:15

Phase Relationship of Photodetected Signals of an Optical Feedback Interferometry Sensor

Jalal Al Roumy, Julien Perchoux, and Thierry Bosch

The Centre National de la Recherche Scientifique-Laboratory for Analysis and Architecture of Systems, France

Optical Feedback Interferometry signals can be acquired by photodetection either from rear or front facet of the laser. We present a model that links both signals to the injection current. The comparison with experimental results validates the model.

[27F1-5] 12:15~12:30

A Self-Mixing Effect Based Fiber-Optic Acoustic Sensor Using Oil Surface as an Optical Reflector

Lutang Wang, Nian Fang, and Zhaoming Huang

Shanghai University, China

A novel fiber-optic acoustic sensor based on the laser self-mixing effect is presented, which consists of an oil-immersible ferrule-type sensor probe capable of working inside the power transformer to detect the partial discharge induced ultrasonic waves. General principles are described and experimental results are presented.

Room G (201)

Session Title 27G1 / [T08] Atom-Photon Interaction III
Date & Time Thursday, 27 August, 11:00 ~ 12:15
Session Chair Gleb Maslennikov (National Univ. of Singapore, Singapore)

[27G1-1] 11:00~11:30 Invited Talk

Monolithic Optical Integration for Scalable Trapped-ion Quantum Information Processing

Benjamin G. Norton, Moji Ghadimi, Valdis Blum, and David Kielpinski

Griffith University, Australia

Quantum information processing (QIP) promises to radically change the outlook for secure communications, both by breaking existing cryptographic protocols and offering new quantum protocols in their place. A promising technology for QIP uses arrays of atomic ions that are trapped in ultrahigh vacuum and manipulated by lasers. Over the last several years, work in my research group has led to the demonstration of a monolithically integrated, scalable optical interconnect for trapped-ion QIP. Our interconnect collects single photons from trapped ions using a diffractive mirror array, which is fabricated directly on a chip-type ion trap using a CMOS-compatible process. Based on this interconnect, we have proposed an architecture that couples trapped ion arrays with photonic integrated circuits to achieve compatibility with current telecom networks. Such tightly integrated, highly parallel systems open the prospect of long-distance quantum cryptography.

[27G1-2] 11:30~11:45

Efficient Single Photon Collection Using a μ-Fiber-Coupled Microcavity

Chang-Min Lee[1], Hee-Jin Lim[1], Christian Schneider[2], Sebastian Maier[2], Sven Höfling[2,3], Martin Kamp[2], and Yong Hee Lee[1]

[1]KAIST, Korea, [2]University of Wuerzburg, Germany, [3]University of St. Andrews, UK

Efficient single photon collection is demonstrated based on a μ-fiber-coupled photonic crystal cavity. 249 kHz of single photons are detected, and estimated single photon count rate (overall collection efficiency) is 20 MHz (25 %).

[27G1-3] 11:45~12:00

Phase Dependent Light Switching in a Triple-Λ System

Bongjune Kim, Byoung-Uk Sohn, and Hoonsoo Kang

GIST, Korea

We experimentally demonstrate switching can be occurred between D1 |F'=1>, |F'=2> and D2 |F'=2> pulses. Each of pulses is probe field of triple-system composed of 87Rb D1 and D2 transition line.

[27G1-4] 12:00~12:15

Spectro-Spatial Coherent Control of Ultrafast Laser Interaction with Atomic Vapor

Woojun Lee, Hyosub Kim, Kyungtae Kim, and Jaewook Ahn

KAIST, Korea

Spectro-spatial coherent control methods are reported demonstrating optimized resonant two-photon transitions of rubidium atomic vapor by counter-propagating ultrashort pulse pairs. By properly programming the spectral sign changes across resonance frequencies, unlike non-resonant two-photon transitions, the resonant two-photon transitions probabilities could be enhanced, experiment finds.

Room H (202)

Session Title 27H1 / [T09] Novel Materials and Devices
Date & Time Thursday, 27 August, 11:00 ~ 12:30
Session Chairs Yasufumi Fujiwara (Osaka University, Japan)
Dong-Soo Shin (Hanyang University, Korea)

[27H1-1] 11:00~11:30 Invited Talk

ZnO Microcavity Polariton Lasers

Tien-Chang Lu

National Chiao Tung University, Taiwan

ZnO with a large exciton binding energy and oscillator strength shows its advantages in serving active medium in microcavity polariton lasers. Large temperature operation range promises ZnO polaritonics as future highly efficient emitters.

[27H1-2] 11:30~12:00 Invited Talk

True Green and Yellow Low-Threshold II-VI Laser Heterostructures for II-VI/III-N Laser Diode Converters

Sergey Ivanov[1], Sergei Sorokin[1], Sergei Gronin[1], Irina Sedova[1], Aliaksei Vainilovich[2], and Eugenii Lutsenko[2]

[1]Ioffe Institute, Russia, [2]Stepanov Institute of Physics of NAS Belarus, Belarus

We report on recent progress in developing green-yellow (530-590 nm) II-VI/III-N micro-chip laser converters comprising low-threshold (0.8-2.5 kW/cm2) II-VI laser heterostructures with CdSe/Zn(Cd)Se quantum dot active region, optically pumped by InGaN laser diodes.

[27H1-3] 12:00~12:15

Temperature Dependence Photoluminescence of Co-axial ZnO/PVK Nanocables

Sheng-Hung Hsu, Chien-Hung Lin, and Shih-Shou Lo

Feng-Chia University, Taiwan

In this study, we demonstrated an inorganic-organic coaxial nanocable fabricated through facile-coating of organic molecules on an inorganic nanorod. The coaxial nanocable consists of a unique core (ZnO nanorod) and a shell (poly(N - vinylcarbazole)PVK). The temperature dependence of nanocables were carried out.

[27H1-4] 12:15~12:30

E-beam Pumped Mid-ultraviolet Sources Based on AlGaN Multiple Quantum Wells Grown by MBE

Xin Rong[1], S.V. Ivanov[2], V.N. Jmerik[2], V.I. Kozlovsky[3], Guang Chen[1], Fujun Xu[1], Bo Shen[1], and Xinqiang Wang[1]

[1]Peking University, China, [2]Ioffe Physical-Technical Institute, Russia, [3]Lebedev Physical Institute, Russia

We report on the development of e-beam pumped mid-UV (~ 280nm) sources fabricated from AlGaN MQWs grown by plasma-assisted (PA) MBE on AlN/c-Al_{203} templates. The high output power above 100 mW has been demonstrated in a pulse-scanning regime. This achievement is attributed to the enhanced carrier confinement within the high-quality sub-monolayer digital alloying quantum wells and improved quality of the AlN buffer layer due to the high temperature PA MBE growth employed. The time-resolved photoluminescence shows the radiative recombination dominate the recombination process, indicating high crystal qualities.

Room I (203)

Session Title 27I1 / [T10] Biosensors
Date & Time Thursday, 27 August, 11:00 ~ 12:30
Session Chair Jin Tae Kim (ETRI, Korea)

[27I1-1] 11:00~11:30 Invited Talk

Photonics beyond Multiple Light Scattering

Wonshik Choi

Korea University, Korea

I will introduce an experimental method that makes use of multiple-scattered waves for performing optical imaging and enhancing light energy delivery through scattering media.

[27I1-2] 11:30~11:45

A Portable Grating-Based Spectrometer for Plasmonic Biosensing Applications

Shu-Cheng Lo[1], En-Hung Lin[2], Pei-Kuen Wei[2], and Wan-Shao Tsai[1]

[1]National Chi Nan University, Taiwan, [2]Academia Sinica, Taiwan

A portable grating-based spectrometer for plasmonic biosensing is presented. Spectral resolution on the order of nm is achieved within wavelength range 628-640 nm. The spectrometer shows good sensitivity response by testing the biosensor with glycerin solutions.

[27I1-3] 11:45~12:00

Molecular Range Light Confinement of Metal-Air-Metal Structure for Biosensor Applications

Jaehak Lee[1], Sangkeun Sung[2], and Jung H. Shin[1]

[1]KAIST, Korea, [2]Korea Institute of Machinery and Materials, Korea

We report on an MIM-type plasmonic resonator with a 4-nm slot. The gap was defined using selfaligned deposition using conventional photolithography. The structure shows great promise for a biosensor, with 12 nm/nm surface sensitivity at least.

[27I1-4] 12:00~12:15

Disorder Effect on Broad-angle Reflection from Morpho-inspired Structures

Bokwang Song, Seok Chan Eom, and Jung H. Shin

KAIST, Korea

We investigate the effect of disorder on broad-angle reflection from Morpho-inspired structures. And we also propose Morpho-inspired structures applying grating diffraction to fully reproduce the reflection of Morpho butterflies.

[27I1-5] 12:15~12:30

Three Dimensional Optical Manipulation on a Lap-on-a chip Device through Standing Wave

Jisu Kim and Jung H. Shin

KAIST, Korea

We propose and demonstrate optical manipulation in three dimensional space through standing wave. FEM simulations suggest a capability of trapping 1 μm particle at room temperature, and stationary trapping by counter propagating beams is achieved.

Room J (204)

Session Title 27J1 / [T12] Integrated Optical Devices
Date & Time Thursday, 27 August, 11:00 ~ 12:15
Session Chairs Yong-Zhen Huang (Chinese Academy of Sciences, China)
Min-Suk Kwon (UNIST, Korea)

[27J1-1] 11:00~11:30 Invited Talk

Narrow Linewidth Tunable Lasers for Digital Coherent System

Toshikazu Mukaihara, Toshio Kimura, and Hiroyuki Koshi

Furukawa Electric, Japan

We describe μ-ITLA characteristics with DFB/DR laser array based narrow linewidth tunable laser. We also introduce ITXA of a co-packaged DFB array based laser and InP-based modulator for metro digital coherent application.

[27J1-2] 11:30~11:45

Microring-based Tunable Optical Delay Lines for Optical Time-division Multiplexers

Zhihua Yu[1], Xin Jin[1], Jun Chen[1], Gaifang Wang[1], and David R. Selviah[2]

[1]China University of Geosciences, China, [2]University College London, UK

Microring-based tunable optical delay lines are proposed to construct an optical time division multiplexer (OTDM) system, with which, we can get ultrahigh bit rates with several low-speed channels.

[27J1-3] 11:45~12:00

Dielectric-Loaded Magnetic and Nonmagnetic Plasmonic Waveguides on SOI Wafer

Terunori Kaihara and Hiromasa Shimizu

Tokyo University of Agriculture and Technology, Japan

Propagation characteristics of magnetic and nonmagnetic plasmon waveguides using Au and Fe have been studied. The devices are theoretically optimized and fabricated on a SOI substrate. The transmission characteristics are investigated on those waveguides.

[27J1-4] 12:00~12:15

Design of Optical Isolators Utilizing Directional Coupling within Asymmetric Waveguides

Masashi Hosoda, Jo Sato, Danish Wahid, Takaya Sato, and Hiromasa Shimizu

Tokyo University of Agriculture and Technology, Japan

We designed magneto-optic waveguide isolators based on the nonreciprocal coupling by the coupled mode theory. Optical isolation over 40 dB was estimated with the waveguide length of 700 μm.

Room A (101)

Session Title 27A2 / [T01] Solid-State & Mid-IR Lasers
Date & Time Thursday, 27 August, 15:45 ~ 17:45
Session Chair Fabian Rotermund (Ajou University, Korea)

[27A2-1] 15:45~16:15 Invited Talk

Solid-State Lasers Directly Pumped by InGaN Blue/Green Diode Lasers

Fumihiko Kannari

Keio University, Japan

Current progress in blue and green InGaN laser diodes (LDs) realizes direct pumping of solid-state lasers. Performances of Pr^{3+}-doped $LiYF_4$ visible lasers and Ti^{3+}-doped Al_2O_3 lasers pumped by 440-nm and 532-nm LDs respectively are reviewed.

[27A2-2] 16:15~16:30

Mid-IR Supercontinuum Generation in ZBLAN Fiber Pumped by Diode-Seeded Tm-Doped MOPA

Hongxing Shi, Kun Liu, Fangzhou Tan, Jiang Liu, and Pu Wang

Beijing University of Technology, China

We demonstrate 22 W average power mid-IR supercontinuum (1900nm-3600nm) generations in a single mode ZBLAN fiber pumped by nanosecond pulses from diode-seeded Tm-doped MOPA.

[27A2-3] 16:30~16:45

Handedness Control of Sub-Millijoule Mid-Infrared (6-12μm) Vortex Laser

A. Ogawa[1], M.-T. Horikawa[1], K. Miyamoto[1], and T. Omatsu[1,2]

[1]Chiba University, Japan, [2]CREST Japan Science and Technology Agency, Japan

We demonstrate the handedness control of a 6-12 μm optical vortex output from an optical vortex parametric laser formed of a 1-μm vortex pumped $KTiOPO_4$ optical parametric oscillator in combination with a $ZnGeP_2$ difference frequency generator.

[27A2-4] 16:45~17:00

Room Temperature High Energy High Efficient Fe^{2+}:ZnSe Laser

Changjun Ke, Ran Wang, Zhiyong Li, and Yin Hang

Chinese Academy of Sciences, China

The characteristics of a room-temperature Fe^{2+}:ZnSe laser based on a polycrystalline sample pumped by a non-chain HF laser were studied. The Fe^{2+}:ZnSe laser energy was E = 15 mJ at the efficiency with respect to the absorbed HF laser energy η_{ab}=15%.

[27A2-5] 17:00~17:15

Intracavity-Pumped Ho:KLu$(WO_4)_2$ Microchip Laser at 2.1 μm

J. M. Serres[1], X. Mateos[1], P. Loiko[2], K. Yumashev[2], N. Kuleshov[2], V. Petrov[3], U. Griebner[3], M. Aguiló[1], and F. Díaz[1]

[1]Universitat Rovira i Virgili, Spain, [2]Belarusian National Technical University, Belarus, [3]Max-Born-Institute for Nonlinear Optics and Ultrafast Spectroscopy, Germany

Maximum output power of 285 mW is achieved at 2080 nm (Ho^{3+} emission) with a slope efficiency of 8.3% in a compact intracavity-pumped microchip Ho-laser using stacked Tm:KLuW / Ho:KLuW N_g-cut crystals.

[27A2-6] 17:15~17:30

Passively Mode-Locked Mid-Infrared Solid-State Laser

Lingchen Kong[1], Jie Ma[2], Guoqiang Xie[1], Zhipeng Qin[1], Peng Yuan[1], and Liejia Qian[1]

[1]Shanghai Jiao Tong University, China, [2]Nanyang Technological University, China

Passively mode-locked lasers provide a convenient way to generate ultrafast laser pulses with high peak power. In this report, we gave introduction of progress of passively mode-locked mid-infrared solid-state lasers at 2 μm region in our laboratory.

[27A2-7] 17:30~17:45

Experimental Investigation of 2.8 μm Er^{3+}-Doped ZBLAN Fiber Lasers

Hongwei Chen, Yanlong Shen, Ke Huang, Kunpeng Luan, Li Yu, Aiping Yi, and Guobin Feng

Nothwest Institute of Nuclear Technology, China

In this presentation, we reported the recent progress on 2.8 μm Er^{3+}-doped ZBLAN fiber laser in our research group. Ten-watt-level CW, watt-level passively Q-switched and 122-nm tunable mid-infrared fiber lasers have been demonstrated.

Room B (102)

Session Title 27B2 / [T03] Terahertz Technologies and Applications II
Date & Time Thursday, 27 August, 15:45 ~ 17:45
Session Chair Tae In Jeon (Korea Maritime and Ocean University, Korea)

[27B2-1] 15:45~16:15 Invited Talk

Biomedical Science and Technology Using Terahertz Waves

Joo-Hiuk Son

University of Seoul, Korea

Various biomedical applications utilizing terahertz technology are presented. Technical challenges in such applications are discussed in terms of limited penetration depth, blurred spectral features, and deficient contrast and the feasible solutions to the problems are also suggested.

[27B2-2] 16:15~16:45 Invited Talk

A Terahertz Technology for Label-free Immune Assay

Toshihiko Kiwa, Mashiro Ogawa, Kosuke Akimune, Hiroyuki Akimune, Kenji Sakai, and Keiji Tsukada

Okayama University, Japan

This paper reviews recent works of label-free immune assay using terahertz technologies, which includes a terahertz chemical microscopy. Experimental results of label-free detection of lectin-suger chain reactions were also presented.

[27B2-3] 16:45~17:15 Invited Talk

Ultrafast Spin Spectroscopy for Rare-earth Orthoferrites and Orthochromites by THz Pulses

Makoto Nakajima

Osaka University, Japan

Impulsive excitation of terahertz magnetic field induces spin precession motions and the spin dynamics are probed. The results of temperature dependence in $ErCr_{03}$ and enhancement of spin precession amplitudes using metamaterial in $ErFe_{03}$ is reported.

[27B2-4] 17:15~17:30

In Vivo Analysis of Immune Cell Motility After THz Wave Irradiation

Yoonha Hwang[1], Jungho Mun[2], Jinhyo Ahn[1], Sangyoon Bae[2], Young Uk Jeong[2], Nikolay A. Vinokurov[2], and Pilhan Kim[1]

[1]KAIST, Korea, [2]KAERI, Korea

Cellular-level effects by THz wave irradiation on live animal were visualized by intravital laser-scanning confocal microscopy. Time-lapse imaging analysis revealed an acute inflammatory response induced by THz wave irradiation in vivo.

[27B2-5] 17:30~17:45

Simultaneously Detection Two Types of Ions Using THz Chemical Microscopy

Kosuke Akimune, Yuki Okawa, Kenji Sakai, Toshihiko Kiwa, and Keiji Tsukada

Okayama University, Japan

THz chemical microscopy has been proposed and developed to detect ions in water solutions. In this work, the change in the amplitude of THz radiation was measured when ion solutions was dropped on detection plate.

Room C (103)

Session Title	27C2 / [T02] Characterization of Ultrashort Laser Pulses
Date & Time	Thursday, 27 August, 15:45 ~ 17:30
Session Chair	Ya Cheng (Shanghai Institute of Optics and Fine Mechanics, China)

[27C2-1] 15:45~16:15 Invited Talk

Measurement and Control of Optical Waveforms

Kyung Taec Kim[1,2], Kyungseung Kim[1,3], and Chang Hee Nam[1,2,3]

[1]Institute for Basic Science, Korea, [2]GIST, Korea, [3]KAIST, Korea

An arbitrary optical waveform can be measured by adding a weak additional signal field in high harmonic experiments. The wavelength dependence of the signal field is investigated using the quantum path analysis.

[27C2-2] 16:15~16:30

Gain Dynamics and Temporal Characteristics of Nitrogen Lasers Pumped by Circularly-polarized Femtosecond Laser Pulses

Jinping Yao[1], Bin Zeng[1], Wei Chu[1], Hongqiang Xie[1], Ziting Li[1], Jielei Ni[1], Guihua Li[1], Chenrui Jing[1], Huailiang Xu[2], and Ya Cheng[1]

[1]Shanghai Institute of Optics and Fine Mechanics, China, [2]Jilin University, China

We experimentally investigate gain dynamics and temporal characteristics of a free-space nitrogen laser pumped by circularly-polarized femtosecond laser pulses based on the pump-probe scheme.

[27C2-3] 16:30~16:45

All-optical Single-shot Ultrafast 2D-burst Imaging Using a Linearly Frequency Chirped Pulse

Takakazu Suzuki, Fumihiro Isa, Leo Fujii, Kenichi Hirosawa, and Fumihiko Kannari

Keio University, Japan

We demonstrate a new scheme of spatially and temporally resolved all-optical wavelength-multiplexed imaging (STRAW) in the 4f configuration with a DOE and a band-pass filter. Using a frequency chirped pulse, we realize single-shot ultrafast imaging.

[27C2-4] 16:45~17:15 Invited Talk

Measurement and Synthesis of Ultrafast Scalar and Vectorial Optical Arbitrary Waveforms

Shang-Da Yang

National Tsing Hua University, Taiwan

The latest methods to simultaneously characterize and synthesize ultrafast optical arbitrary waveform in the scalar and vectorial regimes are reviewed.

[27C2-5] 17:15~17:30

Ultrafast Pre-damage Dynamics in Al_2O_3/SiO_2 Reflector

Juan Du[1], Zehan Li[1], Bing Xue[2], Takayoshi Kobayashi[2], Yuanan Zhao[1], and Yuxin Leng[1]

[1]Chinese Academy of Sciences, China, [2]University of Electro-Communications, Japan

Ultrafast reflectivity decrease due to free electron absorption and spectral shift due to generation of defect state in Al_2O_3/SiO_2 UV reflector have been observed for the first time to the best of our knowledge.

Room D (106)

Session Title	27D2 / [T10] Quantum Phenomena in Micro/Nano Optics
Date & Time	Thursday, 27 August, 15:45 ~ 17:00
Session Chair	Zee Hwan Kim (Seoul National University, Korea)

[27D2-1] 15:45~16:00

Radiation Coupling Between Two Deformed Microcavities

Fang-Jie Shu[1], Chang-Ling Zou[2], F.-W. Sun[2], and Wen-Cong Chen[1]

[1]Shangqiu Normal University, China, [2]University of Science and Technology of China, China

Strong and steady coupling between optical elements is important in integrated optical circuit. Through deforming the boundary of microcavities we construct a coupling system composed with two cavities. Then the characteristics of the system are studied.

[27D2-2] 16:00~16:15

Influence of the Relative Positions of Quantum Dots and Nanocavities on the Optical Coupling Strength

Kazuhiro Kuruma, Yasutomo Ota, Daisaku Takamiya, Masahiro Kakuda, Satoshi Iwamoto, and Yasuhiko Arakawa

The University of Tokyo, Japan

We use scanning electron microscopy to precisely measure the locations of quantum dots buried in photonic crystal nanocavities. We show that well-positioned dots (at the field maximum) can exhibit vacuum Rabi splittings larger than 180μeV.

[27D2-3] 16:15~16:30

Enhanced Second-harmonic Generation Efficiency in a Waveguide-coupled Photonic Nanocavity

Heungjoon Kim, Chan Lee, and Bong-Shik Song

Sungkyunkwan University, Korea

We investigate second-harmonic generation (SHG) efficiency in a waveguide-coupled photonic nanocavity. The factors for highly-efficient SHG are analyzed. It is found that 100% efficiency is achievable by introducing a mirror at the waveguide.

[27D2-4] 16:30~16:45

Ultra-Widely Tunable Nanofiber Bragg Cavities for Quantum Optics

Andreas W. Schell[1,2,3,4], Hideaki Takashima[1,3,4], Shinya Kamioka[3,4], Yasuko Oe[1,3,4], Shinjiro Fujita[1], Masazumi Fujiwara[2,3,4], Oliver Benson[2], and Shigeki Takeuchi[1,3,4]

[1]Kyoto University, Japan, [2]Humboldt-Universitat zu Berlin, Germany, [3]Hokkaido University, Japan, [4]Osaka University, Japan

For efficient interfacing of quantum emitters nano- and microcavities are important tools. Here, we introduce Bragg cavities fabricated on nanofibers. We show strain-tuning of the cavity resonance and first coupling experiments with quantum emitters.

[27D2-5] 16:45~17:00

Frequency Comb Generation in Green, Red and Infrared Region from AlN Microring Resonator

Hojoong Jung, Rebecca Stoll, Xiang Guo, Debra Fischer, and Hongxing Tang

Yale University, USA

We demonstrate optical frequency comb generation in visible and IR spectrum within a high Q aluminum nitride microring resonator. High resolution spectroscopic study of the comb indicates matched free spectral range over all the bands.

Room E (107)

Session Title 27E2 / [T06] Novel Laser and Optical Technologies in Manufacturing
Date & Time Thursday, 27 August, 15:45 ~ 17:30
Session Chair Dongsik Kim (POSTECH, Korea)

[27E2-1] 15:45~16:15 Invited Talk

High Precision Prediction of Thin Film Composition by LIBS

Jung Hwan In, Chan Kyu Kim, Seok Hee Lee, and Sungho Jeong

GIST, Korea

The measurement of average composition or spatial elemental distribution in thin films of a few micrometer thickness is important for product evaluation or process monitoring in thin film product industry. This work reports that the average composition of thin solar cell films (~ 2 mm) could be predicted with high precision (< 1% relative standard deviation) by laser induced breakdown spectroscopy (LIBS). The depthwise distribution of constituent elements could also be measured with a spatial resolution below 100 nm as was confirmed with secondary ion mass spectrometry. It is discussed that the high precision of LIBS with its intrinsic rapid, no sample preparation, in-air measurement capability provides a powerful technique for composition monitoring at manufacturing sites.

[27E2-2] 16:15~16:30

Highly Stable Periodic Structures Using Nonlinear Laser Lithography

Özgün Yavuz[1], Ihor Pavlov[1], Onur Tokel[1], Emre Ergecen[2], Anıl Rızaoğlu[1], and F. Ömer Ilday[1,2]

[1]Bilkent University, Turkey, [2]Middle East Technical University, Turkey

Nonlinear laser lithography (NLL) emerged as a novel surface structuring method allowing long range periodic order. We present mathematical formalism for NLL, analysis of structure stability to perturbations and a way to control final tiling patterns.

[27E2-3] 16:30~16:45

The Formation of Periodic Surface Structures on Ni-Fe Film Induced by Single Femtosecond Laser Pulse with Diffraction Rings

Kan Zhou, Tian Qing Jia, and Xin Jia

East China Normal University, China

We have observed the formation of periodic surface structures on Ni-Fe film irradiated by a single femtosecond laser pulse. We propose that this is due to the modulated transient permittivity and the surface plasmon.

[27E2-4] 16:45~17:00

Ultrafast Micromachining of Cu and Si at Ultra-high Repetition Rates with Pulse Bursts

Can Kerse[1], Hamit Kalaycıoğlu[1], Parviz Elahi[1], Koray Yavuz[1], Inam Mirza[2], Nadezhda M. Bulgakova[2,3], and F. Ömer Ilday[1]

[1]Bilkent University, Turkey, [2]Institute of Physics, Czech Republic, [3]Institute of Thermophysics, Russia

We report a novel ultrafast burst mode fiber laser system, which can deliver pulses at ultra-high repetition rates in order to systematically investigate micromachining efficiency on copper and silicon samples.

[27E2-5] 17:00~17:15

Hybrid Manufacturing of Stainless Steel and Zirconia Micro Components Using Laser Micromachining and Powder Injection Molding

Hyeseong Sin[1], Daehwan Ahn[1], Youngsam Kwon[2], and Dongsik Kim[1]

[1]POSTECH, Korea, [2]CetaTech Co., Ltd., Korea

This work reports a hybrid manufacturing process for fabricating zirconia and SUS micro components using ns/fs laser micromachining and powder injection molding. Mechanisms of material removal and characteristics of the process were analyzed.

[27E2-6] 17:15~17:30

Femtosecond Laser Machining of Transparent Materials at High Speed and Quality

Frank Hendricks and V. Matylitsky

Spectra-Physics, Austria

We have developed and characterized ablative and nonablative femtosecond laser processes for precision machining of transparent materials. Ablation process is compared with a newly developed non-ablative patent pending femtosecond process, ClearShape™, using the Spectra-Physics® Spirit® industrial femtosecond laser.

Room F (108)

Session Title 27F2 / [T07] Optical Metrology and Sensing VIII
Date & Time Thursday, 27 August, 15:45 ~ 17:30
Session Chair Haiyong Gan (National Institute of Metrology, China)

[27F2-1] 15:45~16:00

Nondestructive Inspection of Fiberglass-Reinforced Plastic Mortar Pipes Using Electro-Optic Sensors and Microwave Propagation

Fumiaki Ueno[1], Yoshiyuki Azuma[1], Hiroshi Murata[1], Tadahiro Okuda[2], Masaya Hazama[2], and Yasuyuki Okamura[1]

[1]Osaka University, Japan, [2]Kurimoto Ltd., Japan

A nondestructive measurement technique for fiberglass-reinforced plastic mortar pipes using electro-optic (EO) sensors and microwave propagation is proposed. The change in field distributions of microwave propagating along the pipes was verified clearly using EO sensors.

[27F2-2] 16:00~16:15

Two FBG Spectral Convolution for Strain Sensing

Shih-Hsiang Hsu, Kuo-Wei Chuang, and Ci-Syu Chen

National Taiwan University of Science and Technology, Taiwan

Two FBG spectral convolution was characterized using a delayed self-homodyne method for strain sensing. The strain sensitivity demonstrated 165-MHz/$\mu\varepsilon$ and sensing limitation could achieve 1-nε with 165 kHz bandwidth resolution in the electric spectrum analyzer.

[27F2-3] 16:15~16:30

Highly Sensitive Magnetic Field Sensor Using Long-Period Fiber Grating

Meng Ying Zhang[1], Xinyong Dong[1], Ping Shum[1], Juan Juan Hu[2], Haibin Su[1], Wen Siang Lew[1] and Lei Wei[1]

[1]Nanyang Technological University, Singapore, [2]Agency for Science, Technology and Research, Singapore

We experimentally demonstrate a magnetic field sensor based on long-period fiber grating (LPG) and magnetic fluid. Our proposed sensor possesses a high sensitivity of ~0.154 dB/Gauss and a low measurement threshold of ~7.4 Gauss.

[27F2-4] 16:30~16:45

Self-Heterodyne Interference Spectroscopy Using Pseudo-Noise Modulation

Vincent Michaud-Belleau[1], Nicolas Bourbeau Hébert[1], James D. Anstie[2], André N. Luiten[2], and Jérôme Genest[1]

[1]Université Laval, Canada, [2]University of Adelaide, Australia

A new spectroscopic technique that uses a single CW laser and pseudo-noise modulation provides an absorption spectrum having spectral point spacing of 40 MHz over a 2.5 GHz span in a single 1-ms measurement.

[27F2-5] 16:45~17:00

Irreversible Gold Nanospheres Adsorption on Optical Fiber Tapers and Microspheres

Jihaeng Yi

Dankook University, Korea

The surfaces consist of tapers and microspheres fibers and were coated with a polycation, enabling irreversible nanosphere adsorption. We compare the results with the theory that particle adsorption rates depend strongly on surface geometry.

[27F2-6] 17:00~17:15

Development of Ultrasound Sensor Using an SU-8 Polymer Based Fabry-Perot Interferometer

Hyunmin Yoon[1], Jeongmin Heo[2], Hyoungwon Baac[2], and Junseok Heo[1]

[1]Ajou University, Korea, [2]Sungkyunkwan University, Korea

Ultrasound sensing was investigated with SU-8 polymer based Fabry-Perot interferometers consisting of TiO_2/SiO_2 distributed Bragg mirrors (DBRs). The DBRs are properly modified to transmit an excitation pulse laser (532 nm) generating ultrasound in all-optical transducers.

[27F2-7] 17:15~17:30

Sensitive Oxygen Detection Using Second Harmonic Generation of a Telecommunication Band Semiconductor Laser

Kazuo Maeda, Shunsuke Kuwabara, Ryutaro Yamashita, Ryuta Someya, Kazuyoku Tei, and Shigeru Yamaguchi

Tokai University, Japan

Tunable source employed a waveguide periodically poled $LiNbO_3$ with distributed-feedback diode laser was successfully demonstrated to measure the oxygen A band absorption lines. Developed spectrometer can detect trace oxygen as low as 10 ppm level.

Room G (201)

Session Title 27G2 / [T08] Quantum Information III
Date & Time Thursday, 27 August, 15:45 ~ 17:45
Session Chair Yong-Su Kim (KIST, Korea)

[27G2-1] 15:45~16:15 Invited Talk

Quantum State Estimation and Discrimination

Shigeki Takeuchi

Kyoto University, Japan

Quantum state estimation and discrimination are important tasks not only for many quantum information protocols but also precise measurements. In this paper, we report our recent efforts on this issue. In the first part, we report adoptive quantum state estimation, which provides the most accurate estimation using an optimal measurement basis for each measurement. In the second part, we introduce quantum state data mining where the erroneous states (density matrices) are discriminated from the normal ones efficiently using machine learning method.

[27G2-2] 16:15~16:45 Invited Talk

Advances in Photonic Remote Entanglement Sharing

Geoff J. Pryde

Griffith University, Australia

Remote entanglement sharing is a primitive for a range of quantum information science tasks and for fundamental studies of nonlocality. We experimentally demonstrate advances in performing secure, loss-tolerant entanglement sharing with photonic systems.

[27G2-3] 16:45~17:00

Quantum Teleportation of Two Different Types of Optical Hybrid Qubits Over a Lossy Environment

Hoyong Kim, Seung-Woo Lee, and Hyunseok Jeong

Seoul National University, Korea

Hybrid of photon-polarized states with coherent states and hybrid of vacuum and single-photon states with coherent states are compared for teleportation. We have shown that the latter is better than the former under photon losses.

[27G2-4] 17:00~17:15

Waveguide Logic Gates for Polarization Encoded Magneto-Optical Qubits

Shukhrat Egamov and Islom Abdunazarov

Samarkand State University, Uzbekikistan

Results of magneto-optical waveguide logic gates properties investigation are presented. Simple logic operations can be realized using photon properties in modulated magnetic field. Changing the magnetic field amplitude and its orientation relating to light propagation direction, choosing polarizer and analyzer orientation and proper waveguide geometry, we can design logic gates avoiding small coherence time of regular optic qubits.

[27G2-5] 17:15~17:30

Quantum Refractometer

Anna Paterova[1], Dmitry Kalashnikov[1], Sergei Kulik[2], and Leonid Krivitsky[1]

[1]Agency for Science Technology and Research, Singapore, [2]Lomonosov Moscow State University, Russia

We exploit interference of two Parametric Down Conversion (PDC) sources to observe infrared resonances of CO_2. Frequency correlations of PDC enable determination of the refractive index at IR wavelengths with visible range optics and photodetectors.

[27G2-6] 17:30~17:45

Non-Maximal Polarization-Entangled Photons with Spectrally-Varying Non-Maximality

Mao Tong Liu[1] and Han Chuen Lim[1,2]

[1]Nanyang Technological University, Singapore, [2]DSO National Laboratories, Singapore

We pump two periodically-poled lithium niobate waveguides of different lengths in a Sagnac loop to produce photons with spectrally-varying non-maximal polarization entanglement for the first time. The desired non-maximality is selectable by optical wavelength filtering.

Room H (202)

Session Title 27H2 / [T11] Innovative Methods in Biophtonics
Date & Time Thursday, 27 August, 15:45 ~ 17:15
Session Chairs Chris Xu (Cornell University, U.S.A.)
Yong Keun Park (KAIST, Korea)

[27H2-1] 15:45~16:00

Polarimetric Characterization of Healthy and RF Ablated Myocardial Tissue

Iftikhar Ahmad[1,2], Adam Grillble[2], Alex Vitkin[2], and Masroor Ikram[1]

[1]Pakistan Institute of Engineering and Applied Sciences, Pakisatn, [2]University of Toronto, Canada

Polarization signatures of ex-vivo healthy and RF ablated porcine hearts in backscattered geometry were explored through Mueller matrix polarimetry. Significant differences in depolarization and linear retardance values were observed between the healthy, ablated and rim regions.

[27H2-2] 16:00~16:15

Multiphoton 3D Structured Illumination Microscopy for Enhanced Axial Resolution in Deep Imaging

Qiyuan Song[1,2], Keisuke Isobe[1,4], Fumihiko Kannari[2], Hiroyuki Kawano[1], Akiko Kumagai[1], Atsushi Miyawaki[1], and Katsumi Midorikawa[1]

[1]RIKEN, Japan, [2]Keio University, Japan, [3]JST, Japan

By combining 3D structured illumination microscopy with temporal focusing, the axial resolution is improved by a factor of 2.3 compared with that of 2D structured illumination microscopy.

[27H2-3] 16:15~16:30

Experimental Investigation of Timing Jitter of a 1.06-μm Gain-Switched Laser Diode for Stimulated Raman Scattering Microscopy

Kyoya Tokunaga[1], Yi-Cheng Fang[2], Yuta Kusama[2], Hiroyuki Yokoyama[2], and Yasuyuki Ozeki[1]

[1]The University of Tokyo, Japan, [2]Tohoku University, Japan

The timing jitter of 13-ps gain-switched laser diode pulses at 1.06 μm is measured to be 3.9 ps, which is further reduced by external injection. We successfully demonstrate stimulated Raman imaging using the pulses.

[27H2-4] 16:30~16:45

Identification of Amyloid Plaques in Mouse Brain Tissue Slides Using Quantitative Phase Imaging

Moosung Lee, Jae Hwang Jung, Eeksung Lee, Yong Jeong, and Yong Keun Park

KAIST, Korea

We demonstrate that quantitative phase imaging (QPI) can detect amyloid plaques in the brain of Alzheimer's disease (AD). Comparing QPIs and fluorescence images from wild-type and AD mice brains, we suggest that digital microscopic holography can be utilized for diagnosing AD.

[27H2-5] 16:45~17:00

Quantitative Characterisation of MPP+ Effects on Neurons Using 3-D Refractive Index Tomography

Su-A Yang, Jonghee Yoon, and Yong Keun Park

KAIST, Korea

Quantitative characterization of neurodegeneration in Parkinson's disease-like model via 3-D refractive index (RI) tomogram measurements is presented. 3-D RI information enables quantification of neurodegenerative sequences, which provides insight on pathogenesis of neurodegeneration in Parkinson's disease.

[27H2-6] 17:00~17:15

Dark-field Imaging Tracking of BSA Stabilized Gold Nanorods in Macrophage

Rui Hu[1], Ken-Tye Yong[2], and Junle Qu[1]

[1]Shenzhen University, China, [2]Nanyang Technological University, Singapore

Bovine serum albumin (BSA) stabilized gold nanorods were fed to macrophages and tracked through dark-field imaging. Intracellular aggregation of the nanorods was observed before they were excreted from cells.

Room I (203)

Session Title 27I2 / [T13] Advanced Imaging Techniques
Date & Time Thursday, 27 August, 15:45 ~ 17:45
Session Chair Jae-Hyeung Park (Inha University, Korea)

[27I2-1] 15:45~16:15 Invited Talk

Classical Imaging Seasoned with Quantum Concepts

Tomohiro Shirai

National Institute of Advanced Industrial Science and Technology, Japan

As one of quantum-mimetic classical imaging techniques, we outline the basic principle and potential applications of recently proposed intensity-interferometric spectral-domain optical coherence tomography that enables dispersion insensitive, scanless cross-sectional imaging with resolution improvement.

[27I2-2] 16:15~16:45 Invited Talk

Intelligent Video Surveillance System based on Distributed Fiber Vibration Sensing Technique

Kun Liu, Tiegen Liu, Junfeng Jiang, Qinnan Chen, Chunyu Ma, Yu Li, and Dingjie Li

Tianjin University, China

An intelligent video surveillance system was proposed together with distributed fiber vibration sensing technique and advanced intelligent identification algorithm, in order to monitor all kinds of real-time disturbance and intrusion on the cable.

[27I2-3] 16:45~17:00

Optical Detection of Micro Defect by Single-pixel Imaging

Kyuki Shibuya, Yauhiro Mizutani, Hirotsugu Yamamoto, Takeshi Yasui, and Tetsuo Iwata

The Tokushima University, Japan

We propose an optical detection method of micro defect by single-pixel imaging microscopy. Our results demonstrate the micro defect imaging by detecting an anisotropic scattered light on mirror surface.

[27I2-4] 17:00~17:15

Digital Holographic Microscopy using Partially Coherent, Instantaneously Bright, Femtosecond Pulse Light

Dahi Abdelsalam[1,2], Hirotsugu Yamamoto[2,3], and Takeshi Yasui[1,2]

[1]The Tokushima University, Japan, [2]JST, Japan, [3]Utsunomiya University, Japan

Digital holographic microscopy utilizing partially coherent light is employed to feature a sarcomere sample precisely. Merits of the presented technique include real time, high resolving power, and no spurious noise in the reconstructed object wave.

[27I2-5] 17:15~17:30

Upconversion Properties and Mechanisms in Er^{3+} ions upon 800 nm Excitation

Xiaoying Shang and Tianqing Jia

State Key Laboratory of Precision Spectroscopy, China

We researched the spectral properties of upconversion luminescence in Er^{3+} doped NaYF4-glass ceramics, and found that the upconversion mechanisms of Er^{3+} ions are different between excitation of CW laser and fs laser.

[27I2-6] 17:30~17:45

Manufacturing of Smartphone Based Real-time Cell Observation Microscope

Taerim Yoon and Kyujung Kim

Pusan National University, Korea

In this study, we designed microscope for real-time observation of the cells. This microscope uses a smartphone as detector. Therefore, we can observe in real time cells through the remote control of smartphone.

Room J (204)

Session Title 27J2 / [T12] Microcavity Integrated Devices
Date & Time Thursday, 27 August, 15:45 ~ 17:45
Session Chairs Yun-Feng Xiao (Peking University, China)
Toshi Mukaihara (Furukawa Electric, Japan)

[27J2-1] 15:45~16:15 Invited Talk

High Speed Modulation Characteristics for Semiconductor Microdisk Lasers

Yong-Zhen Huang, Ling-Xiu Zou, Xiu-Wen Ma, Yue-De Yang, Jin-Long Xiao, and Yun Du

Chinese Academy of Sciences, China

High speed modulation characteristics are investigated for directional emission microdisk lasers. The increase of modulation speed with the decrease of the radius is observed, and improvement of 3dB bandwidth is demonstrated at optical injection locking.

[27J2-2] 16:15~16:30

Integrated Metal-cavity NanoLEDs in III-V Membranes on Silicon

Meint Smit, Andrea Fiore, Rene van Veldhoven, Francesco Pagliano, Bruno Romeira, Dominik Heiss, and Victor Dolores Calzadilla

Eindhoven University of Technology, Netherlands

We demonstrate the first waveguide-coupled metalcavity nanoLED in a III-V photonic membrane bonded to a silicon substrate, which operates at telecommunication wavelengths. The device works under electrical injection and was characterized through a grating coupler.

[27J2-3] 16:30~16:45

Electro-Optic Modulator Using Meta-Surface Structure for 100 GHz-Band Wireless Signals

Nobuhiro Suenari, Hiroshi Murata, and Yasuyuki Okamura

Osaka University, Japan

We propose new 100 GHz-band electro-optic modulators using meta-surface structure for RoF systems. Using strong electric fields in the meta-surface structure, effective conversion is expected. A new technique for quasi-phasematching is also proposed.

[27J2-4] 16:45~17:00

Membrane-based High Efficiency Metallic Grating Couplers for Integrated Photonics

Meint K. Smit, Dominik Heiss, Yuqing Jiao, Erik J. Geluk, Victor Dolores-Calzadilla, and Aura Higuera-Rodriguez

Eindhoven University of Technology, Netherlands

We developed a novel buried metal grating coupler for membrane platforms. We experimentally demonstrated a chip-to-fiber coupling efficiency of 56%, which makes them an attractive building block for on-wafer testing and dense optical interconnects.

[27J2-5] 17:00~17:15

Vortex Beam Emitter Laterally Integrated with Vertical Cavity Surface Emitting Laser

Kenji Tanabe, Xiaodong Gu, Akihiro Matsutani, and Fumio Koyama

Tokyo Institute of Technology, Japan

We demonstrate a compact vortex beam emitter laterally integrated with VCSEL for OAM mode multiplexing. The device generates an azimuthally polarized vortex beam from a ring-shape waveguide laterally connected with an electrically pumped 980nm VCSEL.

[27J2-6] 17:15~17:30

Characterization of a Two-Section Integrated Tunnel-Junction Phototransistor

Yung Lin Chou, Yuan-Fu Hsu, and Chao-Hsin Wu

National Taiwan University, Taiwan

A two-section integrated tunnel-junction heterojunction phototransistor (TJHPT) is fabricated and characterized in this report. By incorporating tunnel-junction in the basecollector region of the phototransistor, the responsivity can be greatly enhanced owing to direct tunneling effect.

[27J2-7] 17:30~17:45

Micro-Raman Investigations of Free-standing GaAs/AlGaAs Single Quantum well (SQW) Microtubes

Yunxia Gao, Qi Wang, Zhihong Pan, Xiankun Wang, Hao Liu, and Xiaomin Ren

Beijing University of Posts and Telecommunications, China

The micro-Raman spectra of as-grown area SQW GaAs/AlGaAs shows 281, 378 cm^{-1} for GaAs-like LO, AlAslike LO of AlGaAs barrier, demonstrating two-mode behavior. For rolled-up microtubes, all LO modes shifted to lower frequencies.

Room A (101)

Session Title 28A1 / [T01] Fiber-based Sources
Date & Time Friday, 28 August, 09:00 ~ 10:15
Session Chair Kwanil Lee (KIST, Korea)

[28A1-1] 09:00~09:15

Formation Sequences of Noise-Like Pulse in Fiber Ring Cavity Configuration and Their Effect on the Partial Coherence

Seungjong Lee, Luis Alonso Vazquez-Zuniga, Youngchul Kwon, Hansol Kim, Dongyeul Lee, and Yoonchan Jeong

Seoul National University, Korea

We experimentally investigate the partially coherent nature of noise-like pulses (NLPs) generated from passively mode-locked fiber ring cavity, and emphasize that the coherence of NLPs can be completely different, depending on the NLP formation sequence.

[28A1-2] 09:15~09:30

Widely-Tunable Single-Frequency Yb-Doped Fiber Ring Laser

Hou Yubin, Wang Jing, Zhang Qian, Liu Jiang, and Wang Pu

Beijing University of Technology, China

We report a widely-tunable single-frequency Yb-doped fiber ring laser based on a loop mirror filter and a tunable filter with a wavelength tunable range of 17.5 nm and a linewidth of less than 2 kHz.

[28A1-3] 09:30~09:45

On the Efficiency of Self-Similar Pulse Evolution in Fiber Amplifiers with Gain Shaping

Sijia Wang[1], Lei Wang[1], Bowen Liu[2], Youjian Song[2], and Minglie Hu[2]

[1]China Academy of Space Technology, China, [2]Tianjin University, China

Influences of initial pulse parameters on self-similar evolution efficiency in fiber amplifiers with gain shaping are discussed. Optimal center wavelength, duration, negative chirp and triangular profile can minimize the gain-shaping disturbance and accelerate self-similar amplification.

[28A1-4] 09:45~10:00

CW High Power Dual Wavelength Switching in an Ytterbium Doped Coupled Cavity Fiber Laser

W. J. Lai and L. Wang

Nanyang Technological University, Singapore

We demonstrate CW dual wavelength switching in an Ytterbium doped coupled cavity fiber laser by changing the direction and power of the pump. Slope efficiencies of > 70% and output power of > 100W have been achieved.

[28A1-5] 10:00~10:15

Experimental Investigation on Laser Performance of Distributed Side-Pumping Fiber Amplifier

Cong Gao, Li Ni, Xiaolong Wang, Yuying Wang, Zhen Wang, Kun Peng, Zhihua Huang, Jianjun Wang, Feng Jing, and Aoxiang Lin

Chinese Academy of Sciences, China

1+1 type distributed-side pumping active fibers were fabricated. Pumped with 976 nm LD, over 1 kW output power was achieved at 1064 nm and 581 W power was launched into the coupling unit via one port.

Room B (102)

Session Title 28B1 / [T03] Terahertz Technologies and Applications III
Date & Time Friday, 28 August, 09:00 ~ 10:30
Session Chair Toshihiko Kiwa (Okayama University, Japan)

[28B1-1] 09:00~09:30 Invited Talk

Efficient Broadband THz Wave Generation Based on Organic Phenolic Electro-Optic Crystals

O-Pil Kwon, Seung-Heon Lee, Bong-Joo Kang, and Fabian Rotermund

Ajou University, Korea

Highly efficient broadband THz wave generations based on electro-optic phenolic molecular crystals are reviewed. As-grown phenolic quinolinium crystals exhibited large macroscopic nonlinearity and suitable crystal characteristics for THz wave generation.

[28B1-2] 09:30~10:00 Invited Talk

Novel THz-wave Detection Technique via Interaction between Optical Pumping Waves and THz-wave Generated by Cherenkov Phase Matching

Koji Suizu[1], Noaya Kaneko[1], Takuya Akiba[1], Katsuhiko Miyamoto[2], and Takashige Omatsu[2]

[1]Chiba Instutute of Technology, Japan, [2]Chiba University, Japan

THz-wave and optical waves in nonlinear optical process are strongly correlated. Thus, THz-wave information can be transferred to pump and signal wave. THz-wave generated by Cherenkov phase matching can be used as evanescentprobe at interface facet of the crystal. Phase shift and attenuation of reflected THz-wave has information of a sample set at the interface, so the information can be detected by optical analysis for pump and signal wave.

[28B1-3] 10:00~10:15

Polarization Independent and Optical-controlled Metamaterial Modulator in Terahertz Regime

Yang Bai and Kejian Chen

University of shanghai for Science and Technology, China

We demonstrated a polarization independent and optical-controlled terahertz wave modulator based on hybrid metamaterials. Experimental validations confirm an intensity modulation depth more than 90% by changing the pump power between 0 and 2.5 W, spanning 0.45-0.85 THz.

[28B1-4] 10:15~10:30

Broadband THz Vortex Pulse Generation by a Tsurupica Spiral Phase Plate

Katsuhiko Miyamoto[1], Bong Joo Kang[2], Won-Tea Kim[2], Fabian Rotermund[2], and Takashige Omatsu[1,2]

[1]Chiba University, Japan, [2]Ajou University, Korea

We demonstrate a broadband, highly intense 0.6-terahertz vortex pulse by utilizing a polymeric Tsurupica spiral phase plate.

Room C (103)

Session Title 28C1 / [T02] Nonlinear Optics
Date & Time Friday, 28 August, 09:00 ~ 10:30
Session Chair Dong-Il Yeom (Ajou University, Korea)

[28C1-1] 09:00~09:15

Second Harmonic Generation and Shaping of Contra-propagating Light Pulses in Negatively Dispersive Metamaterials

Alexander Popov[1], Sergey Myslivets[2], Alexander Kildishev[1], and Alexandr Korotkevich[3]

[1]Purdue University, USA, [2]Siberian Federal University, Russia, [3]University of New Mexico, USA

The possibility of great enhancement of short pulse second harmonic generation by employing phase matching of ordinary and backward electromagnetic waves in the metamaterials with mixed negative/positive spatial dispersion is demonstrated with numerical simulations.

[28C1-2] 09:15~09:30

Second-harmonic Generation of Near Ultraviolet Wavelength by Surface Nonlinearity Polarization

Jinhui Yuan[1,2], Xinzhu Sang[1], Xianting Zhang[1], Zhe Kang[1], Feng Li[2], Chongxiu Yu[1], and P. K. Alexander Wai[2]

[1]Beijing University of Posts and Telecommunications, China, [2]The Hong Kong Polytechnic University, Hong Kong

Second-harmonic generation of near ultraviolet wavelength by the surface nonlinearity polarization is experimentally demonstrated in a silica photonic crystal fiber. The maximum conversion efficiency of secondharmonic centered at 410 nm can be up to1.6×10^{-6}.

[28C1-3] 09:30~09:45

Analysis on Morphological Domain Changes at the Hexagonal Corner of MgO:SLN Crystals

Ju Won Choi[1], Do-Kyeong Ko[1], Nan Ei Yu[1], and Jung Hoon Ro[2]

[1]GIST, Korea, [2]Pusan National University, Korea

A mesospheric approach based on a simple microscopic 2D Ising model is developed to explain the macroscopic observation of 'asymmetric in-out domain wall motion' in (0001) plane of MgO:SLN single crystals.

[28C1-4] 09:45~10:00

Heat-Removal Wavelength-Conversion Module by Air-bubble Reduction

Masanobu Nonaka[1,2], Wataru Nagashima[1,2], Hwan Hong Lim[1], Sunao Kurimura[1], and Ichiro Shoji[2]

[1]National Institute for Materials Science, Japan, [2]Chuo University, Japan

We report improved thermal performance in the heat removal module for stable wavelength conversion, fabricated by a new method, air-bubble reduction. The quantitative relation between focusing position, normalized conversion efficiency and effective heat capacity is investigated.

[28C1-5] 10:00~10:15

Multi-component Chalcogenide Glasses for Mid-infrared Nonlinear Optics

T. Wang[1,5], K. Chamma[2], C. Smith[2], W. Chen[3], G. F. R. Chen[1], A. M. Agarwal[4], K. A. Richardson[2], and D. T. H. Tan[1]

[1]Singapore University of Technology and Design, Singapore, [2]University of Central Florida, USA, [3]National University of Singapore, Singapore, [4]Massachusetts Institute of Technology, USA, [5]Chinese Academy of Sciences, China

We report here a series of z-scan experiments of the third-order nonlinearity of three typical chalcogenide glasses (As_2S_3, As_2Se_3 and $Ge_{23}Sb_7S_{70}$) from the near-IR to mid-IR wavelengths for the first time. This work measured the n2 values of As_2S_3 tobe 1.3×10^{-14} cm^2/W, of As_2Se_3 to be 5×10^{-15} cm^2/W and of $Ge_{23}Sb_7S_{70}$ to be 6.75×10^{-15} cm^2/W at the wavelengths of 2600 nm.

[28C1-6] 10:15~10:30

Improved Sellmeier Equations of Undoped and Mg-doped Stoichiometric $LiNbO_3$ and $LiTaO_3$ from Visible to Mid-IR Region

Daiki Kato[1], Syota Nuki[1], Daisuke Gunji[1], Tatsuro Fukui[2], Yasunori Furukawa[2], and Ichiro Shoji[1]

[1]Chuo University, Japan, [2]OXIDE Corporation, Japan

We have succeeded in deriving accurate and simple Sellmeier equations for stoichiometric $LiNbO_3$ and $LiTaO_3$ available from visible to mid-IR region, based on the direct measurements of refractive indices and previously reported OPO experiments.

Room D (106)

Session Title 28D1 / [T04] High Power, High Energy Lasers II
Date & Time Friday, 28 August, 09:00 ~ 10:00
Session Chair Yong-Ho Cha (KAERI, Korea)

[28D1-1] 09:00~09:30 Invited Talk

Strong Electromagnetic Wave Generation and Electron Guidance on a Metal Wire Interacted with Intense Femtosecond Laser Pulses

Shuji Sakabe, Masaki Hashida, Shigeki Tokita, and Shunsuke Inoue

Kyoto University, Japan

Ultrafast field propagating along a metal wire driven by an intense femtosecond laser pulse has been measured by femtosecond electron deflectometry, and it is confirmed that electromagnetic surface waves guide laser-accelerated electrons along the wire.

[28D1-2] 09:30~09:45

Particle Acceleration with Laser and Applications

Kaniz Fatema Kakolee[1], Domenico Doria[2], and Marco Borghesi[2]

[1]GIST, Korea, [2]Queen's University, UK

The biological effectiveness of laser driven protons on cells at high dose rate in a single exposure has been studied. V79 cell lines were irradiated with laser driven protons.

[28D1-3] 09:45~10:00

Capture and Loss of Electron by MeV Ions Penetrating through Liquid Spray: Formation of Negative Ion and Neutral Atom Beams

Sargis Ter-Avetisyan[1,2], M. Borghesi[3], M. Schnürer[4], J. Bränzel[4], S. Jequier[5], and V. Tikhonchuk[5]

[1]IBS, Korea, [2]GIST, Korea, [3]The Queen's University of Belfast, UK, [4]Max Born Institute, Germany, [5]University Bordeaux, France

Charge changing processes of MeV ions penetrating through liquid spray is confirmed to be abundant source of various energetic negative ion and neutral atom beams its generic nature is demonstrated.

Room E (107)

Session Title 28E1 / [T05] Plasmonics and Metamaterials VIII
Date & Time Friday, 28 August, 09:00 ~ 10:15
Session Chair Hong-Gyu Park (Korea University, Korea)

[28E1-1] 09:00~09:15

MoS_2 Monolayers for Propagating Plasmon Emitter and Detector in Long Range

Hyun Seok Lee, Min Su Kim, Youngjo Jin, Gang Hee Han, Young Hee Lee, and Jeongyong Kim

Sungkyunkwan University, Korea

We used a hybrid configuration of monolayer MoS_2 and silver nanowires to demonstrate the coupling, propagation and imaging of surface plasmon polaritons. The results suggest highly efficient way of plasmonic nanophotonic circuits.

[28E1-2] 09:15~09:30

Graphene Plasmonics for Light Trapping and Tunable Absorption Enhancement

Jianfa Zhang, Zhihong Zhu, Wei Liu, Xiaodong Yuan, and Shiqiao Qin

National University of Defense Technology, China

We propose the usage of graphene plasmonics for light trapping and show that the excitation of localized plasmons in doped, nanostructured graphene can enhance absorption in surrounding materials by tens of times.

[28E1-3] 09:30~09:45

Photoinduced Nonlinear Mixing of Terahertz Dipole Resonances in Graphene Metadevice

Chihun In[1], Hyeon-Don Kim[2], Bumki Min[2], and Hyunyong Choi[1]

[1]Yonsei University, Korea, [2]KAIST, Korea

The plethora of nonlinear optical phenomena can offer an innovative route for developing subwavelength-scale optical components. Here, using graphene-integrated metadevices, nonlinear interaction between two electric dipole resonances is demonstratedby ultrafast terahertz spectroscopy.

[28E1-4] 09:45~10:00

Multimode Plasmonically Induced Transparency in Dual Coupled Graphene Ring Resonators

Xiushan Xia, Baojie Tang, Xiaosai Wang, and Jicheng Wang

Jiangnan University, China

The graphene-based multi-mode PIT device has been numerically investigated. The spectral response shows active control of the device through varying the Fermi energy of the graphene, which provides guideline for a compact high-performance PIT device.

[28E1-5] 10:00~10:15

Surface Plasmon Supermodes in Graphene Multilayers

Chengzhi Qin, Bing Wang, and Peixiang Lu

Huazhong University of Science and Technology, China

We investigate the effective indices and mode profiles theoretically and reveal the forming mechanisms of the supermodes in graphene multilayers. Out-of-phase coupling supermode possess both the lowest propagation loss and shortest mode wavelength.

Room F (108)

Session Title 28F1 / [T07] Optical Metrology and Sensing IX
Date & Time Friday, 28 August, 09:00 ~ 10:30
Session Chairs Terubumi Saito (Tohoku Institute of Technology, Japan)
Seung Kwan Kim (KRISS, Korea)

[28F1-1] 09:00~09:30 Invited Talk

Si Based Integrated Switchable Mode Convertor

Songnian Fu and Yu Yu

Huazhong University of Science and Technology, China

An on-chip switchable mode convertor compatible with WDM operation is proposed and experimentally demonstrated. By selecting input horizontal or vertical linear polarization, the input signal can be converted to either LP_{11} or LP_{01} mode over C-band.

[28F1-2] 09:30~09:45

Counting the Cycles of Light with an Optical Microresonator

John Jost[1], Tobias Herr[1,2], Caroline Lecaplain[1], Erwan Lucas[1], Victor Brasch[1], Martin Pfeiffer[1], and Tobias Kippenberg[1]

[1]École Polytechnique Fédérale de Lausanne, Switzerland, [2]Centre Suisse d'Electronique et de Microtechnique, Switzerland

Microresonator based optical frequency combs have the potential to greatly extend optical frequency measurements. Here we demonstrate the first self referenced microresonator based optical comb suitable for optical frequency metrology applications.

[28F1-3] 09:45~10:00

Improvement of Modulation speed in Si Slow Light Modulator by Optimizing Doping Profile

Moe Takeuchi, Yosuke Terada, and Toshihiko Baba

Yokohama National University, Japan

We theoretically investigated the modulation speed of Si photonic crystal slow light modulators. Optimizing the doping profile of p/n junction reduces the RC time constant and enhances the speed to 40 Gbps.

[28F1-4] 10:00~10:15

Polyimide Coated Fibre Bragg Grating Based Moisture Sensor Development

Adam Swanson[1,2], Sebastiampillai Raymond[1], Stefaan Janssens[1], Robert Breukers[1], Delower Bhuiyan[1], Jeremy Lovell-Smith[1], and Mark Waterland[2]

[1]Callaghan Innovation, New Zealand, [2]Massey University, New Zealand

The humidity and temperature characteristics of a 53 µm polyimide coated fibre Bragg grating (FBG) were investigated. The humidity response was 7.09 pm / %rh resulting in a coefficient of moisture expansion of 74.3 ppm /%rh. The temperature response was 12.8 pm / °C.

[28F1-5] 10:15~10:30

Temperature Compensation for Birefringent Filter-based Wavelength Measurement Systems

Jihong Liu, Chunhe Wang, Pengfei Ding, and Binzhang Zhang

Xi'an University of Posts and Telecommunications, China

Material-based thermal compensation and temperature monitoring are combined to improve the thermal stability of wavelength measurement systems. Experimental results show that the frequency drift can be reduced more than three orders of magnitude.

Room G (201)

Session Title 28G1 / [T01] Novel Lasers & Techniques
Date & Time Friday, 28 August, 09:00 ~ 10:15
Session Chair Kwang Jun Ahn (Ajou University, Korea)

[28G1-1] 09:00~09:30 Invited Talk

Novel Lasers in the Visible Spectral Range

Christian Kränkel[1,2], Daniel-Timo Marzahl[1], and Philip Werner Metz[1]

[1]Universität Hamburg, Germany, [2]The Hamburg Centre for Ultrafast Imaging, Germany

We report on blue semiconductor laser pumped solid-state lasers doped with different rare earth ions with emission wavelengths in the visible spectral range. Highly efficient, tunable and pulsed lasers are presented.

[28G1-2] 09:30~09:45

RIN of Hybrid Soliton Pulse Source with Sinusoidally Chirped Grating

Nuran Dogru and Erhan Ersoy

University of Gaziantep, Turkey

Hybrid soliton pulse sourse utilizing a sinusoidally chirped fiber Bragg grating (FBG) produces shorter pulses with and without noise than linearly chirped FBG as well as giving a RIN reduction at the fundamental frequency.

[28G1-3] 09:45~10:00

Lasing from Penrose Quasicrystal Made by Holographic polymer-Dispersed Liquid Crystals

D. Luo

South University of Science and Technology of China, China

Lasing emissions are obtained in a dye-doped two-dimensional Penrose photonic quasicrystal fabricated by all organic materials of holographic polymer dispersed liquid crystals. The linear polarization property of laser has been demonstrated. The directional dependence property of laser, whereas different directions of photonic quasicrystal correspond to different lasing spectra, was also studied. Our experiment showed that the lasing actions can be generated in two-dimensional Penrose photonic quasicrystal with even very small index contrast.

[28G1-4] 10:00~10:15

Simulation of 1550nm Mode Locked DBR Semiconductor Lasers Using Travelling Wave Equations

A. Çağlar Duman[1] and B. Bülent Çakmak[1,2]

[1]Erzurum Technical University, Turkey, [2]Atatürk University, Turkey

A distributed Bragg reflector (DBR) InGaAsP semiconductor laser with an absorber region was modelled using travelling wave equations. Thus, it was shown that optical pulses with ultrashort durations were obtained from a passively mode-locked laser.

Room H (202)

Session Title 28H1 / [T11] Plasmonics in Biophotonics
Date & Time Friday, 28 August, 09:00 ~ 10:30
Session Chair Chris Xu (Cornell University, USA)

[28H1-1] 09:00~09:30 Invited Talk

Superresolution Imaging Based on Nonlinearities of Plasmonic Scattering

Shi-Wei Chu[1], Yen-Ta Huang[1], Hsuan Lee[1], Ryosuke Oketani[2], Yasuo Yonemaru[2], Masahito Yamanaka[2], Satoshi Kawata[2], and Katsumasa Fujita[2]

[1]National Taiwan University, Taiwan, [2]Osaka University, Japan

We demonstrated novel non-bleaching contrast for super-resolution imaging based on saturation and on/off switching of scattering from plasmonic particles, for the first time. Our study opens up new paradigms for both plasmonics and super-resolution microscopy.

[28H1-2] 09:30~09:45

Broadband Enhanced Hyperspectral Coherent anti-Stokes Raman Scattering by Gold Shell Particles and Gold Surface

Baoshan Guo[1,2], Kevin Tsia[2], Jinjiang Xu[2], Wei Shi[1], and Jianquan Yao[1]

[1]Tianjin University, China, [2]HongKong University, Hong Kong

The gold shell particles and gold surface having a broadband plasmonic enhancing spectrum is demonstrated to enhance the forward and backward hyperspectral coherent anti-Stokes Raman scattering by enhancing the pump and broadband Stokes beam simultaneously.

[28H1-3] 09:45~10:00

Sub-diffraction Limted Imaging Based on Plasmonic Silver Nanodot Arrays

Taehwang Son, Yongjin Oh, Wonju Lee, Heejin Yang, and Donghyun Kim

Yonsei University, Korea

Blocks of metallic nanodot arrays enable image deconvolution using localized near-fields. Under total internal reflection, J774 cells were imaged on silver nanodot arrays. Sub-diffraction limited resolution was achieved in the range of 100-150 nm.

[28H1-4] 10:00~10:15

Optofluidic Guiding Based on Plasmonic Absorption

Jiajia Chen and Zhiwen Kang

The Chinese University of Hong Kong, Hong Kong, China

We demonstrate a novel microfluidic guiding technique by using plasmonic energy absorption in gold nano-islands produced by thermal annealing. Live cells and nanoparticles in aqueous medium can be readily guided with good speed control.

[28H1-5] 10:15~10:30

Real-time Single-molecule Co-immunoprecipitation Analyses Reveal Cancer-specific Ras Signaling Dynamics

Hong-Won Lee[1], Taeyoon Kyung[1], Janghyun Yoo[1], Tackhoon Kim[1], Chaeuk Chung[1], Ji Young Ryu[1], Hanki Lee[2], Kihyun Park[3], Sangkyu Lee[1], Walton D. Jones[1], Dae-Sik Lim[1], Changbong Hyeon[3], Won Do Heo[1,4], and Tae-Young Yoon[1]

[1]KAIST, Korea, [2]BioNanotechnology Research Center, Korea, [3]Korea Institute for Advanced Study, Korea, [4]Institute for Basic Science, Korea

The conventional co-immunoprecipitation provides static and qualitative information about protein-protein interactions. We report real-time imaging of coimmunoprecipitation process with single-molecule resolution, allowing for characterization of the native Ras proteins derived from individual cancers.

Room I (203)

Session Title 28I1 / [T13] Holographic Display
Date & Time Friday, 28 August, 09:00 ~ 10:30
Session Chairs Peter Tsang (City University of Hong Kong, Hong Kong, China)
Vladimir Saveljev (KIST, Korea)

[28I1-1] 09:00~09:30 Invited Talk

Video-rate Color Holographic Displays Using Doped Liquid Crystals

Yikai Su, Xiao Li, Pengcheng Zhou, Yan Li, and Chaoping Chen
Shanghai Jiao Tong University, China

Real-time holographic displays are achieved with dyedoped and quantum-dot doped liquid crystals. Reconstructed holographic videos at a refresh rate of 60 Hz are demonstrated by experiments with color multiplexing capability.

[28I1-2] 09:30~10:00 Invited Talk

3D Color Holographic Imaging by Wavefront Printing

Hoonjong Kang[1], Elena Stoykova[2], Youngmin Kim[1], Sunghee Hong[1], Joosup Park[1], and Jisoo Hong[1]
[1]Korea Electronics Technology Institute, Korea, [2]Bulgarian Academy of Sciences, Bulgaria

Design and implementation of a holographic wavefront printer with demagnification of the object beam is presented. The printer prints a white light viewable color analog hologram from a set of computer generated holograms displayed on an amplitude spatial-light modulator. We achieved bright 3D reconstruction with a motion parallax at saturated colors from holograms of test objects that were printed on a silver-halide emulsion.

[28I1-3] 10:00~10:15

Full-color 13-inch Electronic Holographic Display with 16.5 Megapixels

Woonchan Moon[1], Hwi Kim[2], and Joonku Hahn[1]
[1]Kyungpook National University, Korea, [2]Korea University, Korea

We propose a high-resolution electronic holographic system with eight high resolution liquid crystals. We use two large parabolic mirrors where one is for the collimation and the other is for focusing on the viewing window.

[28I1-4] 10:15~10:30

RGB Emitters by Optical Parametric Generation Using Nonlinear Waveguide

Hwan Hong Lim, Sunao Kurimura, and Kazufumi Fujii
National Institute for Materials Science, Japan

We demonstrated RGB laser sources by optical parametric-generation using first-order quasi-phasematched adhered slab waveguides with a periodically-poled Mg-doped stoichiometric lithium tantalate core. We also examined the extensible spectral bandwidth by chirped periods against speckle with simulation.

Room J (204)

Session Title 28J1 / [T12] Band-broadening Photonics
Date & Time Friday, 28 August, 09:00 ~ 10:15
Session Chairs Francisco M. Soares (Fraunhofer HHI, Germany)
Hyun-min Bae (KAIST, Korea)

[28J1-1] 09:00~09:30 Invited Talk

Material Platforms for Nonlinear Integrated Microwave Photonics

David Marpaung
University of Sydney, Australia

Harnessing nonlinear optical effects in a photonic chip scale has been proven useful for a number of key microwave photonic applications. Here we look at a number of material platforms that can serve as the ideal platform for nonlinear integrated microwave photonics.

[28J1-2] 09:30~09:45

Multiple Frequencies Microwave Measurement Using a Tunable Brillouin RF Photonic Filter

Hengyun Jiang[1,2], David Marpaung[1], Mattia Pagani[1], Lianshan Yan[2], and Benjamin Eggleton[1]
[1]University of Sydney, Australia, [2]Southwest Jiaotong University, China

A photonic scheme of instantaneous multiple microwave frequencies measurement is realized using a narrow-band tunable notch filter based on stimulated Brillouin scattering. Using this technique, estimation of multiple GHz microwave frequencies with errors lower than 250 kHz is achieved.

[28J1-3] 09:45~10:00

Enhanced Four-wave Mixing in a Compact Silicon-graphene Microring Resonator

Mengxi Ji[1], Like Deng[1], Yahui Cheng[1], Heng Cai[1], Jinsong Xia[1], Jinzhong Yu[1,2], and Yi Wang[1]
[1]Huazhong University of Science and Technology, China, [2]Chinese Academy of Sciences, China

Monolayer graphene is transferred onto a 10-μm-radius silicon microring. A 6.8-dB continuous-wave four-wave mixing conversion efficiency enhancement in the compact silicon-graphene microring is demonstrated, which is assisted by the nonlinearity of the monolayer graphene.

[28J1-4] 10:00~10:15

Tunable Wavelength Filters Based on Dual Polymer Bragg Gratings and a Mode Sorting Waveguide

Jin-Soo Shin[1], Chang-Hee Lee[1], Sang-Yung Shin[1], Tae-Hyun Park[2], Woo-Sung Chu[2], and Min-Cheol Oh[2]
[1]KAIST, Korea, [2]Pusan National University, Korea

Tunable wavelength filter is proposed and demonstrated by using Bragg reflector and asymmetric Xjunction, which is suitable for low-cost compact WDM application.

Room A (101)

Session Title 28A2 / [T01] Mid-IR OPOs & High-Power Fiber Lasers
Date & Time Friday, 28 August, 11:00 ~ 12:30
Session Chair Yoonchan Jeong (Seoul National University, Korea)

[28A2-1] 11:00~11:30 Invited Talk

Progress in 1-μm Pumped Mid-IR Optical Parametric Oscillators Based on Non-Oxide Nonlinear Crystals

Valentin Petrov

Max Born Institute, Germany

This talk reviews recent developments in singly-resonant optical parametric oscillators based on wide band-gap nonoxide nonlinear crystals pumped near 1 μm for generation of high energy and average power mid-IR (3-10 μm) pulses.

[28A2-2] 11:30~11:45

Single-End Pumped 2 kW All-Fiber Integrated Laser Oscillator with Near Diffraction Beam Quality

Xiaolin Wang, Jinyong Leng, Pu Zhou, Hanwei Zhang, Hailong Yu, Rumao Tao, Rongtao Su, and Xiaojun Xu

National University of Defense Technology, China

We report a monolithic laser oscillator with record power of 2 kW employing all-fiber format and single-end pump configuration. The optical to optical efficiency is 68.9% and beam quality M^2 factor is about 1.3.

[28A2-3] 11:45~12:00

Generation of 1.2-nJ, 62-fs, Chirp-Free Pulses Directly from a Yb-Doped Fiber Oscillator

Tesfay G. Teamir and F. Ömer Ilday

Bilkent University, Turkey

1.2-nJ, 62-fs, linear-chirp-free pulses are generated directly from a mode-locked fiber oscillator through optimized interaction of second- and third-order dispersion with self-phase modulation.

[28A2-4] 12:00~12:15

Quasi-CW Yb Fiber Laser with 3 kW Peak Power

Minjee Jeon[1], Yeji Jeong[1], Hoon Jeong[2], and J. W. Kim[1]

[1]Hanyang University, Korea, [2]KITECH, Korea

We report on a 3 kW quasi-cw Yb fiber laser with a 10 ms pulse width and a 10 Hz repetition rate by combining two Yb fiber lasers with a 1.5 kW peak power.

[28A2-5] 12:15~12:30

174 W, Linearly-Polarized, Flat-Top, All-Fiber Pulsed MOPA Seeded by a DSR Fiber Oscillator

Hailong Yu, Haibin Lv, Pengfei Ma, Rumao Tao, Xiaolin Wang, and Pu Zhou

National University of Defense Technology, China

We demonstrate an single-polarization all-fiber pulsed MOPA producing flat-top pulses with average power of 174 W, pulse energy of 51 μJ and peak power of 38.5 kW, which is seeded by one dissipative soliton resonance (DSR) fiber oscillator.

Room B (102)

Session Title 28B2 / [T03] Terahertz Technologies and Applications Ⅳ
Date & Time Friday, 28 August, 11:00 ~ 12:15
Session Chair O-Pil Kwon (Ajou University, Korea)

[28B2-1] 11:00~11:30 Invited Talk

THz Spectroscopic Analysis of Transparent Conductive Silver Nanowire Films

Hyeyoung Ahn

National Chiao-Tung University, Taiwan

The influence of thermal heating and oxidation on the percolational characteristics of silver nanowire films is investigated through the comprehensive measurements of terahertz spectroscopy.

[28B2-2] 11:30~12:00 Invited Talk

Terahertz Response of Electron Charge and Spin Studied by Time-domain Spectroscopy

Takeshi Nagashima

Setsunan University, Japan

THz time-domain spectroscopy is a powerful tool for investigating dynamics of electron charges and spins. Estimation of electrical properties of semiconductors and studies of coherent magnons in antiferromagnets are carried out by using THz-TDS.

[28B2-3] 12:00~12:15

Millimeter-Wave Antenna Using Metamaterial ELC Resonators on Electro-Optics Substrate

Ashif Aminulloh Fathnan[1], Yusuf Nur Wijayanto[1,2], Pamungkas Daud[1], Dadin Mahmudin[1], Atsushi Kanno[2], and Tetsuya Kawanishi[2]

[1]Indonesian Institute of Science, Indonesia, [2]National Institute of Information and Communications Technology, Japan

We propose and present millimeter-wave antennas using metamaterial ELC resonators on electro-optic substrates for wireless millimeter-wave receivers and optical modulators. Analysis for the antenna characteristics of the device are discussed at millimeter-wave frequency of 100GHz.

Room C (103)

Session Title 28C2 / [T09] Light Emitting Devices
Date & Time Friday, 28 August, 11:00 ~ 12:30
Session Chairs Sergey Ivanov (Ioffe Physics and Technique Institute, Russia)
Tien-chang Lu (National Chiao Tung University, Taiwan)

[28C2-1] 11:00~11:30 Invited Talk

Growth of Semipolar GaN Substrates by Hydride Vapor Phase Epitaxy on Patterned Sapphire Substrate

Kazuyuki Tadatomo[1], Takushi Inagaki[1], Narihito Okada[1], Keisuke Yamane[2], Hiroshi Furuya[3], and Yasuhiro Hashimoto[3]

[1]Yamaguchi University, Japan, [2]Toyohashi University of Technology, Japan, [3]Tokuyama Corpoation, Japan

The surface roughening and crack generation during the HVPE growth on the MOVPE-grown semipolar GaN template were successfully suppressed by using SiO_2 striped masks perpendicular to the a-axis on the semipolar GaN template. The growth toward the –c-direction during the MOVPE growth was also successfully suppressed by using the growth temperature control; this resulted in a large reduction in the formation of stacking faults in semipolar GaN.

[28C2-2] 11:30~12:00 Invited Talk

Extremely Low-resistivity and High-carrier-concentration Si-doped AlGaN with Low AlN Molar Fraction for Improvement of Wall Plug Efficiency of Nitride-based LED

Motoaki Iwaya[1], Daisuke Iida[1], Kunihiro Takeda[1], Toru Sugiyama[1], Tetsuya Takeuchi[1], Satoshi Kamiyama[1], and Isamu Akasaki[1,2]

[1]Meijo University, Japan, [2]Nagoya University, Japan

We discovered that Si-doped AlGaN with low AlN molar fraction has been used to realize an external low-resistivity n-layer at room temperature. This Si-doped n-Al0.05Ga0.95N underlying layer is extremely useful for the realization of high-performance nitride-based light emitting diodes. We also confirmed a reduction in the differential resistance of a violet light-emitting diode by using this n-AlGaN.

[28C2-3] 12:00~12:15

Enhanced Light Extraction Efficiency of AlGaN-based Deep-Ultraviolet Light-Emitting Diodes by Utilizing Strong Sidewall Emission

Jong Won Lee[1], Jun Hyuk Park[1], Dong Yeong Kim[1], Jungsub Kim[2], E. Fred Schubert[3], and Jong Kyu Kim[1]

[1]POSTECH, Korea, [2]Samsung Electronics, Korea, [3]Rensselaer Polytechnic Institute, USA

We demonstrate new design of Deep-UV LEDs extracting strong sidewall-emission redirect top direction. We observe considerably enhanced optical and improved electrical properties and expect this model can provide key idea in current DUV LEDs for enhancing light extraction efficiency.

[28C2-4] 12:15~12:30

Optimization of p-Electrode Pattern for AlGaN-based Deep-Ultraviolet Light-Emitting Diodes

Guo-Dong Hao, Manabu Taniguchi, Kousei Nakaya, and Shin-Ichiro Inoue

National Institute of Information and Communications Technology, Japan

We studied on various p-electrode patterns to solve current crowding problem in AlGaN-based deep-ultraviolet light-emitting diode. Simulation results of optimized pelectrode pattern showed a uniform current density distribution and improved performance of light output power.

Room D (106)

Session Title 28D2 / [T10] Micro/Nanophotonics
Date & Time Friday, 28 August, 11:00 ~ 12:00
Session Chair Ki-Hun Jeong (KAIST, Korea)

[28D2-1] 11:00~11:30 Invited Talk

Single-mode Parity-time-symmetric Micro-ring Lasers

Mercedeh Khajavikhan, H. Hodaei, M. A. Miri, and D. Christodoulides

University of Central Florida, USA

Parity-time (PT) symmetry has been recently emerged as a new paradigm for mode management in micro-cavity lasers. Single-mode lasing is demonstrated in longitudinally and transversely multi-moded PT-symmetric micro-ring arrangements.

[28D2-2] 11:30~11:45

Particle Propulsion Using Higher Order Microfiber Modes

Maimaiti Aili[1,2], Viet Giang Truong[1], Marios Sergides[1], Ivan Gusachenko[1], and Sile Nic Chormaic[1]

[1]Okinawa Institute of Science and Technology Graduate University, Japan, [2]University College Cork, Ireland

Propulsion of polystyrene particles in the evanescent field of the first group of higher order modes in an optical microfiber were studied. Higher speeds were observed for higher order mode propulsion than for fundamental mode.

[28D2-3] 11:45~12:00

FRET-mediated Wavelength Conversion for Enhanced Solar Cell Efficiency

Xi Ding and Yu-Chueh Hung

National Tsing Hua University, Taiwan

We report an efficient Förster resonance energy transfer (FRET) realized in biopolymer thin films. Via FRET, shorter wavelengths of solar light are down-shifted which may result in enhanced light absorption by Si solar cells.

Room E (107)

Session Title 28E2 / [T05] Plasmonics and Metamaterials IX
Date & Time Friday, 28 August, 11:00 ~ 12:30
Session Chair Hong-Gyu Park (Korea University, Korea)

[28E2-1] 11:00~11:15

Fiberized Plasmonic Fresnel Zone Plate for Wavelength Dependent Position Tunable Optical Trapping

Hyuntai Kim, Luis Alonso Vazquez-Zuniga, Jinseob Kim, Kyoungyoon Park, Dongyeul Lee, Seungsoo Hong, and Yoonchan Jeong

Seoul National University, Korea

We propose a Fresnel metal plate on top of a fiber facet for wavelength-dependent position tunable optical trapping. We achieved a tunable trapping range of 10.79 μm among a wavelength shift of 505 nm.

[28E2-2] 11:15~11:30

Analysis of Plasmonic Mach-Zehnder Modulator with Metal Taper Structure Embedded in FTC-EO Polymer

Naoya Hojo, Tomohiro Amemiya, Zhichen Gu, Nobuhiko Nishiyama, and Shigehisa Arai

Tokyo Institute of Technology, Japan

We analyzed a Mach-Zehnder plasmonic modulator with metal-insulator-metal structure embedded by the FuranThiophene Chromophore. π-phase shift between two Mach-Zehnder arms can be obtained with a device length of 6.5 μm and the figure of merit of 3.1.

[28E2-3] 11:30~11:45

Gain-assisted Propagation of Surface Plasmons in Nanodisk Resonator

Genquan Han, Yan Liu, and Jing Yan

Chongqing University, China

Gain medium is introduced into the nanodisk resonator to enable loss-negligible surface plasmon polaritons propagation in near-infrared wavelengths, which benefits the applications of switches and lasers based on SPPs in the planar optoelectronic densely integration.

[28E2-4] 11:45~12:00

Optical Properties of Metallic Nanocuboid Dimer Connected by Conductive Bridge

Mingsi Zhang, Yudong Li, Jingjun Xu, and Qian Sun

Nankai University, China

When a conductive bridge is inserted into metallic dimer, the charge transfer and the boding dimer plasmon mode can redshift and blueshift hundreds nanometers by shifting the bridge less than 50 nm, respectively.

[28E2-5] 12:00~12:15

Layered Semiconductor GeS: a Metamaterial With Extremely Low Refractive Index

Abdurrahman Ozturk[1] and Rauf Suleymanlİ[2]

[1]Marmara University, Turkey, [2]Gebze Technical University, Turkey

Reflection and transmission optical spectra of layered semiconductor GeS are investigated. It is shown, that this semiconductor can be considered as natural metamaterial with extremely low, n=0.14, refractive index in wide spectral region, λ =0.8-1.0 μm.

[28E2-6] 12:15~12:30

The Meaning of Enhancement in Hybrid Horizontal Slot Microdisk Whispering Gallery Mode Resonator with Gold Particles

Nabila Khrisna Dewi and Jung H. Shin

KAIST, Korea

Horizontal slot microdisk resonator attached with gold particles is simulated using FDTD resulting hotspot existence in the vicinity of gold. The field enhancement is detected, especially for diameter less than 8 um.

Room F (108)

Session Title 28F2 / [T07] Optical Metrology and Sensing X
Date & Time Friday, 28 August, 11:00 ~ 12:30
Session Chair In-Ho Bae (KRISS, Korea)

[28F2-1] 11:00~11:15

Unfolding of Optical Singularities in Vector Laguerre-Gaussian beams

Sunil Vyas[1], Yuichi Kozawa[2], Shunichi Sato[2], and Yoko Miyamoto

[1]The University of Electro-Communication Tokyo Japan, Japan, [2]Tohoku University, Japan

An analysis of unfolding of inhomogenous polarization distribution of the vector Laguerre-Gaussian beam into polarization singular structure is presented. A linearly polarized Gaussian beam is used as a reference beam to probe the vector singular behavior of the beam. It is found that the singularity at the center of the beam disappear and it appears as the peripheral V-points with characteristic polarization distribution. Different kinds of V-point singularity is observed in the beam cross section. During propagation these vector singularities transformed into polarization singularity triplets. The present result have important implication in understanding the finer structural details of the cylindrically polarized vector beams.

[28F2-2] 11:15~11:30

Estimation of Refractive Index of Crystal Plate from Haidinger Fringes

Ryu Jun Yeol[1], Choi Hee Joo[1], Lee Choong Hwan[1], Jin Jonghan[2,3], and Cha Myoungsik[1]

[1]Pusan National University, Korea, [2]KRISS, Korea, [3]Korea University of Science and Technology, Korea

We proposed and realized an accurate method for measuring the refractive index and physical thickness of a transparent wafer by analyzing the Haidinger fringes. Simply, we took transmitted Haidinger fringes caused by multiple reflections at the back and rear surfaces of the wafer, which worked as a Fabry-Perot eatlon. The refractive index was determined by analyzing the interferogram obtained in terms of an incidence angle at a single-shot. Based on the proposed method, the absolute value of the refractive index of a $LiNbO_3$ wafer was estimated with an overall uncertainty of 10^{-4}.

[28F2-3] 11:30~11:45

Cosine Apodization of In-Fiber Acousto-Optic Gratings for Sensing Application

Kwang Jo Lee[1] and Hyun Chul Park[2]

[1]Kyung Hee University, Korea, [2]POSCO, Korea

We present a novel cosine-apodization scheme for optical fiber-based acousto-optic gratings. The technique is based on the modulation of coupling strength by the combination of fiber twist and input acoustic polarization.

[28F2-4] 11:45~12:00

All-Fiber Variable Polarization Rotator Based on Geometric Effects

Il-Kyu Han, Jaekwon Ko, and Byoung Yoon Kim

KAIST, Korea

We demonstrate a simple all-fiber variable polarization rotator based on geometric effects. The device rotates the orientation of polarization minimizing the change in other parameters of the polarization state. The rotation angle is controlled by a simple mechanical adjustment.

[28F2-5] 12:00~12:15

Strain Characteristics of a Photonic Crystal Fiber with Two Birefringent Cores in the Sagnac Loop

Youngjoo Chung and Khurram Naeem

GIST, Korea

We experimentally investigated the strain sensing characteristics of two types of the high-birefringent two-core photonic crystal fibers (HB-TCPCF) in the Sagnac loop configuration using phase-monitoring method, where each elliptic core in a typical birefringent fiber independently forms a distinct Sagnac loop interferometer.

[28F2-6] 12:15~12:30

Radiation in 45-Degree tilted Fiber Bragg Gratings

Nai-Hsiang Sun[1], Shih-Cing Lei[1], Yu-Wei Liu[1], Jung-Sheng Chiang[1], and Wen-Fung Liu[2]

[1]I-Shou University, Taiwan, [2]Feng Chia University, Taiwan

Surface-normal radiation of 45° tilted fiber gratings are fabricated and measured. A 3-minute exposure time of tilted FBGs can cause -15 dB radiation efficiency, while a 1.5-minute exposure time can create the radiated efficiency of -16.2 dB.

Room G (201)

Session Title 28G2 / [T01] Optical Mode Control
Date & Time Friday, 28 August, 11:00 ~ 12:15
Session Chair Jiwon Kim (Hanyang University, Korea)

[28G2-1] 11:00~11:15

High Efficient Frequency Doubling of Optical Vortex

Yuta Sasaki[1], Taximaiti Yusufu[1,2], Katsuhiko Miyamoto[1], and Takashige Omatsu[1,2]

[1]Chiba University, Japan, [2]CREST Japan Science and Technology Agency, Japan

We present the first demonstration of the ultrahighly efficient second harmonic generation of an optical vortex pulse. An optical-optical efficiency of >70% frequency- doubled vortex output was obtained.

[28G2-2] 11:15~11:30

Transverse Mode Control of a Nd:YAG Laser Using an Acousto-Optic Modulator

E. J. Park, D. J. Kim, and J. W. Kim

Hanyang University, Korea

A simple technique to control the transverse beam profile employing an acousto-optic modulator in the secondary cavity of a solid state laser systemis reported.

[28G2-3] 11:30~11:45

Conversion of Orbital Angular Momentum in Helical Long-Period Fiber Gratings

Xiaoqiang Zhang and Anting Wang

University of Science and Technology of China, China

In this paper, we use an UV-side exposure method to obtain a helical long-period fiber grating (H-LPG) which can generate and convert the optical vortices (OVs). The H-LPG is obtained by rotating fiber which is three layer during single-side UV exposure. The H-LPG is directly inscribed on the central layer of the ring-core-fiber (RCF). Using this fiber the order of the OVs can be adjusted efficiently and we can get higher order vortices easily.

[28G2-4] 11:45~12:00

Coupled Multicore Fibers in the High Power Regime: Impact of Core Size Mismatch

Henrik Tünnermann and Akira Shirakawa

University of Electro-Communications, Japan

The impact of core diameter mismatch in multicore fibers in the context of the Kerr nonlinearity is analyzed. A mismatch decreases the stability of the even mode. The odd mode is unaffected.

[28G2-5] 12:00~12:15

Passively Q-switched and Cylindrical Vector Fiber Laser

Lin Zou, Yao Yao, and Jianlang Li

Chinese Academy of Sciences, China

We demonstrated a passively Q-switched Yb-doped fiber laser that emitted azimuthally polarized pulse with high efficiency and high output power. The polarization discrimination mechanism by utilizing a single lens and a birefringent crystal was developed.

Room H (202)

Session Title 28H2 / [T11] In vivo and In vitro Methods
Date & Time Friday, 28 August, 11:00 ~ 12:30
Session Chair Shi-Wei Chu (National Taiwan University, Taiwan)

[28H2-1] 11:00~11:30 Invited Talk

In Vivo Multiphoton Imaging of Mouse Brain

Chris Xu

Cornell University, USA

3-photon microscopy at the long wavelength spectral windows is well suited for deep imaging within scattering biological tissues. In vivo 3-photon imaging of neuronal structure and function deep within an intact mouse brain is presented.

[28H2-2] 11:30~12:00 Invited Talk

Intravascular Photoacoustic Tomography for Characterization of Atherosclerotic Lipid and Inflammation

Sihua Yang, Jian Zhang, Yue Zhao and Da Xing

South China Normal University, China

This study sought to examine whether intravascular photoacoustic tomography (IVPAT) allows localization and quantification of lipid content in atherosclerotic plaques.

[28H2-3] 12:00~12:15

Seeing an Explosive Way of NSF/SNAP-mediated SNARE-complex Disassembly Using Single-molecule Measurements

Je-Kyung Ryu[1], Duyoung Min[1], Sang-Hyun Rah[1], Haesoo Kim[1], Reinhard Jahn[2], and Tae-Young Yoon[1]

[1]KAIST, Korea, [2]Max-Planck-Institute for Biophysical Chemistry, Germany

N-ethylmaleimide-sensitive factor (NSF) and alpha soluble NSF attachment protein (α-SNAP) disassemble the SNAP receptor (SNARE) complex for recycling of the SNARE proteins. Using single-molecule fluorescence and force spectroscopy, we found that NSF appears to use a "spring-loaded" mechanism.

[28H2-4] 12:15~12:30

In-fiber Photo-immobilized Bioactive Surfaces for Liposome Tethering

Derrick Yong[1,2], Elizabeth Lee[1], Kwang Yong Lee[2], Yi Yang Tan[2], Xia Yu[1], Chi Chiu Chan[2], Quan Liu[2], and Chenjie Xu[2]

[1]Singapore Institute of Manufacturing Technology, Singapore, [2]Nanyang Technological University, Singapore

The in-fiber surface-attachment of dye-loaded liposomes is demonstrated. This was achieved via in-fiber lightinduced biotin-functionalization, enabling the subsequent sandwiching of streptavidin with biotinylated-liposomes. Liposomes were then probedthrough in-fiber fluorescence spectroscopy.

Room I (203)

Session Title	28I2 / [T13] Optical Storage and Information Processing
Date & Time	Friday, 28 August, 11:00 ~ 12:15
Session Chairs	Hoonjong Kang (KETI, Korea)
	Jae-Hyeung Park (Inha University, Korea)

[28I2-1] 11:00~11:30 Invited Talk

Encryption and Data Embedding of Error Diffusion Hologram

Peter Tsang

City University of Hong Kong, Hong Kong, China

A fast method for converting a complex hologram into an encrypted data embedded phase-only hologram (POH) is described. Both the hologram and the embedded data can only be retrieved with the correct encryption key.

[28I2-2] 11:30~11:45

Optical Beam and Operator in Low Dimensional Space

Shifeng Li, Gang Zhao, Yiqiang Qin, Xinjie Lv, and Shining Zhu

Nanjing University, China

The concept of low dimensional optical beam and operator are proposed. Beam and operator can be decomposed to orthogonal low dimensional beams and operators through the singular value decomposition method. Storage space can be saved.

[28I2-3] 11:45~12:00

Simultaneous 10 Gbit/s 4-PAM Wired Signal and 1 Gbit/s MB-UWB Wireless Signal Downstream Transport in WDM-PON

Huan Ma, Fei Wang, Weibin Wang, Xin Zhang, and Qiong Yu

Chongqing University of Technology, China

Simultaneously transport multi-band ultra-wideband (MB-UWB) wireless signal and multi-level wired signal over single wavelength in wavelength-division multiplexing passive optical network (WDM-PON) is proposed, which can greatly improve spectrum efficiency and transmission ability of optical infrastructure.

[28I2-4] 12:00~12:15

Wavelets for Multiview Imaging

Vladimir Saveljev[1,2]

[1]Hanyang University, Korea, [2]KIST, Korea

Considering the previously proposed reference functions for multiview and integral images as scaling functions of a wavelet transform, the multiview wavelets are proposed.

Room J (204)

Session Title	28J2 / [T12] Nano Grating Lasers
Date & Time	Friday, 28 August, 11:00 ~ 12:30
Session Chairs	David Marpaung (University Sydney, Australia)
	Min-cheol Oh (Pusan National University, Korea)

[28J2-1] 11:00~11:30 Invited Talk

A Fully Analog Electronic Dispersion Compensator for 10-Gb/s Directly Modulated Distributed-Feedback Lasers

Kyeongha Kwon, Jonghyeok Yoon, Hyosup Won, and Hyeon-Min Bae

KAIST, Korea

This paper presents the design of an electronic dispersion compensator (EDC) for 10-Gb/s directly modulated distributed-feedback (DM-DFB) lasers. The proposed EDC overcomes the chirp-induced dispersion and achieves 2x reach extension in SMF-28 optical fiber.

[28J2-2] 11:30~11:45

Room-temperature Continuous-wave Operation of λ/4-shifted Membrane Distributed Feedback Lasers

Takahiro Tomiyasu, Daisuke Inoue, Takuo Hiratani, Yuki Atsuji, Tomohiro Amemiya, Nobuhiko Nishiyama, and Shigehisa Arai

Tokyo Institute of Technology, Japan

We realized λ/4-shifted membrane DFB lasers for an ultralow threshold current operation. A threshold current of 280 μA was obtained for the cavity length of 30 μm under room-temperature continuous-wave condition.

[28J2-3] 11:45~12:00

A Sub-microwatt Threshold Raman Silicon Laser Using a High-Q Nanocavity

Daiki Yamashita[1], Yasushi Takahashi[1], Takashi Asano[2], and Susumu Noda[2]

[1]Osaka Prefecture University, Japan, [2]Kyoto University, Japan

We develop a nanocavity Raman Si laser with a submicrowatt threshold of 0.52 μW by accurately matching a frequency spacing of the two nanocavity modes to the Raman shift of Si nanocavity.

[28J2-4] 12:00~12:15

Radio Frequency Signal Stability Study of the Dual-Wavelength DFB Laser

Yi-Chia Hwang, Jen-Hung Huang, Bai-Ci Chen, Yao-Zhong Dong, Shun-Chieh Hsu, and Chien-Chung Lin

National Chiao Tung University, Taiwan

The peak frequency stability in the time domain is examined in the monolithic and discrete component conditions. The RF peak drift is two times less in the monolithic case than that of the discrete component.

[28J2-5] 12:15~12:30

Cut-off Frequency Enhancement of Light-Emitting Transistor under Illumination

Shan Fong Leong, Yuan-Fu Hsu, and Chao-Hsin Wu

National Taiwan University, Taiwan

A monolithic-integrated device with light-emitter and photodetector in light-emitting transistor (LET) format is fabricated. The electrical speed, i.e. cut-off frequency, of the LET is found to be modulated and enhanced by the selfaligned optical input.

Poster Session I (Exhibition Hall / Wednesday, 26 August, 13:45~15:15)

[26P-1] Q-Switching of Yb:KLu(WO_4)$_2$ Lasers with Graphene Saturable Absorbers

J. M. Serres[1], P. Loiko, X. Mateos[1], K. Yumashev[2], V. Petrov, U. Griebner, M. Aguiló[1], and F. Díaz[1]

[1]Universitat Rovira I Virgili, Spain, [2]Belarusian National Technical University, Belarus, [3]Max-Born-Institute for Nonlinear Optics and Ultrafast Spectroscopy, Germany

A diode-pumped Q-switched Yb:KLu(WO_4)$_2$ mini-laser generated a maximum average output power of 170 mW at 1030 nm. The shortest pulse duration was 165 ns at a pulse repetition rate of 350 kHz.

[26P-2] Halide Gas-Phase-Doping Technique to Fabricate Large-Mode-Area Laser Fiber

Kun Peng[1,2], Yuying Wang[1], Li Ni[1], Zhen Wang[1,2], Cong Gao[1], Huan Zhan[2], Jianjun Wang[1], Feng Jing[1], and Aoxiang Lin[1]

[1]China Academy of Engineering Physics, China, [2]Chinese Academy of Sciences, China

By using rare-earth-halide gas-phase-doping technique, we fabricated Yb-doped large-mode-area fiber preform. Yb concentration is of ~9500ppmw in core area and 951W@1064nm laser output was obtained with a slope efficiency of 83.3%.

[26P-3] Diode-Pumped Kerr-Lens Mode-Locked Femtosecond Yb:YAG Ceramic Laser

Ziye Gao[1], Jiangfeng Zhu[1], Junli Wang[1], and Zhiyi Wei[2]

[1]Xidian University, China, [2]Chinese Academy of Sciences, China

We experimentally demonstrated a diode-pumped pure Kerr-lens mode-locked femtosecond laser based on a Yb:YAG ceramic. Pulses with 97 fs pulse width, 2.8 nJ pulse energy and 320 mW average power were obtained.

[26P-4] Diode-Pumped Mode-Locked Picosecond Nd,Y-Codoped:SrF_2 Laser

Václav Kubeček[1], Michal Jelínek[1], Miroslav Čech[1], David Vyhlídal[1], Liangbi Su[2], Dapeng Jiang[2], Fengkai Ma[2], Qian Zhang[2], Yuexin Cao[2], and Jun Xu[2]

[1]Czech Technical University in Prague, Czech Republic, [2]Chines Academy of Sciences, China

Passively-mode-locked operation of Nd,Y:SrF_2 laser pumped by low-power-laser-diode at 796 nm is reported. The continuous pulse train with total output power of 100 mW and pulse duration of 1.5 ps at 136 MHz was generated.

[26P-5] Numerical Study on Spectral Coherence of Noise-Like Pulses in a Fiber Ring Cavity Configuration

Youngchul Kwon, Seungjong Lee, Kyoungyoon Park, Dongyeul Lee, Luis Alonso Vazquez-Zuniga, and Yoonchan Jeong

Seoul National University, Korea

We numerically investigate the noise-like pulse (NLP) operation in a simply modelled fiber ring cavity. Under the different cavity conditions, we verify how the spectral coherence of the NLP is altered.

[26P-6] Wavelength-Selectable Visible Operation in a Miniature Crystalline Ramanlaser

Xiaoli Li

Beijing University of Technology, China

We demonstrate a miniature crystalline Raman laser operating at three discretely-tunable wavelengths in the green-yellow. Over 200 mW output powers were obtained for each wavelength with 3.8 W pumping. The threshold is below 0.4 W.

[26P-7] Investigation of Thermooptical Effects in a High-Brightness Yb:KGW Laser

J. Yang[1], G. H. Kim[1], B. Lee[1], E. G. Sall[1], S. A. Chizhov[1], V. E. Yashin[2], and U. Kang[1]

[1]KERI, Korea, [2]S. I. Vavilov State Optical Institute, Russia

The thermo-optical effects in the diode-end-pumped lasers with Yb:KGW anisotropic crystals is experimentally investigated. Strong dependence of optical power and aberrations of the lenses on orientation of laser crystals concerning a direction of laser radiation propagation and a polarization direction is confirmed. By optimizing the crystal configuration we obtained a high-power output laser beams with the high spatial quality M2 close to unit in Q-switched mode and at regenerative amplification of chirped pulses.

[26P-8] Tm,Ho:KLu(WO_4)$_2$ Microchip Laser Q-Switched by a Cr^{2+}:ZnS Saturable Absorber

P. Loiko[1], J. M. Serres[2], X. Mateos[2], K. Yumashev[1], V. Petrov[3], U. Griebner[3], M. Aguiló[2], and F. Diaz[2]

[1]Belarusian National Technical University, Belarus, [2]Universitat Rovira i Virgili, Spain, [3]Max-Born-Institute for Nonlinear Optics and Ultrafast Spectroscopy, Germany

A diode-pumped Tm,Ho:KLu(WO_4)$_2$ microchip laser Q-switched by a Cr^{2+}:ZnS saturable absorber generated average output power of 131 mW at 2061 nm. The shortest pulses had duration of 9 ns and energy of 10 µJ.

[26P-9] A Design of Symmetrically Phase-Shifted FBG Structures with Improved Transmission Characteristics for Dual-Wavelength Fiber Lasers

Xu Ou and Han Yishi

Guangdong University of Technology, China

An improved approach is presented for a two symmetrically phase shifted structure based on FBGs. A step-apodized profile is designed to raise the transmission of peaks, which can help lasing building in dual-wavelength fiber lasers.

[26P-10] The Feasibility of Multi-Wavelength Lasers Fabricated Using Femtosecond Laser Pulses

Yuwen Duan, Xi Chen, and Ru Zhang

Beijing University of Posts and Telecommunications, China

We discuss the feasibility of multi-wavelength lasers fabricated using femtosecond laser pulses. A stable and narrow linewidth (<10 pm) dual-wavelength waveguide laser with the spacing between two lasing wavelength of ~ 140 pm is reported.

[26P-11] Revisiting Low Frequency Fluctuations in High Power Multi-Mode Laser Diodes Subject to Filtered Optical Feedback

Fadwa Baladi[1], Min Won Lee[1], Jean-René Burie[2], Mauro A. Bettiati[2], Azzedine Boudrioua[1], and Alexis P. A. Fischer[1]

[1]Université Paris 13, France, [2]3S Photonics Technologies, France

A highly detailed and extended map of low frequency fluctuations is established for a high power multi-mode 980nm laser diode subject to filtered optical feedback from a fibre Bragg grating. The low frequency fluctuations limits and substructures exhibit substantial differences with previous works.

[26P-12] Double Cladding Dispersion Compensating Photonic Crystal Fiber with High and Birefirngence

Yong Soo Lee[1], Chung Ghiu Lee[2], and Soeun Kim[1]

[1]GIST, Korea, [2]Chosun University, Korea

We proposed double cladding photonic crystal fibers based on dual lattice structure which has high and flattened birefringence. Using double cladding structure of square lattice, high flat birefringence and negative flat dispersion can be achieved atthe same time over wide wavelength region including S, C and L bands.

[26P-13] Mode Analysis of Tunable Single Longitudinal Mode Tm-Doped Fiber Ring Laser

Jae-Keun Yoo[1,2], Sun Do Lim[1,2], and Seung Kwan Kim[1]

[1]KRISS, Korea, [2]Korea University of Science and Technology, Korea

Longitudinal modes of a tunable Tm-doped fiber ring laser with/without an unpumped Tm-doped fiber as a saturable absorption grating are analyzed using an all-fiber scanning ring resonator. Temporal characteristics of the laser are also discussed.

[26P-14] Efficient Sum-Frequency Generation of a Yb Fiber Laser and an Er, Yb Fiber Laser Using an External Resonant Cavity

J. H. Lee and J. W. Kim

Hanyang University, Korea

We report efficient sum-frequency generation of a Yb fiber laser at 1064 nm and an Er, Yb fiber laser at 1550 nm by employing a bow-tie resonant cavity system.

Poster Session I (Exhibition Hall / Wednesday, 26 August, 13:45~15:15)

[26P-15] Sub-10 ps, 700 kW Peak-Power Pulses from a Nonlinearly Compressed All-Fiber MOPA System

Ryutaro Yamashita[1], Kazuo Maeda[1], Goro Watanabe[1], Kazuyoku Tei[1], Shigeru Yamaguchi[1], Jun Enokidani[2], and Shin Sumida[2]

[1]Tokai University, Japan, [2]OPT-i Co., Ltd., Japan

We demonstrate sub-10-ps pulse generation by nonlinear compression of pulses from an all-fiber-MOPA. The architecture supports wide range in pulse width, 8 ps to 2 ns. The shortest pulse has 700 kW peak power and <0.15 nm line width.

[26P-16] High Power Monolithic Linearly Polarized Narrow Linewidth Single Mode Fiber Laser at 1064 nm

Wei Shi[1,4], Qiang Fang[2,3,4], Jingli Fan[1,2], Ting Qu[2,3], and Xiangjie Meng[2,3]

[1]Tianjin University, China, [2]Shangdong HFB Photonics Co., Ltd., China, [3]Tianjin Optera Laser Technology Co., Ltd., China, [4]Tianjin Institute of Modern Laser & Optics Technology, China

We report a high power, narrow linewidth, linearly polarized, MOPA based fiber laser at 1064.46 nm with 520W average power, 30 GHz linewidth, 18 dB polarization extinction ratio, 88.7% slope efficiency, and diffraction-limited beam quality.

[26P-17] 85-W 2015-nm Single-Frequency Thulium-Doped All-Fiber Laser Amplifier

Kyung-Hyun Lee[1,2], Yonghee Kim[3], Yong-Ho Cha[3], Gwon Lim[3], Hyunmin Park[3], Hyuck Cho[2], and Do-Young Jeong[3]

[1]Duchembio Institute, Korea, [2]Chungnam National University, Korea, [3]KAERI, Korea

We report on the development of 2015-nm single-frequency Thulium-doped fiber amplifiers. The average output power is 85 W, and the slope efficiency is 54%. The laser linewidth is 20 MHz.

[26P-18] Stable and Amplitude-Equalized Rational Harmonic Mode-Locked Short-Cavity Fiber Laser Using a Bismuth-Oxide-Based Highly Nonlinear Erbium-Doped Fiber

Yutaka Fukuchi and Akihiro Enda

Tokyo University of Science, Japan

We demonstrate a rational harmonic mode-locked fiber laser employing a 151-cm-long bismuth-oxide-based highly nonlinear erbium-doped fiber. The cavity length is as short as 6 m. Stable and amplitude-equalized short pulses up to 40GHz are obtained.

[26P-19] Flat Optical Frequency Comb Generation from an Actively Mode-Locked Short-Cavity Fiber Laser Using a Bismuth-Based Highly Nonlinear Erbium-Doped Fiber

Yutaka Fukuchi, Kouji Hirata, and Joji Maeda

Tokyo University of Science, Japan

We generate frequency comb from a 10-GHz actively mode-locked laser using a bismuth-based highly nonlinear erbium-doped fiber and an optical filter with a rectangular filter profile. Flat 20 comb lines within 3-dB variation are obtained.

[26P-20] Fluorescence Resonance Energy Transfer (FRET) in Random Dye Lasers

Wan Zakiah Wan Ismail[1,2,3], Ewa M. Goldys[1] and Judith M. Dawes[1,2]

[1]Macquarie University, Australia, [2]ARC Centre of Excellence for Ultrahigh Bandwidth Devices for Optical Systems, [3]Islamic Science University of Malaysia, Malaysia

We demonstrate the effect of fluorescence resonance energy transfer on the emission spectra and threshold of Rhodamine 6G / methylene blue / titania random lasers. Rhodamine 6G enhances the laser emission of methylene blue at ~700 nm.

[26P-21] Impact of Cascading on the Efficiency of External Cavity CW Raman Laser

Soumya Sarang, Robert J. Williams, Ondrej Kitzler, Aaron McKay, Hadiya Jasbeer, and Richard P. Mildren

Macquarie University, Australia

Factors affecting the output efficiency of an external cavity quasi-cw KYW Raman laser were investigated. We show that a major limit to efficiency, in addition to thermal effects, results from a cascading effect involving a secondary Raman mode of KYW at 87 cm^{-1}.

[26P-22] Temperature Rise Measurement from Lasing Spectrum in a Diode Pumped Yb:YAG Crystal

Won-Kyo Jung[1], Changhwan Lim[2], and Hee-Jong Moon[1]

[1]Sejong University, Korea, [2]KAERI, Korea

A temperature measurement scheme using spectral shift was applied to a diode end-pumped Yb:YAG laser with ~ 4 W pumping level. The temperature rise was ~ 90 °C at the input power of 3.3 W.

[26P-23] Study of Femtosecond Laser Pulse Induced Thermal Lensing Effect in CS_2

Yi-Ci Li, Yu-Ting Kuo, Po-Yuan Huang, and Tai-Huei Wei

National Chung Cheng University, Taiwan

We experimentally verified fs laser pulse induced thermal lensing effect in CS_2 with the Z-scan technique and explain this effect as a result of relaxation of stimulated Raman scattering excited libration.

[26P-24] Generation of Cubic-Quintic Nonlinear Strodinger Equation Dark Pulse

Zian Cheak Tiu[1,2], Harith Ahmad[2], and Sulaiman Wadi Harun[2]

[1]KDU University College, Malaysia, [2]University of Malaya, Malaysia

CQNLSE dark pulse is demonstrated in EDFL with NPR technique. Pulse repetition rate, pulse width, and highest pulse energy of the CQNLSE dark pulse are obtained at 1.52 MHz, 219 ns, and 0.59 nJ, respectively.

[26P-25] Transient Kerr Effect and Its Influence in a Nonlinear Photonic Crystal Nanocavity

Chao Li, Min Wang, Yong-Lu Hu, Dao-Liu Liu, and Jun-Fang Wu

South China University of Technology, China

We present an analytical model to investigate the dynamic features of the transient Kerr effect in a nonlinear photonic crystal microcavity, and the theoretical predictions agree perfectly with the proposed experimental results.

[26P-26] Numerical Analyses of All-Optical Retiming Switches Using Quasi-Phase Matched Lithium Niobate Waveguide Devices: Output Deterioration by Domain Length Error

Yutaka Fukuchi and Masaru Yamamoto

Tokyo University of Science, Japan

We analyze characteristics of all-optical retiming switches employing the cascaded second-order nonlinear effect in quasi-phase matched lithium niobate waveguides. The domain length error decreases the switching efficiency and causes significant deterioration of the output signal.

[26P-27] Various Soliton Molecules in Large Anomalous Dispersion Fiber Laser

Xiaoxiang Han and Xueming Liu

Chinese Academy of Sciences, China

Soliton molecules (SMs) induced by the spectral filtering with the phase difference of 0, π, π/2 and multiple separations are observed. It is found that the equilibrium distances of SMs are multiple and discrete.

[26P-28] Strong Modulation Instability and Ultra-short Pulse Train Generation in Silicon-organic Hybrid Slot Waveguide

Xianting Zhang[1], Jinhui Yuan[1,2], Zhe Kang[1], Xinzhu Sang[1], Feng Li[2], Chongxiu Yu[1], and P. K. Alexander Wai[2]

[1]Beijing University of Posts and Telecommunications, China, [2]The Hong Kong Polytechnic University, Hong Kong

We investigate the strong modulation instability at telecommunication band in a silicon-organic hybrid slot waveguide. The pulse train is obtained via pump pulses with pulse width of 10 ps and peak power of 250 mW.

Poster Session I (Exhibition Hall / Wednesday, 26 August, 13:45~15:15)

[26P-29] Bidirectional Soliton Spectral Tunneling Effects in the Regime of Optical Event Horizon

Jie Gu[1], Hairun Guo[2], Shaofei Wang[1], Xuekun Bai[1], Jun Yuan[1], and Xianglong Zeng[1]

[1]Shanghai University, China, [2]Technical University of Denmark, Denmark

We study the cross-phase-modulation-induced soliton spectral shifting in the regime of the optical event horizon. The perturbed soliton to either red-shifting or blue-shifting is controllable, which could evoke bidirectional soliton spectral tunneling effects.

[26P-30] Defect Solitons in Two-dimensional Gaussian Potential

Yang Zheng, Huijie Zhang, and Youwen Liu

Nanjing University of Aeronautics and Astronautics, China

We report on the existence and stability of defect solitons in 2D optical Gaussian potentials. The power of the defect solitons is a monotonic decreasing function of the propagation constant, and the existence domain expands when the defect gets deep. Fundamental solitons are stable in the entire existence domain regardless of the depth of the defect. Dipole solitons exhibit instability in most of the power region and the instability window expands with the depth of the defect.

[26P-31] Active Control of Nano Plasmonic Field Using a Few Cycle Laser Pulse

Sungho Choi, Ziaul Hoque, Seungchul Kim, and Dong-Eon Kim

POSTECH, Korea

In this study, we show that localized ultrafast plasmonic field of nano structure can be spectrally or spatially manipulated under excitation of few cycle pulse. By controlling geometrical parameters of nanostructure, plasmonic response can be actively tailored.

[26P-32] Refinement of Dispersion Relations in the VUV from Spectral Fringes in Non-Phase-Matched Second Harmonic Generation

Peter Trabs[1], Frank Noack[1], Aleksandr Aleksandrovsky[2], Alexandre Zaitsev[2], Nikita Radionov[2], and Valentin Petrov[1]

[1]Max-Born-Institute for Nonlinear Optics and Ultrafast Spectroscopy, Germany, [2]Russia and Siberian Federal University, Russia

Spectral fringes in the second harmonic of fs pulses under strong phase- and group-velocity mismatch are used to evaluate the refractive index of SrB4O7 down to 160 nm, essential for random quasi-phase-matching in the VUV.

[26P-33] CEP-stabilized Infrared Optical Parametric Amplifier with High Efficiency

Xiaotao Geng[1], Weijun Ling[1,2], Shuyan Guo[3], Zhiyi Wei[3], Ferenc Krausz[4,5], and DongEon Kim[1]

[1]POSTECH, Korea, [2]Tianshui Normal University, China, [3]Chinese Academy of Sciences, China, [4]Max-Planck-Institut for Quantum Optics, Germany, [5]Ludwig-Maximilians-Universit, Germany

A high efficiency, tunable, carrier-envelope-phase (CEP) stabilized optical parametric amplifier (OPA) is demonstrated with single crystal. We achieved a pump-tosignal conversion efficiency of 34% which is the highest conversion efficiency reported in broadband OPAusing two stages.

[26P-34] CEP-stable, Sub-6 fs, 300-kHz OPCPA System with an Average Power of more than 15 W

Yeon Lee[1], Stephan Prinz[2,3], Matthias Haefner[2], Catherine Yuriko Teisset[2], Robert Bessing[2], Knut Michel[2], Xiao Tao Geng[1], Seungchul Kim[1], Dong Eon Kim[1], Thomas Metzger[2,4], and Marcel Schultze[2]

[1]POSTECH, KOREA, [2]TRUMPF Scientific Lasers GmbH + Co. KG, German, [3]Technische Universität München, German, [4]Max-Planck-Institut für Quantenoptik, German

We report on a CEP-stable OPCPA system reaching multi-GW peak power at 300 kHz repetition rate. It delivers over 50 uJ of pulse energy and pulse duration below 6 fs. Power fluctuations < 1.5% was achieved including a pump-seed-synchronization.

[26P-35] Laser-driven Fast Electron Beam from the Solid Target for Ultrafast Electron Diffraction

Ye Tian and Jiansheng Liu

Shanghai Institute of Optics and Fine Mechanics, China

We have obtained stable collimated quasimonoenergetic electrons near the target specular direction. The fast electron pulse is prominent for the laser-driven fast electron diffraction source.

[26P-36] Ultrafast Interaction between Water-soluble Corrole and DNA

Hui Wang[1], Li-Li Wang[1], Lei Zhang[1], Hai-Yang Liu[2], and Liang-Nian Ji[1]

[1]Sun Yat-Sen University, China, [2]South China University of Technology, China

The interaction of the water-soluble Ga(III) corrole with calf thymus DNA via an outside binding mode has been studied by femtosecond transient absorption spectroscopy. The forward (kf > 6.41´1012 s-1) and back (kb ~ 2.35´1012 s-1) electron transfer processes have been observed.

[26P-37] Ultrafast Broadband Third-order Optical Nonlinearity of Silk Biopolymer

Byung Jic Lee, Hyunsoo Kwon, Fabrian Rotermund, and Sunghwan Kim

Ajou University, Korea

We report on ultrafast broadband third-order nonlinearity of silk, a newly and high-technologically reinvented biopolymer in optics and electronics. Z-scan and optical Kerr-gate measurements at various wavelengths were used to investigate third order susceptibilities of silk films.

[26P-38] Ultrafast Optical Modulation of Magnetization Orientation in TbFeCo/GdFeCo Coupled Bilayer

Zhifeng Chen, Xiaohui Fang, Bingzhi Zhang, Wenan Li, and Jun Peng

Guangzhou University, China

We study the optical modulation effect of magnetization orientation in TbFeCo/GdFeCo bilayer using pump-probe polar Kerr spectroscopy. The magnetization rotation is triggered by fs pulse, driven by exchange interaction, and occurs within ~300 ps.

[26P-39] Broadband Red Green Blue Light Source for Speckle Noise Reduction

Seong-Jin Son, Ju Won Choi, Do-Kyeong Ko, and Nan Ei Yu

GIST, Korea

We design the apodized aperiodic poled lithium niobate crystals that generated broadband red, green, blue light based on second harmonic generation for laser projection display. The spectral and temporal bandwidth are about 10nm. The broadband lightsources exhibited speckle noise free.

[26P-40] Insulator-to-semimetal Transition of Calcium Fluoride Induced by Optical Field

Ojoon Kwon and Dong Eon Kim

POSTECH, Korea

We studied response of calcium fluoride single crystal against intense optical field. It undergoes transition into semimetal, ensured by detecting optical-field-induced current. The transient conductivity jumps by 16 orders of magnitude within sub-femtosecond time scale.

[26P-41] Large Diameter Ceramic TGG Faraday Rotator for High-average-power Laser Systems

Hidetsugu Yoshida, Koji Tsubakimoto, Hisanori Fujita, and Noriaki Miyanaga

Oasaka university, Japan

A large diameter Faraday isolator for few kW laser systems was demonstrated using a TGG Faraday rotator compensated for thermal induced depolarization.

[26P-42] 300-W Spectral Beam Combination of Narrow-linewidth Pulsed Rod-type Fiber Lasers

Yong-Ho Cha, Gwon Lim, Yong-Hee Kim, Jae Sung Shin, and Do-Young Jeong

KAERI, Korea

We have demonstrated spectral beam combination of three narrow-linewidth pulsed rod-type fiber lasers with different wavelengths by using a multi-layer dielectric grating. The combined laser power is 300 W with a good beam quality.

Poster Session I (Exhibition Hall / Wednesday, 26 August, 13:45~15:15)

[26P-43] Computational Simulation Methodology for the Beam Quality of a High Power Zigzag Slab Laser

Jae Sung Shin[1], Yong Ho Cha[1], Byung Heon Cha[1], Hyeon Cheor Lee[2], and Hyun Tae Kim[2]
[1]KAERI, Korea, [2]Doosan DST, Korea

A computational simulation methodology for the beam quality of a high power zigzag slab laser has been developed. This methodology can predict the beam quality for the various optical arrangements and optimize the design effectively.

[26P-44] Generation of 30 mW CW Ultraviolet by a Two-path Geometry for Cascaded $\chi^{(2)}$ Processes with Periodically Poled Lithium Niobate Crystals

Yin-Kuang Yang[1], Chia-Lun Tsai[1], Jui-Yu Lai[1,2], Chen-Shao Hsu[2], Yen-Yin Lin[1], Chiang-Chung Fu[1], and Shang-Da Yang[1]
[1]National Tsing Hua University, Taiwan, [2]Hsinchu Science Park, Taiwan

30 mW continuous wave ultraviolet radiation is generated via a two-path geometry for cascaded frequency doubling and sum-frequency generation (SFG) at 18.9 W pump, where SFG is enabled by a third-order periodically poled $MgO:LiNbO_3$.

[26P-45] Investigation of Contamination Induced by Various Processes on Fused Silica Optics

Liu Hongjie, Huang Jin, Jiang Xiaodong and Zheng Wanguo
China Academy of Engineering Physics, China

We investigated contamination on fused silica optics with various processes by TOF-SIMS. The kinds and quantities of metal-impurities and their distribution as a function of depth from the surface are obtained.

[26P-46] Single Shot Third-order Cross-correlator for Ultra-high Intensity Laser

A. Kon, M. Nishiuchi, H. Kiriyama, K. Ogura, H. Sakaki, Y. Fukuda, M. Kando and K. Kondo
Japan Atomic Energy Agency, Japan

We have developed a multi-channel cross-correlator (MCCC) for single-shot measurement of temporal contrast of Peta-watt class laser pulse. We report experimental results with the MCCC system.

[26P-47] Generation of High Power High Quality Beam for Supersonic Laser Plasmatron

Victor Shulyatyev and Anatoly Orishich
Khristianovich Institute of Theoretical and Applied Mechanics, Russia

The results of development of the optical system for the repetition rate laser plasmaton are presented. A self filtering resonator is applied to form the high-quality beam at the high power short pulse Q-switching CO_2 laser. The system permits formingthe quasi-stable plasmoid in the supersonic air flow.

[26P-48] Development of 1 J, 100 Hz Yb:YAG Laser Amplifier System for OPCPA Pumping

Shigeki Tokita[1], Martin Divoky[2], SungIn Hwang[1], Koichi Iyama[3], Toshiyuki Kawashima[3], Hajime Nishioka[4], and Junji Kawanaka[1]
[1]Osaka University, Japan, [2]Institute of Physics, Czech Republic, [3]Hamamatsu Photonics K.K., Japan, [4]The University of Electro-Communications, Japan

We report on our progress in the development of a 1 J class Yb:YAG laser system with a repetition rate of 100 Hz for OPCPA pumping. We have demonstrated amplification of 10 ns pulses to 1 J at 100 Hz by using a multi-TRAM.

[26P-49] Pulse Stretching in a Narrow-band Yb:YAG Regenerative Amplifier using Transmission Gratings

Shigeki Tokita[1], SungIn Hwang[1], Toshiyuki Kawashima[3], Hajime Nishioka[2], and Junji Kawanaka[1]
[1]Osaka University, Japan, [2]Hamamatsu Photonics K. K., Japan, [3]The University of Electro-Communication Tokyo Japan, Japan

We report on our progress in the development of a highpulse-energy Yb:YAG laser system for OPCPA pumping. We have demonstrated generation of 160-ps chirped-pulses with a spectral bandwidth of 0.12 nm and a pulse energy of a few mJ by using a Yb:YAG regenerative amplifier inserting a transmission grating pair.

[26P-50] Fano Resonant Chiral Electromagnetic Fields by Metasurfaces

Seo Joo Lee, Seok Jae Yoo, Suyeon Lee, and Q-han Park
Korea University, Korea

We demonstrate for the first time that chiral electromagnetic fields display Fano resonance using nanohole metasurfaces. We show the nano-hole structure can be utilized as biosensors to detect chiral molecules.

[26P-51] Double Fano Resonances in a Composite Metamaterial Possessing Tripod Plasmonic Resonances

Yeon Ui Lee and Jeong Weon Wu
Ewha Womans University, Korea

Double Fano resonances are observed in a planar composite metamaterial possessing tripod plasmonic resonances, where a common subradiant driven oscillator is coupled with two superradiant oscillators. As a classical analogue of four-level tripod atomic system, the extinction spectrum of the composite metamaterial exhibits a coherent effect based on double Fano resonances. It is shown that a transfer of the absorbed power between two orthogonal superradiant oscillators is mediated by a common subradiant oscillator.

[26P-52] Active Control of On-chip Plasmonic Nanocavities by Two-plasmonic Absorption

Zhen Chai, Xiaoyong Hu, Hong Yang, and Qihuang Gong
Peking University, China

The tunable on-chip plasmonic coupled nanocavities are realized by two-plasmonic absorption of (SU-8)-co-(gold nanoparticles) composite film. Strong near resonance nonlinear absorption and localized field plasmonic can realize microwatts order pump tunability.

[26P-53] Low Propagation Loss in an Asymmetric Plasmonic Crystal Waveguide

Motoki Itou[1], Masashi Fukuhara[1,2], Masashi Ota[1], Asahi Sumimura[1], Yuya Ishii[1], and Mitsuo Fukuda[1]
[1]Toyohashi University of Technology, Japan, [2]Japan Society for the Promotion of Science, Japan

We present a promising design for low-loss asymmetric plasmonic crystal waveguides. The plasmonic crystal consists of Au cylinders, and the waveguide is introduced by eliminating a single line of cylinders on Au metal.

[26P-54] Designing Whispering Gallery Modes via Transformation Optics

Yushin Kim[1], Soo-Young Lee[2], Jung-Wan Ryu[2], Inbo Kim[2], Jae-Hyung Han[2], Heung-Sik Tae[2], Muhan Choi[2], and Bumki Min[1]
[1]KAIST, Korea, [2]Kyungpook National University, Korea

Transformation optics suggest a novel way to control the propagation of light. By applying it to resonant optical cavity, we restore the whispering gallery mode in an optical cavity of deformed boundary.

[26P-55] Giant Electric Field Enhancement in a Multilayered Dipole Nano-antenna

Evgeny Mironov[1,2], Abdul Khaleque[1], Liming Liu[1], and Haroldo Hattori[1]
[1]UNSW Australia, Australia, [2]Australian National University, Australia

We investigate the electric field enhancement in multilayered dipole nano-antenna and show that the combination of Au/SiO2 layers taken at a 50% filling factor can produce extremely high field enhancements in the order of 17.9.

[26P-56] All-semiconductor Optical Microcircuit Board

Li Min and Lirong Huang
Huazhong University of Science and Technology, China

A low-loss all-semiconductor metamaterial-based optical circuit board with optical inductors, capacitors, insulators and conductors at the microscale is proposed, which can always hold band-stop filtering function for various polarized waves.

Poster Session I (Exhibition Hall / Wednesday, 26 August, 13:45~15:15)

[26P-57] Graphene Plasmonic Metamaterials to Manipulate Infrared Light

Chao Zeng, Xueming Liu, and Jing Guo

Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China

Two and three dimensional graphene plasmonic metamaterials are proposed and investigated to manipulate infrared light. The gradient-index lenses are implemented to focus, collimate, and guide the surface plasmon waves. High-contrast electro-optic modulator is also conceived.

[26P-58] Resolving the Optical Modulation Mechanism of Graphene-hybridized Plasmonic Metamaterials

Lei Zhu, Zhonghui Nie, Yongbing Xu, and Frank Wang

Nanjing University, China

Optical modulation characterisitics of graphene hybridized plasmonic metamaterials is investigated. It is revealed that resonance peak transmission can be effectively tuned by the applied gate voltage, suggesting an electroabsorption modulation (EAM) mechanism.

[26P-59] Optimization of Lorentz Model Parameters for Crystalline As_2S_3, SiC and Modified Lorentz Model Parameters for Nanocrystalline SiO

Mehedi Islam, Md. Nazmul Islam, Monzurul Islam, Md. Ghulam Saber, and Rakibul Hasan Sagor

Islamic University of Technology, Bangladesh

We have presented the optimized Lorentz model parameters for crystalline arsenic sulfide (As_2S_3), silicon carbide (SiC) and modified Lorentz model parameters for nanocrystalline silicon monoxide (SiO) obtained using a large scale non-linear algorithm. The complex relative permittivity calculated using the optimized parameters agree well with the experimental values over broad frequency bands. The associated RMS deviations are 0.254, 0.003, 0.010 and 0.009 respectively.

[26P-60] Metamaterial-based Light Diffuser with Deep-subwavelength Thickness

Jong Uk Kim and Jonghwa Shin

KAIST, Korea

Metamaterial based angular light diffuser with deep subwavelength thickness is proposed. It consists of metallic strips with randomized width and separations. We numerically demonstrate that metamaterial diffuser exhibits light diffusion angles comparable to conventional, thick diffusers.

[26P-61] Magnetic Response Based on Deep Subwavelength Nonmagnetic Metallic Structures

Minsung Heo and Jonghwa Shin

KAIST, Korea

We proposed the nonmagnetic metallic coil-plate array to manipulate the magnetic resonance caused by an inductor capacitor circuit resonance in microwave range. The effect of geometrical parameters on the magnetic response is studied.

[26P-62] Bowtie-shaped Hole Array for Fiber-optic Refractive Index Sensing in Telecom-wavelengths

Hang-Eun Joe[1], Farid Ahmed[2], Martin B.G. Jun[2], and Byung-Kwon Min[1]

[1]Yonsei University, Korea, [2]University of Victoria, Canada

Array of bowtie-shaped holes is proposed to develop a fiber-optic refractive index sensor. Reflection spectra in telecom-wavelength range around 1.3 μm and 1.55 μm obtained by FDTD simulations are analyzed to design and evaluate its performance.

[26P-63] Surface-Plasmon Sensor in Photonic Crystal Fiber

Jung-Sheng Chiang, Yong-Hang Wu, Syuan-Yu Jhang, and Nai-Hsiang Sun

I-Shou University, Taiwan

We analyze the surface-plasmon sensor of photonic crystal fiber by the finite element method. The photonic crystal fiber sensor with the thin-film of copper corresponds to the resonance wavelength 750 nm.

[26P-64] Three-Dimensional Plasmonic Ruler Based on Silver Metal Blocks

Tae-Woo Lee, Da Eun Lee, Yung Jin Lee, and Soon-Hong Kwon

Chung-Ang University, Korea

We introduce a three-dimensional plasmonic ruler based on silver metal double nano-blocks. Two resonant modes show different wavelength dependences on x- or y-directional shift of blocks, which enables the measurement of spatial position with nanometer resolutions.

[26P-65] Energy Harvesting with Black Si/plasmonics Composite Material

Ryosuke Komatsu[1], Armandas Balcytis[2,3], Gediminas Seniutinas[2,3], Yoshiaki Nishijima[1], and Saulius Juodkazis[2,3]

[1]Yokohama National University, Japan, [2]Swinburne University of Technology, Australia, [3]The Australian National Fabrication Facility ANFF, Australia

The photo-thermo electrical conversion system using black silicon and gold nanoparticles have been suggested for energy harvesting. Efficient light absorption with black silicon and plasmonic photo-thermal energy conversion was successfully improving the energy conversion efficiency of light. Totally ~50% of improvements has been achieved with optimization of Au nanoparticles diameters and density.

[26P-66] Heterogeneous Three-Dimensional Assembly of Metamaterials and Metadevices by Modular Transfer Printing

Seungwoo Lee[1], Byungsoo Kang[1], Hohyun Keum[2], Alaa Alokaily[2], Hyun-Sung Park[1], Numair Ahmed[2], John A. Rogers[2], Placid M. Ferreira[2], Seok Kim[2], and Bumki Min[1]

[1]KAIST, Korea, [2]University of Illinois, Urbana Champaign, USA

A metamaterial transfer printing method done by adhesion switching of viscoelastic stamp is presented. 3-D stack of heterogeneous material can be built at a desired position regardless of target substrate even on cheese.

[26P-67] Three-dimensional Sub-5-nm-gap Plasmon Antenna Printed on the Apex of Optical Fiber

Seung Ju Yoon, Hongchul Sim, Myung-Ki Kim, and Yong Hee Lee

KAIST, Korea

We demonstrate fiber-integrated three-dimensional sub-5-nm-gap plasmon antennas by employing proximal milling and micro-transfer printing techniques. The photons are extremely confined in a volume of $10^{-7}\ \lambda^3$ and efficiently couple to a single-mode optical fiber.

[26P-68] Whispering Gallery Mode Biosensor Detection Using Nanopost Structures

Seunghun Lee and Kyujung Kim

Pusan National University, Korea

High-quality (Q) factor whispering gallery mode biosensor which detects wavelength shift induced by biomolecules can be amplified by introduction of nanostructures. We demonstrate molecule detection by localized WGM field on nanopost structures.

[26P-69] Simulation of Improved Sensitivity of Whispering Gallery Modes Sensor by Nanostructure Chip

Taeyoung Kang and Kyujung Kim

Pusan National University, Korea

We simulated Whispering Gallery Mode (WGM) sensor that is highly sensitive enough to detect unlabeled single molecule and method of improving sensitivity using nano structure chip.

[26P-70] Effect of DC Power on Alternative Plasmonic Materials Fabrication with Room Temperature High-power Impulse Magnetron Sputtering

Zih-Ying Yang[1], Yi-Hsun Chen[1], Bo-Huei Liao[2], and Kuo-Ping Chen[1]

[1]National Chiao Tung University, Taiwan, [2]National Applied Research Laboratories, Taiwan

TiN thin films were prepared using magnetron sputtering. When the power increases from 80W to 300W, the conductivity rises to 16.8 times, and the plasma frequency is blue-shifted from 515 nm to 460 nm.

Poster Session I (Exhibition Hall / Wednesday, 26 August, 13:45~15:15)

[26P-71] Polarization Independent Terahertz Metamaterial Filters Based on Combinatory Array of Crosses and Mesh Network

Dongju Kim, Muhammad Tayyab Nouman, Soyeon Kim, Kyejeong Lee, and Jae-hyung Jang
GIST, Korea

Design of a polarization independent bandpass filter based on cross and two dimensional wire lattice metamaterial is presented. Introducing wires among the dipoles transforms its bandstop characteristics to bandpass characteristics. By applying aboveprinciple to cross shaped metamaterials a polarization independent bandpass characteristic is demonstrated.

[26P-72] Plasmonic Vortex Lens with Distributed Nanoslits for Arbitrary Tuning of Vortex Size

Gun-Yeal Lee, Seung-Yeol Lee, and Byoungho Lee
Seoul National University, Korea

A tunable plasmonic vortex lens (PVL) that can adjust the size of vortex by changing optical polarization is proposed. The tunable PVL provides a novel degree of freedom in managing surface plasmon polariton fields.

[26P-73] Tunable Polarizer Based on Graphene Nanoantennas at Terahertz Wave Band

Yi Cheng Tang, Zhi Hong Zhu, Jian Fa Zhang, Chu Cai Guo, Ken Liu, Xiao Dong Yuan, and Shi Qiao Qin
National University of Defense Technology, China

We theoretically and numerically demonstrate that a transmission-type electrically tunable polarizer can be realized using graphene nanoantennas supported on a dielectric film with a graphene sheet behind. The polarization mechanism originates from the antenna plasmon resonance of graphene stripes. The results of fullwave numerical simulations reveal that transmittance of 0.70 for one polarization and 0.0073 for another polarization can be obtained at normal incidence. The transmission-type electrically tunable polarizer provides and facilitates kinds of applications, including filtering, detecting, and imaging.

[26P-74] Enhanced Optical Torque on Planar Metal-insulator-metal Cavity Structured Gammadion

Sun-Je Kim, Kyookeun Lee, Yohan Lee, Hyeonsoo Park, and Byoungho Lee
Seoul National University, Korea

Novel planar metal-insulator-metal cavity structured gammadion is suggested. It is shown that the proposed gammadion can exhibit 8 times higher optical torque under spin-less normally incident light compared to the previous work.

[26P-75] Complex Modulation by One-Port Absorbing Structure in Plasmonic MIM Waveguide

Hyeonsoo Park, Seong-Yeol Lee, and Byoungho Lee
Seoul National University, Korea

We present a sub-micron sized complex modulator. It consists of a magnetic dipole resonant absorbing structure and Fabry-Perot resonator. Additional wave retardation in the resonator gives full modulation of reflected light.

[26P-76] Electrically Tunable Polarizer Based on Pattern-free Graphene

C. Ye, Z. Zhu, W. Xu, X. Yuan, and S. Qin
National University of Defense Technology, China

We theoretically demonstrate that an electrically tunable polarizer can be obtained using a pattern-free graphene monolayer supported on a periodical dielectric array.

[26P-77] Dielectric Environment Affects Photoinduced Voltage in Nanoporous Gold Thin Film

Marjan Akbari and Teruya Ishihara
Tohoku University, Japan

We report an experimental study of photoinduced voltage in nanoporous gold film with/without dielectric infiltration under the radiation of obliquely incident nanosecond laser light in visible frequencies.

[26P-78] Waveguiding of Spoof Surface Plasmon Polaritons

Seong-Han Kim[1], Sang Soon Oh[2], Kap-Joong Kim[3], and Chul-Sik Kee[1]
[1]GIST, Korea, [2]Imperial College London, UK, [3]ETRI, Korea

We numerically and experimentally demonstrate subwavelength scale waveguiding of spoof surface plasmon polaritons at a line defect in a two-dimensional groove metal array that exhibits a band gap region.

[26P-79] Single Line Waveguide inside Ho^{3+}-doped Chalcogenide Glass Inscribed by Femtosecond Laser

Junli Wang[1], Borong He[1], Jiangfeng Zhu[1], Zhiyi Wei[1,2], and Shixun Dai[3]
[1]Xidian University, China, [2]Chinese Academy of Sciences, China, [3]Ningbo University, China

We inscribed a single mode waveguide with the minimum propagation loss of 1.58 dB/cm at 1030nm inside the Ho^{3+}-doped chalcogenide glass by femtosecond laser. The inscribing parameters are 0.4 μJ pulse energy and 90 μm/s translation speed.

[26P-80] Ablation Detph Control on ITO Using Beam Shaped Femtosecond Laser

Hoon-Young Kim[1,2] and Sung-Hak Cho[1,2]
[1]KIMM, Korea, [2]Korea University of Science and Technology, Korea

We report on the ablation depth control with a resolution of 40 nm on indium tin oxide (ITO) thin film using a square beam shaped femtosecond (190 fs) laser (λ p = 1030 nm). A slit is used to make the square, flat top beam shaped from the Gaussian spatial profile of the femtosecond laser. An ablation depth of 40 nm is obtained using the single pulse irradiation at a peak intensity of 2.8 TW/cm^2. The morphologies of the ablated area are characterized using an optical microscope, atomic force microscope (AFM), and energy dispersive X-ray spectroscopy (EDS). Ablations with square and rectangular types with various sizes are demonstrated on ITO thin film using slits with varying x-y axes. The stereo structure of the ablation with the depth resolution of approximately 40 nm is also fabricated successfully using the irradiation of single pulses with different shaped sizes of femtosecond laser.

[26P-81] Analysis of Laser Induced Oxidation Processes with Different Laser Powers

Feng Xia[1], Xinzheng Zhang[1], Meng Wang[1,2], Sanming Yi[1], Qian Liu[2], and Jingjun Xu[1]
[1]Nankai University, China, [2]National Center for Nanoscience and Technology, China

Metal-transparent-metallic-oxide (MTMO) grayscale photomasks fabricated by laser-induced oxidization are studied based on three stages oxidation theories and absorbed laser power density distribution. The calculated fabrication diameter is consistent with the experimental fabrication size.

[26P-82] Ultrashort Laser Ablation for Hydrophilic Surface

Munju Bae[1], Jiyeon Park[1], BinhX. Cao[1], Hyonkee Sohn[1], Cheon-Seog Rim[2], and Jiwhan Noh[1]
[1]KIMM, Korea, [2]Hannam University, Korea

The hydrophilic property of the surface with the microsize spikes was tested. Water drops were placed on the micro-spikes to measure the contact angle, which was 10° while that of the surface without micro spikes was 80°. This shows that a surface can be processed to be hydrophilic with laser ablation.

[26P-83] Maximization of the Ablation Rate of Metal, Semiconductor and Dielectric with a MHz Repetition Rate Ultrafast Laser

Mirae Lim, Yonghyeon Kim, Hyonkee Sohn, Dongsig Shin, and Jiyeon Choi
KIMM, Korea

Maximization of the ablation rate of various materials was investigated by optimization of ultrafast laser parameters. The optimized parameters were used to engrave metal roles for micron-sized pattern transfer of conductive ink to flexible substrates.

[26P-84] Nd:YLF Waveguide Laser Fabricated by Second-Harmonic Femtosecond Laser Pulses

Takuya Sato, Yusuke Yamanaka, Kenichi Hirosawa, and Fumihiko Kannari
Keio University, Japan

Channel waveguides are fabricated in a Nd:YLF crystal with 400-nm femtosecond laser pulses, and the laser oscillation at 1047 nm pumped by an 800-nm laser is demonstrated.

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[26P-85] Fabrication of Micro Lens Shape Array Using Picosecond Laser

Jiyeon Park, Munju Bae, BinhX. Cao, Hyonkee Sohn, and Jiwhan Noh

KIMM, Korea

In this paper, we fabricated a convex-lens-shaped microstructure with a diameter of 50 um on a metallic mold substrate using a laser ablation process. The fabricated convexlens-shaped microstructure on the metallic substrate can be used as the mold for the micro lens or superhydrophobic/hydrophilic surface.

[26P-86] 1-μm Periodical Grating Structure on Stainless Steel Designed by High-power Nanosecond Pulsed Fiber Lasers

Shaoxiang Chen, Seongwoo Yoo, Perry Ping Shum, Xiaohui Li, Meng Liu, Yukun Ma, and Qi Jie Wang

Nanyang Technological University, Singapore

Nanosecond-pulsed, Yb-doped fibre laser has been used to create laser induced periodic surface structure on the surface of stainless steel. Grating periodic structure for visible light with distance of 1 μm is demonstrated and explained.

[26P-87] Holographic Optical Element for Solar Concentrators Using Photopolymer

Jeong Hyeon Lee, Jong-Chan Kim, Jae Wook Jeong, and Nam Kim

Chungbuk National University, Korea

In this study, the holographic optical element for solar concentrators using photopolymer was proposed. For this, we fabricated the holographic solar condensing lens which has maximum efficiency. To add sun tracking function, we performed the angular multiplexing.

[26P-88] Pulsed Laser Sintering for Fabricating Indium Tin Oxide Thin Films

Jeonghong Ha and Dongsik Kim

POSTECH, Korea

A direct excimer laser sintering process and a novel laser-induced plasma sintering process were developed for fabricating Indium Tin Oxide (ITO) thin films from wetcoated ITO nanoparticles.

[26P-89] Laser-induced Spray Jet Cleaning for Nanoscale Contaminant Removal Using Water-isopropyl Alcohol Mixtures

Changho Seo and Dongsik Kim

POSTECH, Korea

In this work, we demonstrate a novel laser-induced spray jet cleaning process using non-water cleaning agents including isopropyl alcohol. The process could remove <30 nm PSL particles from silicon surfaces without watermark generation.

[26P-90] Laser Fabrication of Micro-lens Array on Fused Silica

Ik-Bu Sohn[1,2], Hun-Kook Choi[1,2], Young-Jun Jeong[1], Young-Chul Noh[1], Jae-Hee Sung[1], Seong-Ku Lee[1], Tae-Moon Jeong[1], and Jin-Tae Kim[2]

[1]GIST, Korea, [2]Chosun University, Korea

We fabricated micro-lens array on fused silica glass using femtosecond and CO_2 laser. We micro-machined periodic micro-grooves on the glass surface with femtosecond laser, and polished the patterned surface with CO_2 laser. We confirmed that curvature was formed on the surface by heat from the CO_2 laser beam as the surface roughness was removed. Depending on the fabricated pattern size, we could fabricate micro-lens array with controlling sizes. Using such this laser fabrication technique, we have demonstrated micro-lens array with various dimension.

[26P-91] Bessel Beam Scanning without Mechanical Scanner

Maria Eloisa Ventura, Paul Leonard Atchong Hilario, Giovanni Tapang, and Caesar Saloma

University of the Philippines, Philippines

We demonstrate motionless Bessel beam scanning with a spatial light modulator (SLM). The scanning control was emulated in the SLM by adding a grating phase or chirp phase to translate the beam transversely or axially.

[26P-92] A Single Chip White Light In GaN/GaN Quantum Well Microfacets Using Selective Area Epitaxy

Guofeng Yang[1], Zhenlong Wu[2], and Peng Chen[2]

[1]Jiangnan University, China, [2]Nanjing University, China

A monolithic color synthesis method based on InGaN/GaN multiple quantum wells (QWs) grown on GaN microstripes formed by selective area epitaxy on SiO2 mask patterns is demonstrated. The stripe microfacet structure is composed of (0001) and {11-22} planes, attributing to surface polarity and surface energy. InGaN/GaN QWs on different microfacets contain spatially inhomogeneous composition are due to the diffusion of adatoms among the facets. The unique property allows microfacet QWs emits blue light from the {11-22} plane and yellow light from the top (0001) plane, of which the luminescence reveals white due to the dual color mixing.

[26P-93] Power-loss Mechanisms in Surface Passivated AlGaN/AlN/GaN Heterojunctions

Engin Tiras[1], Gokhan Atmaca[2], Sefer Bora Lisesivdin[2], Sukru Ardali[1], T. Malin[3], V. Mansurov[3], and K. Zhuravlev[3]

[1]Anadolu University, Turkey, [2]Gazi University, Turkey, [3]Siberian Branch of Russian Academy of Sciences, Russia

The surface passivation effect on the power-loss mechanisms in AlGaN/AlN/GaN heterostructures was investigated. The electron temperatures of hot electrons was obtained from the temperature and the applied electric field dependencies of the Hall mobility.

[26P-94] Effect of Nanometer Sized Ni-dot/Ag/Pt Metal on White Light Emitting Diodes

Myoung Gyun Suh[1] and Kyu Sang Kim[2]

[1]California Institute of Technology, USA, [2]Sangji University, Korea

Ni-dot/Ag/Pt metal coating films were incorporated in InGaN blue light emitting diodes as p-type reflection metal to enhance the extraction efficiency of blue light. For the reflectivity change from 84% to 93.7%, the optical output power of blue light before phosphor coating and the luminous flux white light after phosphor deposition have improved by 49.3% and 58.2% at the current of 350 mA, respectively.

[26P-95] Consideration of Number of via Holes for High Efficiency GaN Based VI-LED Design

Gil Jun Lee[1], Yu-Jung Cha[1], Seung-Kyu Oh[1], Hyung-Jo Park[2], Tak Jeong[2], and Joon Seop Kwak[1]

[1]Sunchon National University, Korea, [2]Korea Photonics Technology Institute, Korea

This study examined the electrical and optical characteristics of GaN–based vertical-injection lightemitting diodes (VI-LEDs) with various numbers of via holes.

[26P-96] Modification of Spontaneous Emission Rate in GaN-based Nanorod LED Structures Investigated by FDTD Simulations

Guen-Hwan Ryu and Han-Youl Ryu

Inha University, Korea

The characteristics of modifications in spontaneous emission (SE) from GaN-based nanorod light-emitting diode structures are numerically investigated using finite-difference time-domain methods. It is found that the SE rate can be enhanced by >6 timesin optimized structures.

[26P-97] Analysis of the Characteristics with Increasing the Number of QWs for Near-Ultraviolet LEDs

Hyo-Shik Choi and Jong-In Shim

Hanyang University, Korea

This paper reports the analysis of the near-ultraviolet light-emitting-diodes (NUV LEDs) characteristics with increasing the number of QWs from 5 to 7 by same growth process. By means of optical, electrical characterization and carrier rate equationanalysis, we show that the NUV LEDs performances were improved with increasing the number of QWs by decreasing the non-radiative recombination rate.

[26P-98] Localized Surface Plasmon Resonance from Pt-based Split Ring Structures

Kyung Rock Son, Byeong Ryong Lee, Tae Hoon Park, Kyeong Heon Kim, and Tae Geun Kim

Korea University, Korea

We fabricated split ring (SR) nanostructures to enhance the interaction with resonant photons caused by an excitation of localized surface plasmon resonance (LSPR) in the deep-ultraviolet region. Also, the effect of SR diameter size and split gap angle on the coherent plasmon coupling was investigated in 2D arrays of Pt based SR. The absorption resonance of the fabricated Pt-based SR depends on its diameter, and shifts toward shorter wavelength for the SR with larger diameter.

Poster Session I (Exhibition Hall / Wednesday, 26 August, 13:45~15:15)

[26P-99] Various Metal-doped ITO as Transparent conductive Electrode for Near-ultraviolet Light Emitting Diodes

Min Ju Kim, Ju Hyun Park, Dong Su Jeon, Tae-Ho Lee, and Tae Geun Kim

Korea University, Korea

We fabricated under various metal doped indium tin oxide (ITO) transparent conductive electrodes (TCE) for use in near-ultraviolet (NUV) light emitting diodes (LEDs). The role of metal is to improve the transmittance especially in NUV region and current spreading of ITO. The ITO/metal (Ti, Ga, Ge, Al) TCEs (annealed at 550°C, 1 min) exhibit 90.5 ~ 94.7% transmittance at 385 nm on the quartz substrate and the sheet resistance is ranged from 23.2 to 73.5 Ω/□ on the NUV LED wafer.

[26P-100] Low-Frequency Noise Characteristics of InGaN-Based Light-Emitting Diodes

Chan-Hyoung Oh, Dong-Pyo Han, Dong-Soo Shin, and Jong-In Shim

Hanyang University, Korea

We investigate the low-frequency noise characteristics of InGaN-based light-emitting diodes with different forward leakage currents. It is found that the low-frequency noise characteristics are closely correlated with the forward leakage current.

[26P-101] U-shape Phenomenon in the Efficiency-versus-current Curves in AlGaN-based Deep-ultraviolet Light-emitting Diodes

Junhyuk Park[1], Guan-Bo Lin[2], Dong Yeong Kim[1], Jong Won Lee[1], Jaehee Cho[3], E. Fred Schubert[2], and Jong Kyu Kim[1]

[1]POSTECH, Korea, [2]Rensselaer Polytechnic Institute, USA, [3]Chonbuk National University, Korea

The efficiency of an AlGaN deep-ultraviolet light emitting diode with peak emission wavelength of 285 nm is investigated as a function of current over a wide range of temperatures (110K to 300K). We find that the efficiency-versus-current curve exhibits unique and distinct features over the entire temperature range including three points of inflection, a u-shape phenomenon which the efficiency increases again after the minimum, and higher low temperature efficiency than room-temperature efficiency at high-current density regime.

[26P-102] Influence of Aging on the Characteristics of Near-Ultraviolet LEDs

Hyo-Shik Choi, Jong-In Shim, and Won-Jin Choi

Hanyang University, Korea

We analyzed the influence of a current aging on 380 nm band near-ultraviolet light-emitting diodes with different current densities. Aging have been carried out on LEDs with current densities of 5, 35 and 50 A/cm^2 at room temperature for 1000 h. After stressed, both optical and electrical characteristics of LEDS are getting worse as increasing aging current density. We suggest that the possible degradation mechanism of characteristics is increase of the non-radiative (NR) recombination of LEDs due to generation of NR recombination centers in active regions after a current aging.

[26P-103] Investigations on Correlation between Photoluminescence Images of an LED Epi-wafer and Characteristics of LED Chips

Jongseok Kim[1], Hyung Tae Kim[1], Seungtaek Kim[1], Hoon Jeong[1], In-Sung Cho[2], Min Soo Noh[2], and Hyundon Jung[3]

[1]KITECH, Korea, [2]Soft-Epi, Korea, [3]Etamax Co., Korea

Photoluminescence (PL) imaging is employed in order to inspect InGaN/GaN LED epi-wafers. The image shows a map of integrated PL intensity over the wafer and dark spots with degraded luminescence properties. Dark spots with various sizes indicate areas with nonradiative defects showing that the nonradiative recombination coefficient increases with the size. The PL images are compared with data obtained from LED chips on the wafer after fabrication process. The characterization results for LED chips show that most of the chips fabricated on the dark spots have degraded properties. The result indicates that PL imaging of epi-wafers could be an inspection tool to predict properties of LED chips.

[26P-104] Shadow Excitation of Nanoneedles: Roguing Localization and Strain Effects from Photoluminescence

Hyeong-Yong Hwang[1], Hoonil Jeong[1], Hyun-Jun Baek[2], Gyu-Chul Yi[2], Hyoung-Chan Kim[3], and Young-Dahl Jho[1]

[1]GIST, Korea, [2]Seoul National University, Korea, [3]National Fusion Research Institute, Korea

In order to pinpoint the spatially resolved role of strain, localization, and quantum confinement (QC) in tapered nanoneedles (NNs), angle-resolved photoluminescence (PL) was adapted as a function of temperature.

[26P-105] Dopant-dependent Chemical Wet Etching Phenomena of Semipolar (11-22) GaN Film

Jiyeon Park and Sung-Nam Lee

Korea Polytechnic University, Korea

Wet etching properties of semipolar (11-22) GaN films are investigated by using the different dopants, such as Si and Mg. A trigonal prism cell structure with a (0001) c-plane and the next-nearest-neighbor {10-10} m-planes is formed by KOH wet etchant. Etching rate of semipolar (11- 22) Si-doped GaN film was faster than Mg-doped and undoped GaN. Regardless of dopants, the etching rate increased with etching depth.

[26P-106] Study of the Ideality Factor of Blue Light-Emitting Diodes Using the Photovoltaic Characteristics

Jae-Hoon Ham[1], Chan-Hyoung Oh[1], Dong-Pyo Han[1], Hyunsung Kim[1], Jong-In Shim[1], Dong-Soo Shin[1], and Kyu-Sang Kim[2]

[1]Hanyang University, Korea, [2]Sangji University, Korea

We investigate the diode ideality factors obtained from the photovoltaic characteristics and compare them with the ones from the conventional current-voltage characteristics. By eliminating the series resistance in the bulk region, the ideality factors from the photovoltaic measurements can give more accurate information on the recombination processes and the defects in the active quantum wells.

[26P-107] Experimental Separation of Injection and Radiative Efficiencies in InGaN/GaN Light Emitting Diodes

Nan-Cho Oh[1], Tae-Soo Kim[1], Youngboo Moon[2], and Jung-Hoon Song[1]

[1]Kongju National University, Korea, [2]UJL Inc, Korea

The carrier injection efficiency (CIE) and the radiative efficiency (RE) are experimentally determined in order to clarify the origin of the efficiency droop in blue-emitting GaN light emitting diodes. The difference in the shape of RE curves and the external quantum efficiency (EQE) curves shows the CIE is a function of the injection current, while the RE curves show the droop behavior to a certain degree. The experimentally determined CIE is significantly lower than unity and decreases with the current density, indicating that imperfect carrier injection has strong effects on the efficiency droop. Through our analysis, we conclude that both an intrinsic component, such as Auger recombination, and current leakage component exist and make notable contributions to the total EQE droop. These two components can be quantitatively separated through our proposed method. In addition, the result above is also comparatively investigated with the result of time-resolved electroluminescence (TREL) spectroscopies. The obtained CIE and RE consistently explain the behavior of TREL at various current density levels.

[26P-108] Carrier Overflow in InGaN/GaN Light-Emitting Diodes Investigated by Temperature-Dependent Short-Circuit Current Characteristics

Dong-Kuk Youn, Gyeong Won Lee, Dong-Soo Shin, and Jong-In Shim

Hanyang University, Korea

The temperature dependence of the short-circuit current in the InGaN/GaN multiple-quantum-well light-emitting diode is investigated. From the experiments, we demonstrate that the carrier overflow to the p-GaN clad occurs more severely with decreasing temperature, resembling the behavior of the efficiency droop and the open-circuit voltage.

[26P-109] Quantitative Analysis of Carrier Escape Efficiency in GaN-Based Light-Emitting Diodes

Seung-Hyuk Lim, Young-Ho Ko, and Yong-Hoon Cho

KAIST, Korea

Internal quantum efficiency, non-radiative efficiency in the active region, and efficiency of carrier escape out of the active region in InGaN-based light-emitting diode are deduced by comparison between open- and short-circuit photoluminescence experiments.

[26P-110] Effect of the p-type GaN Thickness on the Near-Ultraviolet Light-emitting Diodes

Hyo-Shik Choi, Jong-In Shim, and Dong-Soo Shin

Hanyang University, Korea

We analyzed the influence of the p-type GaN layer thickness on the 380nm band near-ultraviolet light-emitting diodes. Both electrical and optical characteristics of the LEDs were getting worse p-type GaN layer thickness increases with growth time. We suggest that the possible degradation mechanisms of characteristics are due to the increase of the non-radiative (NR) recombination rate in the active region as a result of thermal damage during p-type GaN layer growth process.

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[26P-111] Strong Correlation Between Efficiency and Carrier Recombination Processes in Efficiency Droop of GaN Based Light-emitting Diodes

Yang Seok Yoo[1], Jong Ho Na[2], Sung Jin Son[2], and Yong Hoon Cho[1]
[1]KAIST, Korea, [2]LG Innotek, Korea

We present strong correlation between efficiency droop and carrier recombination rate variation in GaN based light-emitting diodes. And we analyze effect of radiative and nonradiative recombination processes under current injection without assuming any theoretical model.

[26P-112] Efficiency analysis of AlGaN deep UV-LEDs based on rate equation

Joosun Yun[1], Hideki Hirayama[1], and Jong-In Shim[2]
[1]RIKEN, Japan, [2]Hanyang University, Korea

Efficiencies of 280nm AlGaN Deep UV-LEDs are extracted based on carrier rate equation. The results point out that hole density in p-type cladding layer is one of the important factor for efficiency droop phenomena.

[26P-113] Design Principles of Ultra High Transmittance Dielectric/Metal/Dielectric Electrodes

Jin-Young Na, Han-Kyeol Lee, Yoon-Jong Moon, and Sun-Kyung Kim
Kyung Hee University, Korea

We designed a high-transmittance dielectric/Ag/ITO electrode for high-efficiency GaN-based light-emitting diodes by using the scattering matrix method. The optimized multilayer dielectric/Ag/ITO electrode yielded a transmittance of > 0.90 with an approximately 10-nm-thick Ag layer.

[26P-114] Optimization of AlN Substrate Geometry for AlGaN-based Deep-Ultraviolet Light-Emitting Diodes

Manabu Taniguchi[1,2], Guo-Dong Hao[1], Kousei Nakaya[1], and Shin-Ichiro Inoue[1,2]
[1]National Institute of Information and Communications Technology, Japan, [2]Kobe University, Japan

Light extraction efficiency (LEE) in deep-ultraviolet light emitting diodes with AlN substrate was investigated using Ray Tracing method. The results showed that LEE was dramatically improved by optimizing the sidewalls angle and AlN thickness.

[26P-115] Direct Mapping of Strain State in Nonpolar InGaN/GaN Multilayers Using Dark-field Inline Electron Holography

Ja Kyung Lee[1], Kyung Song[1], Christoph T. Koch[2], Woo Young Jung[1], Dmitry Tyutyunnikov[2], Jong Kyu Kim[1], Chan Gyung Park[1], Peter A. Van Aken[3], and Sang Ho Oh[1]
[1]POSTECH, Korea, [2]Ulm University, Germany, [3]Max-Planck Institute for Intelligente Systeme, Germany

Two-dimensional strain in a nonpolar InGaN/GaN quantum well was measured quantitatively using inline electron holography. A periodic undulation of the strain was observed to arise to compensate otherwise diverging potential associated with the in-plane polarization.

[26P-116] Injection-Locked Dual Fabry-Perot Laser Diodes for Interferometric Noise Suppression

Sang-Hwa Yoo, Myeonggyun Kye, Quoc-Hoai Tran, and Chang-Hee Lee
KAIST, Korea

We propose and demonstrate a reduction of mode partition noise of an F-P LD using a fiber-based Mach-Zehnder interferometer (MZI). Injection-locked dual F-P LDs suppress polarization dependence to reduce a noise power by 3-dB.

[26P-117] Global Performance Investigation of Composite Pulses in Atom Interferometry

Yukun Luo, Shuhua Yan, Jun Yang, Qingqing Hu, Aiai Jia, Chunhua Wei, and Guochao Wang
National University of Defense Technology, China

We theoretically analyzed the global performance of composite pulses on compensating off-resonance effects in atom interferometry. Results suggest emphasis be drawn on the necessity of a uniform phase response.

[26P-118] Optical and Optomechanical Design of Multiscale Gigapixel Camera System

Hyeong-Woo Joo, Hee-Joon Moon, Yeon-Chan Choi, Ho-Kwan Kang, and Cheon-Seog Rim
Hannam University, Korea

As reported in Nature journal, the super resolution gigapixel camera of Duke University was highlighted on June, 2012 from Wall Street Journal and mass media. According to the reports, Duke gigapixel camera system was developed with big grant for the purpose of military operation and surveillance under the supports of DARPA because of the needs of US military. And this gigapixel camera is expected to promote new big market in the area of national defense and vision technology in the near future. In this paper, optical structural study was first proceeded to make a sense of whole optical ray mechanism so that the lens system could be optimized effectively by utilizing the data from structural study. And we also studied optomechanical designfor building whole camera system.

[26P-119] A Bragg Diffraction-based Atomic Gravimeter

Qingqing Hu, Jun Yang, Shuhua Yan, Yukun Luo, Aiai Jia, Chunhua Wei, and Guochao Wang
National University of Defense Technology, China

We presented a Bragg diffraction-based atomic gravimeter, which is able to increase the gravity measurement sensitivity significantly compared with the common Raman atomic gravimeter. We also discussed its advantages and difficulties.

Poster Session II (Exhibition Hall / Thursday, 27 August, 13:45~15:15)

[27P-1] Terahertz Wave Modulators in Organic/Si Bilayers

Hyung Keun Yoo[1], In-Wook Hwang[1], Jung-Min Park[2], and Joong Wook Lee[2]

[1]GIST, Korea, [2]Chonnam National University, Korea

We realized optically controllable active terahertz (THz) modulators with extremely high modulation efficiencies, using organic/silicon hybrid structures. The rapid photo-induced electron transfer in thermally annealed C_{60}/silicon bilayers enables the realization of modulation efficiency up to 98%. Furthermore, we demonstrate the broadband modulation of THz waves due to the change cutoff condition caused by the formation of efficient charge separation by the photo-excitation in the structures. The realization of near-perfect modulation efficiency of THz waves opens up the possibilities of utilizing active modulators for THz spectroscopy and communications.

[27P-2] Terahertz Multi-mode Resonances in T- and Γ-shaped Resonators

Myeong-Seong Song[1], In-Seong Lee[1], Jin-Kyu Yang[2], and Joong Wook Lee[1]

[1]Chonnam National University, Korea, [2]Kongju National University, Korea

We demonstrate the characteristics of multi-mode resonance in coupled resonators with multi-slots. Our results show that the multi-mode resonance is caused by the structural complicity of the multi-slot coupled resonators. Each resonance mode corresponds to each distribution of electric charges determined by the structural dimensions.

[27P-3] Nondestructive and Remote Diagnosis on Coated Metal Surface by THz Imaging

Takashi Kimura, Seiya Takahashi, Kensaku Maeda, and Yutaka Oyama

Tohoku University, Japan

THz wave technique is available for nondestructive diagnosis on invisible metal surface covered with opaque coating and/or painting. The demonstrations are successfully conducted in which samples are insulated copper cable and hot-dip galvanized steel sheet.

[27P-4] Non-destructive Measurement of Water Contents in Polyethylene Films by THz Time Domain Spectroscopy

Yasumasa Matsuoka, Kenji Sakai, Toshihiko Kiwa, and Keiji Tsukada

Okayama University, Japan

Transmittance change of low-density polyethylene films during drying process were measured by THz-TDS. The results suggest that the quantity of water molecules in films were estimated by evaluating the magnitude of absorption peaks.

[27P-5] New Organic Electro-Optic Crystals for Highly Efficient Optical-to-THz Conversion

Seung-Heon Lee, Bong-Joo Kang, Ji-Soo Kim, Fabian Rotermund, and O-Pil Kwon

Ajou University, Korea

New organic electro-optic crystals based on acentric core OHQ exhibit excellent nonlinear optical properties and crystal characteristics, which show one order of magnitude higher THz generation efficiency than inorganic ZnTe.

[27P-6] THz Near-field Spectral Encoding Imaging Using a Rainbow Metasurface

Kanghee Lee, Hyun Joo Choi, Jaehyeon Son, Hyun-Sung Park, Jaewook Ahn, and Bumki Min

KAIST, Korea

We develop a spectral encoding image technique in the terahertz range using a space-frequency converting metasurface. From our developed technique, 2-dimensional images are successfully reconstructed using only 1-dimensional data acquisition processes.

[27P-7] Adaptive Sampling, Terahertz Dual Comb Spectroscopy Using Unstabilized Dual Lasers

Tatsuya Mizuguchi[1], Ryuichi Ichikawa[1], Takuma Matsumoto[1], Yi-Da Hsieh[1,2], Kaoru Minoshima[2,3], Hajime Inaba[2,4], and Takeshi Yasui[1,2]

[1]Tokushima University, Japan, [2]JST, Japan, [3]The University of Electro-Communications, Japan, [4]National Institute of Advanced Industrial Science and Technology, Japan

Terahertz (THz) dual comb spectroscopy (DCS) is a promising method for high-accuracy, high-resolution, broadband THz spectroscopy. In this paper, we have demonstrated adaptive-sampling THz-DCS, allowing the use of unstabilized dual femtosecond lasers.

[27P-8] Phase Modulation of Terahertz Waves in Arrayed Nanowire Heterojunction Diode

Jong-Hyuk Yim[1], Sang Hyuk Park[1], Jeong Woo Hwang[2], Sang-Bae Choi[1], Jung-Hong Min[1], Dong-Seon Lee[1], Jae Cheol Shin[3], and Young-Dahl Jho[1]

[1]GIST, Korea, [2]KOPTI, Korea, [3]Yeungnam University, Korea

We demonstrate how the phase of terahertz (THz) waves could be electrically manipulated in one-dimensional nanostructures such as $InAs_{0.75}P_{0.25}$-InP core-shell nanowires (NWs).

[27P-9] Enhanced Terahertz Transmission through Graphene on Slit Antenna

Hyun-Deok Yoo, Jong-Hyuk Yim, Ik-Bu Sohn, Hun-Kook Choi, and Young-Dahl Jho

GIST, Korea

We observed enhanced terahertz (THz) transmission by implementing visible excitation in bi-layer graphene transferred on a metal slit which was designed for funneling THz field.

[27P-10] Various Photoconductive Antennas for Efficient Terahertz Detection

Won Tae Kim[1], Bong Joo Kang[1], Truong Khang Nguyen[1], Hyeon Sang Park[2], Kang Ho Kim[1], Jae Jin Lee[1], Ik Mo Park[1], Tae In Jeon[2], and Fabian Rotermund[1]

[1]Ajou University, Korea, [2]Korea Maritime University, Korea

We propose three different photoconductive antenna designs applicable as efficient THz receiver and investigate their detection properties. The experimental results showing different characteristics of spectral sensitivity and gain agree very well with the theoretical prediction.

[27P-11] Terahertz Wavefront Characterization Using a Hartmann Sensor Combined with 2D Electro-Optic Imaging

Harsono Cahyadi[1], Jérôme Degert[2], Eric Freysz[2], Takeshi Yasui[3], and Emmanuel Abraham[2]

[1]The University of Tokushima, Japan, [2]Bordeaux University, France

Two-dimension electro-optic imaging combined with a Hartmann sensor enables THz wavefront characterization in time- and frequency-domain without cross-section scanning. Reconstruction with Zernike polynomials method allows qualitative and quantitative analysis as additional advantages.

[27P-12] Gas-Phase Spectroscopy Using THz Frequency Synthesizer Based on Dual Optical Combs

Yi-Da Hsieh[1,2], Kenta Hayashi[1], Hajime Inaba[2,3], Kaoru Minoshima[2,4], and Takeshi Yasui[1,2]

[1]Tokushima University, Japan, [2]JST, Japan, [3]The University of Electro-Communications, Japan, [4]National Institute of Advanced Industrial Science and Technology, Japan

We constructed a THz frequency synthesizer based on photomixing of two continuous-wave lasers phase-locked to dual optical combs, and applied it for precision spectroscopy of molecular gas at low pressure.

[27P-13] Analysis of Fano Coupling in Terahertz Sub-wavelength Hole Arrays with Coupled Oscillator Model

Shan Yin[1], Xinchao Lu[2], Ningning Xu[3], Yiwen E[1], Weili Zhang[3], and Li Wang[1]

[1]Chinese Academy of Sciences, China, [2]Institute of Microelectronics of Chinese Academy of Sciences, China, [3]Oklahoma State University, USA

Firstly employing coupled oscillator model to quantitatively analyze the Terahertz enhanced transmission through sub-wavelength hole arrays, we clarify the surface plasmons resonance is excited by the localized resonance via coupling instead of the external E-field.

[27P-14] Measuring the Both Surfaces Profiles of Optical Element Using Transmission Deflectometry with Liquids

Sanghoon Shin and Younghun Yu

[1]KEPCO KPS, Korea, [2]Jeju National University, Korea

We propose a method for simultaneously measuring the front and back surface profiles of transparent optical components. The proposed method combines dual wavelength transmission deflectometry with liquids to record distorted phases at different wavelengths, and then numerically reconstructs the three-dimensional phase information to image the front and back surfaces of the bifocal lens.

Poster Session II (Exhibition Hall / Thursday, 27 August, 13:45~15:15)

[27P-15] Enhanced Optical Absorption in VO_2 Film Using Photonic Crystal

Zhe Wang, Wei Hong, Qian Chen, Guohua Gu, and Jun Lu

Nanjing University of Science and Technology, China

A VO_2 film with photonic crystal (PC) pattern is investigated and the optical absorption enhancement is significantly enhanced in near IR band. The structural parameters for PC are optimized to get a better performance.

[27P-16] Spectral Dependence of Photovoltaic Cell Conversion Efficiency for Monochromatic Radiation

Minato Takesawa and Terubumi Saito

Tohoku Institue of Technology, Japan

Photovoltaic cell conversion efficiencies for quasi-monochromatic radiation have been measured as a function of the wavelength. It has been proven that the conversion efficiency is nearly proportional to the wavelength of the input radiation as the theory predicts. Also, it has been shown that the efficiency increases as a logarithmic function of the input irradiance. In conclusion, highest conversion efficiency is realized by illuminating a photovoltaic cell by intense radiation of low energy photons close to the bandgap energy while satisfying sufficient absorption.

[27P-17] Stress-induced Optical Rotation in CVD-grown Diamond

Hadiya Jasbeer, Robert Williams, Ondrej Kitzler, Jipeng Lin, Aaron McKay, and Richard Mildren

Macquarie University, Australia

Defect induced stress birefringence in CVD grown diamond has been investigated using Metripol and Mueller polarimetry. Optical rotation was observed, up to a maximum of 28^0 through an 8 mm long diamond sample, in addition to linear birefringence.

[27P-18] Broadband Soft Glass Photonic Crystal Fiber Polarization Splitter

Zhenkai Fan and Shuguang Li

Yanshan University, China

We report on a novel soft glass dual-core photonic crystal fiber (DC-PCF) with a chalcogenide glass core, whose polarization dependent coupling can be enhanced by the high refractive index As_2S_3 core. Numerical results demonstrate the designed soft glass DC-PCF application as a broadband polarization splitter.

[27P-19] Broadband, Ultrahigh-Sensitivity Plasmonic Antennas Prepared from Nanoparticles on Imprinted Mirrors

Yi-Chuan Tseng, Chen-Chieh Yu, Pao-Yun Su, Keng-Te Lin, Chang-Ching Shao, Sin-Yi Chou, Yu-Ting Yen, and Hsuen-Li Chen

National Taiwan University, Taiwan

We developed a low-cost and direct imprint-in-metal method to prepare incident angle–tuned, broadband, ultrahigh-sensitivity plasmonic antennas from nanoparticles (NPs) and imprinted-metal mirrors that can detect analytes at concentrations as low as 10^{-15} M.

[27P-20] Spatial Mode Projection Technique in Extracting Nanofeatures

Nestor Jr. Bareza and Nathaniel Hermosa

University of the Philippines, Philippines

We propose a technique based on spatial mode projection that can access dimensional information of nanofeatures. We demonstrate this by calculating the power of a mode-projected Gaussian beam that has been reflected by a nanocylinder.

[27P-21] Analytical Modeling of a Linear Variable Filter for Hyperspectral Sensing

Cheng-Hao Ko[1], Kuei-Ying Chang[1], You-Min Huang[1], Jih-Run Tsai[2], and Bang-Ji Wang[2]

[1]National Taiwan University of Science and Technology, Taiwan, [2]National Space Organization, Taiwan

An analytical thin film thickness model calculates the profiles of linear variable filters, which perform spectral filtering. Coupled with an image sensor and using a computational algorithm, this device becomes a LVF-hyperspectral imager.

[27P-22] Development of a Transmissometer for Meteorological Visibility Measurement

Seongchong Park, Dong-Hoon Lee, and Yong-Gyoo Kim

KRISS, Korea

We developed a 62 m-baseline transmissometer to establish the national standard on visibility observation. A 75 W, white LED with 3000 K CCT1 is used for transmitter, and two photometers for receiver and monitor.

[27P-23] Phase Relations between the Reflected and Transmitted Light Waves at Beam Splitters

Jueun Park, Byung Woo Son, Hee Joo Choi, and Myoungsik Cha

Pusan National University, Korea

We investigated the phase relations between the reflected and the transmitted light waves at beam splitters made of lossless dielectric stacks. Definite phase relations exist dictated by the generalized Stokes relations irrespective of the detailed layer structure of the beam splitter. We verified it numerically for two representative beam splitters with symmetric and asymmetric layer structures, respectively.

[27P-24] Dual Optical Comb Spectroscopy Using Modified Adaptive Sampling Method

Shuji Miyamoto[1], Yi-Da Hsieh[1,2], Kohei Kotani[1], Sho Okubo[2,3], Hajime Inaba[2,3], and Takeshi Yasui[1,2]

[1]Tokushima University, Japan, [2]Japan Science and Technology Agency, Japan, [3]National Institute of Advanced Industrial Science and Technology, Japan

We apply a modified adaptive sampling method for dual optical comb spectroscopy in order to make signal integration of interferogram in time domain for improvement of signal-to-noise ratio.

[27P-25] 30 GHz Spaced Astro-comb for Low Resolution Astronomical Spectrographs

Yuxuan Ma[1], Yizhou Liu[1], Ziyun Kong[1], Fei Zhao[2], Chen Li[1], Tongxiao Jiang[1], Aimin Wang[1], Gang Zhao[2], and Zhigang Zhang[1]

[1]Peking University, China, [2]Chinese Academy of Sciences, China

We demonstrate an astro-comb for relatively low resolution astronomical spectrographs. The space of comb lines is filtered to 30 GHz by a Fabry-Perot cavity spaced by an ULE glass. The radial velocity precision is <40 cm/s.

[27P-26] Highly Stabilized Fiber-based Optical Frequency Comb Interferometer with Meters-wide Scanning Range by Frequency Tuning

Yoshiaki Nakajima[1,2] and Kaoru Minoshima[1,2]

[1]The University of Electro-Communications, Japan, [2]Japan Science and Technology Agency, Japan

We developed a fiber-based optical frequency comb interferometer with fiber noise cancellation technique. Long reference path was stabilized to nm-level, and extremely wide length scanning range of 2.8-m was demonstrated only by repetition frequency tuning.

[27P-27] Application of Raman Spectroscopy in Detection of Aflatoxin B1 in Maize Kernels

Mary S. Taabu, Zephania Birech, and Kenneth Kaduki

University of Nairobi, Kenya

Use of Raman spectroscopy in detecting aflatoxin B1 (AFB1) in maize kernels is reported. Distinct difference between AFB1 contaminated and uncontaminated kernels were observed from Raman spectral profiles obtained after 532 nm excitation.

[27P-28] Seeking Null Frequencies by Autocorrelation of Spectrum of Interference Signal

Nian Fang, Lutang Wang, and Zhaoming Huang

Shanghai University, China

In order to locate accurately external disturbances in a Sagnac interferometer fiber sensing system, a seeking null frequencies method of calculating autocorrelation of frequency spectrum of interference signal is proposed and demonstrated by software simulation.

Poster Session II (Exhibition Hall / Thursday, 27 August, 13:45~15:15)

[27P-29] Stress Induced Bend Compensation in a Large Mode Area Fiber

Xuan Wu, Huizi Li, and Seongwoo Yoo
Nanyang Technological University, Singapore

Large mode area fiber with pre-compensated index profile by asymmetric stress applying part is proposed to effectively cancel out the bending effects. Mode area scalability up to ~2500 μm^2 is presented.

[27P-30] Fibre Fabrications for High Power Laser Fibres and High Nonlinearity Fibres

Seongwoo Yoo, Sidharthan Raghuraman, Daryl Ho, Men Seng Yue, Xuan Wu, and Liling Zhang
Nanyang Technological University, Singapore

This paper presents fibre fabrications to achieve asymmetric core fibre for high power laser applications and high-nonlinearity fibres for Raman scattering. Fabrication results and challenges are discussed.

[27P-31] Theoretical Study of Deep Laser Cooling of Magnesium Atoms

Oleg Prudnikov[1], Denis Brazhnikov[1,2], Anatoly Bonert[2], Andrei Goncharov[1,2,3], Roman Ilenkov[2], Alexey Taichenachev[1,2], and Valeriy Yudin[1,2,3,4]
[1]Novosibirsk State University, Russia, [2]Institute of Laser Physics SB RAS, Russia, [3]Novosibirsk State Technical University, Russia, [4]Russian Quantum Center, Russia

The two-stage laser cooling strategy for ^{24}Mg is proposed. The calculations based on quantum treatment with full account for the recoil effect. The results can assist overcoming current difficulties in deep laser cooling of magnesium.

[27P-32] Discrete Rogue Waves in an Array of Waveguides

Cem Yuce and S. Efe
Anadolu University, Turkey

We study discrete rogue waves in an array of nonlinear waveguides. We show that very small degree of disorder due to experimental imperfection has a deep effect on the formation of discrete rogue waves. We predict long-living discrete rogue wave solution of the discrete nonlinear Schrodinger equation.

[27P-33] Sub-Doppler DAVLL for D Lines of Rb Atoms

Gyeong-Won Choi and Heung-Ryoul Noh
Chonnam National University, Korea

A theoretical and experimental study of lineshapes in sub-Doppler DAVLL (dichroic atomic vapor laser lock) spectroscopy for the D lines of Rb atoms was presented. From the calculation of sub-Doppler DAVLL spectra using both density matrix equations and rate equations we found that the coherence effect depended significantly on the branching ratios of the transition lines. We also investigated the dependence of the amplitude and the slope of the spectra on the magnetic field and the pump beam intensity, and found good agreement with the results calculated from the rate equation.

[27P-34] Propagation of the Light Phase Pulses in Atomic Λ-type Medium Under EIT Conditions

Maksim Basalaev[1,3], Oleg Prudnikov[1], Alexey Taichenachev[1,2], and Valery Yudin[1,3]
[1]Novosibirsk State University, Russia, [2]Institute of Laser Physics SB RAS, Russia, [3]Novosibirsk State Technical University, Russia

We study the dynamics of the phase pulses of laser radiation with two resonant frequency components propagating in at atomic three-level medium. We show that the effect of great slowing-down occurs also for phase pulses.

[27P-35] Protecting Quantum Discord Using Weak Measurement and Quantum Measurement Reversal

Jiwon Yune[1], Kang-Hee Hong[2], Hyang-Tag Lim[2], Jong-Chan Lee[2], Osung Kwon[1], Sang-Wook Han[1], Sung Moon[1], Yong-Su Kim[1], and Yoon-Ho Kim[2]
[1]KIST, Korea, [2]POSTECH, Korea

We report that quantum discord can be protected from decoherence by making use of weak and reversing quantum measurements, making it possible to distribute quantum correlation between two remote parties in noisy environment.

[27P-36] Generation of Time-Bin Entangled Photon Pairs Utilizing Coherence Revival Property of a CW Multi-mode Laser

Osung Kwon[1], Kwang-Kyoon Park[2], Young-Sik Ra[2], Yong-Su Kim[1], and Yoon-Ho Kim[2]
[1]KIST, Korea, [2]POSTECH, Korea

We report another regime for generation of time-bin entangled photon pairs and demonstrate the scheme experimentally. In our scheme, the photon pairs are pumped by a cw multi-mode laser having coherence revival property.

[27P-37] The Quantum Problem of Laser Cooling of Two-level Atoms: Statistical Approach

Roman Ilenkov[1,2], Oleg Prudnikov[1], Alexey Taichenachev[1,2], and Valery Yudin[1,3]
[1]Novosibirsk State University, Russia, [2]Institute of Laser Physics SB RAS, Russia, [3]Novosibirsk State Technical University, Russia

Developed a statistical approach, which provides information about the cooling time of an atomic ensemble without directly solving a dynamic problem. The effect of velocity saturation of laser cooling with increasing Rabi frequency was found.

[27P-38] Avoiding Entanglement Sudden Death on Two-qubit Systems Using Single-qubit Quantum Measurement Reversal

Hyang-Tag Lim, Jong-Chan Lee, Kang-Hee Hong, and Yoon-Ho Kim
POSTECH, Korea

Decoherence on two-qubit systems degrades entanglement, and sometimes even causes entanglement sudden death (ESD). We show that quantum measurement reversal on only one subsystem can avoid ESD, providing methods for practical entanglement distribution under decoherence.

[27P-39] Apparatus for Generating Quantum Degenerate Gases of Ytterbium Atoms

Min-Seok Kim, Moosong Lee, Jeong Ho Han, and Yong-Il Shin
Seoul National University, Korea

We present an experimental apparatus where we can generate a Bose-Einstein condensate of 6.2×104 174Yb atoms or a degenerate Fermi gas of 7.8×104 173Yb atoms at T/TF=0.31.

[27P-40] Cotrollable Asymmetric Matter-wave Beam Splitter and Ring Potential on an Atom Chip

Seung Jin Kim[1], Seok Tae Gang[1], Hoon Yu[2], and Jung Bog Kim[1]
[1]Korea National University of Education, Korea, [2]University of Colorado, USA

We have constructed an asymmetric matter-wave beam splitter and a ring potential on an atom chip by applying rf-field parallel to the quantization axis added to perpendicular rf-fields. Versatile controllability on the potentials can be obtained.

[27P-41] Quantum Key Distribution with Mode-locked Two-photon States

Tomoyuki Horikiri
Yokohama National University, Japan

Quantum key distribution (QKD) with mode-locked two-photon states is discussed. The photon source with a comblike second-order correlation function is shown to be useful for implementing long distance time-energy entanglement QKD.

[27P-42] Two-photon Interference between Distinguishable Pathways Utilizing SPDC Pumped by a Multimode Diode Laser

Osung Kwon, Yujun Choi, Young-Su Kim, Sang Wook Han, and Sung Moon
KIST, Korea

We report the two-photon interference between distinguishable pathways before arriving at two detectors utilizing SPDC pumped by a multimode diode laser with the distinctive coherence property.

[27P-43] Polymer Planar Optical Waveguides for Optical Interconnections

Vaclav Prajzler[1], Pavla Nekvindova[2], Petr Hyps[1], Jan Brychta[1], and Vitezslav Jerabek[1]
[1]Czech Technical University, Czech, [2]Institute of Chemical Technology, Czech

The paper reports on technology for realization of an optical planar waveguides for optical interconnections. The waveguiding properties were measured by dark mode spectroscopy and optical loss were measured by the fiber probe technique.

Poster Session II (Exhibition Hall / Thursday, 27 August, 13:45~15:15)

[27P-44] Circular Polarization Filters Using Perturbed Chiral Sculptured Thin Films

Zahir Muhammad

Quaid-i-Azam University, Pakistan

A structurally chiral layer defect or central 90◦ twist-defect in chiral sculptured thin film (STF) transmits light of one circular polarization state and reflect other in a spectral Bragg regime. The perturb chiral STF reflects light of both circular polarization states in the Bragg regime if the amplitude of modulation of vapor incident angle is increases. A structurally chiral layer defect in a perturbed chiral STF results as a narrow bandpass or ultranarrow bandstop filter depending upon different thickness of the STF. However, both the bandpass or narrow bandpass and ultranarrow bandstop filters are made polarization-insensitive by the appropriate modulation of the tilt nanohelixes of perturb chiral STF. Moreover, it is also observed that the polarization-insensitive Bragg mirrors, laser mirror and Bragg reflector fabricated using chiral STFs, which are very tolerant of structurally chiral layer defect if the amplitude of modulation vapor incident angle of the structural nano-materials is sufficiently large.

[27P-45] Transmission of Laser Light Through Tapered Glass Capillaries for Microbeams

Wei-Guo Jin[1], Sou Kawamura[1], Yuya Ito[1], Tatsuya Minowa[1], and Tokihiro Ikeda[2]

[1]Toho University, Japan, [2]RIKEN, Japan

Propagation and transmission of laser beam through tapered glass capillary were investigated for light microbeams. Transmittances of laser light at 488 nm and 633 nm through capillaries were measured to be up to 15 %, depending on outlet diameters. By modeling the real capillary, transmittances were calculated using taper angles obtained from shape analysis and agree well with experimental ones.

[27P-46] Tunable Chirality Indouble-layer Metamaterials

Yu Zhu

Peking University, China

An all-optical tunable chirality is realized in a doublelayer photonic metamaterial. The maximum circular dichroism reached 30%. Under excitation of a 40 kW/cm^2 weak pump light, the peak in the circular dichroism shifts 45 nm in the short-wavelength direction and an ultrafast response time of 35 ps is maintained.

[27P-47] Nanolithography Using Micro-scale Mask Enabled by Hyperbolic Metamaterial

Donghwan Kim, Yong Rae Cho, and Bumki Min

KAIST, Korea

We newly developed a nano-scale patterning method overcoming the diffraction limit of conventional photolithography technique by utilizing micro-scale aluminum mask-hyperbolic metamaterials hybrid structures, which is supported by our numerical simulation and experimental results.

[27P-48] PL Emission of InP/GaInAs/InP Core-multishell NWs Grown by Self-catalytic VLS Mode

Takehiro Ogino, Keita Asakura, Takao Waho, and Kazuhiko Shimomura

Sophia University, Japan

Photoluminescence emission of InP/GaInAs/InP core-multishell nanowires was obtained at room temperature. InP nanowires were grown on InP(111)B substrate by selfcatalytic VLS mode of MOVPE using an indium catalyst. InP-core and GaInAs-shell structure was grown by changing the growth temperature. We have successfully obtained the PL emission from these core-shell nanowires at room temperature, and measured the PL spectrum dependent on the thickness of GaInAs-shell.

[27P-49] Terahertz Wire-grid Polarizer with Al Grating

Rei Yoshida[1], Itsunari Yamada[1], Junichi Yanagisawa[1], Keisuke Takano[2], Masanori Hangyo[2], Mitsunori Saito[3], and Wataru Watanabe[4]

[1]University of Shiga Prefecture, Japan, [2]Osaka University, Japan, [3]Ryukoku University, Japan, [4]Ritsumeikan University, Japan

A terahertz (THz) wire-grid polarizer consisting of a micrometer-pitch Al grating on a Si substrate was fabricated by photolithography and wet etching. Extinction ratio (the ratio of TM and TE transmittances) was over 35 dB at 0.5 THz, and over 23 dBin the 0.5–3 THz range. At the Brewster's angle of Si (74°), TM transmission exceeded 90% in the 0.5–3 THz range. The fabricated polarizer had a higher extinction ratio than conventional free-standing terahertz wiregrid polarizers.

[27P-50] Lasing Characteristics of Cardioid-Shaped 2-D Microcavity Laser

In-Goo Lee[1], Sung Min Go[1], Changhwan Yi[2], Ji-Won Lee[2], Ji-Hwan Kim[1], Jin-Hyeok Ryu[1], Kwang-Ryung Oh[3], Sung-Bock Kim[3], and Chil-Min Kim[2]

[1]Sogang University, Korea, [2]DGIST, Korea, [3]ETRI, Korea

Directional emission in a cardioid-shaped microcavity is investigated. When a microcavity laser deformed from a circular shape in polar coordinate is excited by current injection, it emits unidirectionally at a certain deformation parameter. We confirm the emission characteristics in an InGaAsP semiconductor laser.

[27P-51] Dynamical Properties in Asymmetric Reuleaux Triangle 2-D Microcavity

Jinhyeok Ryu[1], Ji-Won Lee[2], Changhwan Yi[2], Ji-Hwan Kim[1], In-Goo Lee[1], Sung-Min Go[1], and Chil-Min Kim[2]

[1]Sogang University, Korea, [2]DGIST, Korea

A Reuleaux triangle microcavity is one of the curves having a constant width. We deform it asymmetrically and compute its ray and wave properties. As a result, we find a uni-directionally emitting mode at a single window. Here, we investigate the emission mechanism and characteristics depending on the deformation.

[27P-52] Mid-Infrared Optical Waveguide Modulator Based on the Epsilon-near-Zero Effect of ITO

Jeonghun Lee and Min-Suk Kwon

UNIST, Korea

Electroabsorption modulators based on the epsilon-nearzero (ENZ) effect of ITO are theoretically investigated. They are designed to work in the mid-infrared. We demonstrate that the modulator length is made smaller than 1.16 μm.

[27P-53] Optical Mode Converter Using Ring Resonator Structure

Intekhab Alam, M. Raquib Ehsan, Saika Muntaha Bari, Mainul Haque, and Nur-E Mohammad Rifat

United International University, Bangladesh

We present a novel ring resonator structure for optical mode conversion for mode division multiplexing. The proposed micro structure (<15x15 μm^2) converts 0th mode to 1st mode with just 1.08 dB conversion loss (λ =1.55 μm, TEmode).

[27P-54] Ultra-flat and Broad Optical Frequency Combs Generation Based on Novel Dispersion-flattened Double-slot Microring Resonator

Yuanwu Wang, Minming Zhang, Luluzi Lu, Meifeng Li, Jinghao Wang, and Deming Liu

Huazhong University of Science and Technology, China

An ultra-flat and broad optical frequency comb with 7 dB bandwidth of 1155 nm wavelength is obtained, based on a novel double-slot microring resonator in simulation, which produces flattened dispersion of 0 ~ 3.8 ps/(nm·km) over a 1150 nm wavelengthrange.

[27P-55] InGaAsP Nanobeam Light Emitter Integrated with Si Waveguide via Transfer Printing

Jaehyeon Son[1], Indra Karnadi[1], Ju-Young Kim[2], Hoon Jang[1], Seungwoo Lee[3], Ki Soo Kim[4], Yong Hee Lee[1], and Bumki Min[1]

[1]KAIST, Korea, [2]Stanford University, USA, [3]Sungkyunkwan University, Korea, [4]ETRI, Korea

A nanobeam photonic crystal cavity made with InGaAsP quantum well and Si waveguide is integrated on SiO_2/Si substrate via transfer printing. The light emitted from the nanobeam showed coupling to waveguide. We demonstrated novel way to integrate III-V devices on Si based photonic integrated circuits.

[27P-56] Ultralow-energy InGaAsP Modulators Based on a Photonic Crystal Waveguide/Nanocavity Involving the Franz-Keldysh Effect

Kengo Nozaki, Shinji Matsuo, Abdul Shakoor, Silviu Dinulescu, Koji Takeda, Takuro Fujii, Eiichi Kuramochi, and Masaya Notomi

NTT Corporation, Japan

Ultrasmall InGaAsP optical modulators were realized using a photonic crystal waveguide/nanocavity with a small capacitance p-i-n junction and the Franz-Keldysh effect. Eye patterns reaching 56 Gb/s and a record-low charging energy of <100 aJ/bit were evaluated.

Poster Session II (Exhibition Hall / Thursday, 27 August, 13:45~15:15)

[27P-57] Microwave Signal Generation Using Sideband Injection Locking in an Fabry-Perot Laser Diode

Liqing Gan[1], Feng Li[1], Jie Liu[2], and P. K. A. Wai[1]

[1]The Hong Kong Polytechnic University, Hong Kong, China, [2]Sun Yat-sen University, China

Microwave signal generation using sideband injection locking in a Fabry-Pérot laser diode is studied numerically. The frequency tuning range in frequency doubling and maximum RF output power in frequency doubling, tripling, and quadrupling is compared.

[27P-58] Spectral Tuning of an Add-drop Filter by Using Double Dielectric Microdisks

Da Eun Lee, Tae-Woo Lee, and Soon-Hong Kwon

Chung-Ang University, Korea

A spectrally tunable add-drop filter based on a whispering gallery mode in a double dielectric microdisk pair with an air gap is proposed, and its operation process and performance are demonstrated by finite-difference time-domain simulation.

[27P-59] Optical Bistable Temperature Switch Properties Using 1DPC with a Kerr Defect

Juan Zhang and Rongjun Zhang

Shanghai University, China

Optical bistable temperature switching is investigated for one-dimensional Kerr defective photonic crystal. Steep transition and high optical contrast can be achieved and switching temperature and the hysteresis width can be precisely tuned.

[27P-60] Emission Characteristics of a Microcavity Laser Comprised of Half Circle and Half Ellipse

Ji-Won Lee[1], Changhwan Yi[1], Ji-Hwan Kim[2], Kwang Ryong Oh[3], Sung-Bock Kim[3], and Chil-Min Kim[1]

[1]DGIST, Korea, [2]Sogang University, Korea, [3]ETRI, Korea

We experimentally investigate emission characteristics of a microcavity laser, which is comprised of a half ellipse and a half circle. The emission direction of the fabricated InGaAsP semiconductor laser is unidirectional. At high injection current, the laser emits a single mode.

[27P-61] Interaction between Slots as Oscillator Model

Suyeon Lee and Q-Han Park

Korea University, Korea

We present oscillator model for coupled plasmonic resonators. Narrow slot on metal film can be modeled as a bound charge oscillator. The oscillator model offers quantitative description about fundamental modes and electromagnetic induced transparency spectrum.

[27P-62] Design of Epsilon-Near-Zero Coherent Perfect Absorption with Indium Tin Oxide Thin Films Using Admittance Matching Method

Tae Young Kim[1], Md. Alamgir Badsha[1], Junho Yoon[1], Young Chul Jun[2], and Chang Kwon Hwangbo[1]

[1]Inha University, Korea, [2]UNIST, Korea

In this study, we report ITO thin film designs for epsilon-near-zero coherent perfect absorption in near infrared wavelength regime using an admittance matching method and investigate their optical properties.

[27P-63] Numerical Simulation of an Ultra-Wide Tunability and Enhanced Spontaneous Emission of a Nanofiber Bragg Cavity

Hideaki Takashima[1,2,3], Andreas W. Schell[1,2,3], Shinjiro Fujita[1], Yasuko Oe[1,2,3], Syunya Kamioka[2,3], Masazumi Fujiwara[2,3], and Shigeki Takeuchi[1,2,3]

[1]Kyoto University, Japan, [2]Hokkaido University, Japan, [3]Osaka University, Japan

A detailed numerical study using 3D FDTD simulation on the fiber Bragg grating cavity is reported in order to further improve the ultra-wide tunability over 20 nm and the enhanced spontaneous emission we recently reported.

[27P-64] Design of High-Efficiency Nanorod Emitters Using Optical Cavity Effects

Da-Som Kim, Jin-Young Na, Yoon-Jong Moon, and Sun-Kyung Kim

Kyung Hee University, Korea

We studied the extraction efficiency of nanorod emitters by performing full-vectorial electromagnetic simulations. The result indicated that the extraction efficiency was dramatically changed by the radial position of a light generation layer.

[27P-65] Polarization-dependent Properties of Human Scleral Tissues at Terahertz Frequencies

Dae-Cheol Shin[1], Jung-Min Park[1], Gyeong Bok Jung[2], Jae-Ho Shin[2], Chul-Sik Kee[3], Chul Kang[3], and Joong Wook Lee[1]

[1]Chonnam National University, Korea, [2]Kyung Hee University, Korea, [3]GIST, Korea

We used terahertz time-domain spectroscopy to distinguish between normal and cross-linked human scleral tissues. Normal tissue is sensitive to the polarization of terahertz waves, whereas cross-linked tissue is polarization insensitive. Our results demonstrate terahertz spectroscopy can be a powerful tool for investigating human scleral tissues.

[27P-66] A Self-calibrating Fluorescent Sensor for Mitochondrial Micro-viscosity Imaging and Measurement

Zhigang Yang, Danying Lin, Xiao Peng, and Junle Qu

Shenzhen University, China

A fluorescent rotor was developed for mitochondrial microviscosity imaging, by which the mitochondrial average viscosity was determined to be ca. 62 cp in normal HeLa cells and was increased to ca. 110 cp after treated by nystatin.

[27P-67] Fluorescence Lifetime Determination of Photo-bleaching Correlation

Won Sang Hwang, Youngsik Song, and Dugyoung Kim

Yonsei University, Korea

FLIM is relatively stable about photo-bleaching effect. In case of dye has multi-exponential decay property, fluorescence lifetime can be affected by photo-bleaching. Such lifetime variation can cause critical error in many FLIM applications. If lifetime is changed by photobleaching, we cannot measure accurately donor lifetime with acceptor. It is difficult to separate lifetime variation by photo-bleaching and FRET. For this reason, we carry out the experiment to know influence of such fluorescence intensity loss on fluorescence lifetime.

[27P-68] Imaging through Turbidity by Using Speckle Illumination

Joo Eon Oh[1], Giuliano Scarcelli[2], and Yoon-Ho Kim[1]

[1]POSTECH, Korea, [2]University of Maryland, USA

We demonstrate that a clear image of an object hidden behind a turbid medium may be obtained by using speckle illumination and correlation measurement whereas coherent illumination only results distorted and blurred images.

[27P-69] Digital Holographic Microscopy for Phase Images of Cervical Cells 3D Structure

Mona Mihailescu[1], Irina Alexandra Paun[1], Eugen Scarlat[1], Irina Grigorescu[1], Oana Tatiana Nedelcu[2], and Roxana Radu[3]

[1]Politehnica University from Bucharest, Rumania, [2]National Institute for Microtechnology, Rumania, [3]Lotus Hospital, Rumania

The phase images of cervical cells were obtained in digital holographic microscopy to establish the cells 3D characteristics as criteria for information quantification and cells classification. We introduced a simple approach for the cells overlapping regions based on the focalization criteria.

[27P-70] Supercontinuum as a Light Source for Miniature CMOS Sensors in Endoscopic Imaging

Ming-kuan Lu[1,2], Hsin-Yu Lin[1], Chih-Cheng Hsieh[3], and Fu-Jen Kao[1]

[1]National Yang-Ming University, Taiwan, [2]Chung-Hua Telecom Research Institute, Taiwan, [3]Taipei Veteran General Hospital, Taiwan

We have successfully implemented supercontinuum through fiber coupling as a light source for miniature CMOS sensors (~0.8 mm) in endoscopic imaging. Comparison with LED and other light sources are also made to show the advantages and characteristics of supercontinuum.

Poster Session II (Exhibition Hall / Thursday, 27 August, 13:45~15:15)

[27P-71] Multiple Labeling Fluorescence Lifetime Analysis in a Single Shot Imaging

Young Sik Song[1], Young Jae Won[2], Chang Jun Lee[1], and Dug Young Kim[1]

[1]Yonsei University, Korea, [2]Osong Medical Innovation Foundation, Korea

We propose new approaches analysis for fluorescence lifetime imaging measurement of multiple labeling at single shot process. This paper suggests analysis concept of which can extract small scale signal ratio simply in the complex environment.

[27P-72] Detection of Blood Flow Using Laser Speckle Contrast Imaging with Dual Wavelengths

Youngmo Jeong, Jiwoon Yeom, and Byoungho Lee

Seoul National University, Korea

A detection system for blood flow using laser speckle contrast with dual wavelengths is proposed. A 780 nm near-infrared laser and a 450 nm blue laser are simultaneously utilized to eliminate the effect of scattering at skin.

[27P-73] Mapping the Progression of Malaria Infected Erythrocytes with Holographic Microscopy

Xuefei He, Alexander Maier, and Steve Lee

The Australian National University, Australia

We demonstrate an off-axis digital holographic microscopy system for imaging infected red blood cell and propose to combine that with flow channels to study adhesion bonds of infected blood cells at the cellular and molecular level.

[27P-74] Compact Probe Head of Second-Harmonic-Generation Microscopy for Dermatological Applications

Kosuke Atsuta, Eiji Hase, and Takeshi Yasui

The Tokushima University, Japan

We construct a compact probe head of the fiber-based SHG microscopy for the dermatological applications, and successfully demonstrated SHG imaging of the tendon sample using it.

[27P-75] Lithium-Niobate-Silica Hybrid Whispering-Gallery-Mode Resonators

Fang Bo[1,2], Jie Wang[1], Jiao Cui[1], Sahin Ozdemir[2], Yongfa Kong[1], Guoquan Zhang[1], Jingjun Xu[1], and Lan Yang[2]

[1]Nankai University, China, [2]Washington University, USA

Hybrid wishpering-gallery-mode resonators were made by depositing a ploycrystalline lihtium noibate film onto silica resonators. Efficient coupling with tapered fiber and all-optical modulation were realized in these resonators.

[27P-76] Optical Feedback Effects on the Dynamics of Semiconductor Nano-lasers

Alan Shore and Zubaida Sattar

Bangor University, UK

Enhanced spontaneous emission effects are shown to increase the sensitivity of semiconductor nano-lasers to optical feedback. These results have significance for the use of nano-lasers in photonic integrated circuits.

[27P-77] Lasing on Surface States at the Edge of a Defect-free Photonic Crystal

Yonan Su[1], Chun-Yan Lin[1], Ray-Ching Hong[1], Wen-Xing Yang[1,2], Chien-Chung Jeng[3], Tien-Chang Lu[4], and Ray-Kuang Lee[1]

[1]National Tsing-Hua University, Taiwan, [2]Southeast University, China, [3]National Chung-Hsing University, Taiwan, [4]National Chiao Tung University, Taiwan

We report experimental observation of lasing on surface states, in the form of standing waves at the termination of a defect-free photonic crystal on top of vertical cavity surface emission lasers. Direct images of lasing modes at the truncated periodic potential, along one side of a square lattice, are demonstrated by collecting near-field radiation patterns, as well as in numerical simulations.

[27P-78] Realization of Bragg Grating Based Integrated Fractional Photonic Hilbert Transformer

Bolan Liu[1], Chaotan Sima[1], Wei Yang[1], Deming Liu[1], Yu Yu[1], James Gates[2], Michalis Zervas[2], and Peter Smith[2]

[1]Huazhong University of Science and Technology, China, [2]University of Southampton, UK

Wideband integrated fractional order photonic Hilbert transformer (FrPHT) is proposed and demonstrated, by using single apodized Bragg gratings with phase shifts in a silica-on-silicon planar platform. Effects of apodization profiles and operation bandwidths are analyzed.

[27P-79] Lasing Characteristics of Resonance Modes in a Racetrack Cavity with Hexagonal Corners

Jae-Dong Kim, Kyung-Sook Hyun, and Hee-Jong Moon

Sejong University, Korea

We propose resonance mode in a racetrack cavity with hexagonal corners, in which the modes are guided by both boundaries of the corner. The modes were demonstrated by investigating the laser oscillations in semiconductor cavities.

[27P-80] Optical Heterodyne Detection of a Surface Plasmon Signal in an Electronic Circuit

Shinya Okahisa[1], Hiroki Sakai[1], Takuma Aihara[1,2], Masashi Fukuhara[1,2], Yuya Ishii[1], and Mitsuo Fukuda[1]

[1]Toyohashi University of Technology, Japan, [2]Japan Society for the Promotion of Science, Japan

We demonstrate the dynamic operation of monolithically integrated plasmonic detector and MOSFETs on silicon. The integrated device operates at the beat signal of surface plasmons converted from two light beams in 1.31-μm wavelength band.

[27P-81] In-Situ Monolithic Integration of Nanobeam Laser with Passive Waveguide on SOI

Jungmin Lee, Hoon Jang, Indra Karnadi, Putu E. Pramudita, Hwi-Min Kim, and Yong Hee Lee

KAIST, Korea

We demonstrate in-situ monolithic integration of an InPbased nanobeam laser and a passive waveguide on SOI using selective quantum well etching technique. The device on SOI platform is realized by employing transfer printing process.

[27P-82] Cavity Length Dependence on Lasing Characteristics of Double-capped QDs Laser

Toshiki Sukigara, Yuta Yamamoto, Tetsuo Nishiyama, and Kazuhiko Shimomura

Sophia University, Japan

Cavity length dependence on lasing characteristics was obtained in the p-modulation doped double-capped InAs QDs laser on the InP substrate at 1.65 μm wavelength. Stranski-Krastanov InAs QDs was grown low-pressure MOVPE, and employed the p-modulationdoping in the capping layer during the double-capped process. Lasing characteristics was obtained under pulsed injection current at room temperature. We have shown the lasing wavelength and threshold current dependent on the cavity length of the laser.

[27P-83] Monolithic Integration of Microlaser with Passive Waveguide via Selective Quantum well Etching

Hwi-Min Kim, Hoon Jang, Sejeong Kim, and Yong Hee Lee

KAIST, Korea

Monolithic integration of a photonic crystal laser and a passive waveguides via selective quantum well etching are demonstrated. Coupling efficiency between photonic crystal cavity and waveguide is investigated numerically.

[27P-84] Integrated Polarization Rotator on Silicon Waveguides with an Asymmetric Trench

Yudeuk Kim[1], Dong Wook Kim[1], Moon Hyeok Lee[1], Min Hee Lee[1], Dong Eun Yoo[2], Ki Nam Kim[2], Sang Chul Jeon[3], and Kyong Hon Kim[1]

[1]Inha University, Korea, [2]National Nanofab Center, Korea, [3]Korea Polytechnics, Korea

We demonstrate an integrated polarization rotator with a single trench on a silicon waveguide fabricated using a single etch-step complementary metal–oxide–semiconductor (CMOS)-compatible process. The measured polarization rotation efficiency is 95 %with 0.76 dB insertion loss for a total 67-μm long and 100-nm wide asymmetric trench.

Poster Session II (Exhibition Hall / Thursday, 27 August, 13:45~15:15)

[27P-85] Measuring Equi-frequency Contours of Spoof Surface Plasmon Polaritons

Kap-Joong Kim[1], Seong-Han Kim[2], Chul-Sik Kee[2], and Yong Hee Lee[3]
[1]ETRI, Korea, [2]GIST, Korea, [3]KAIST, Korea

By directly measuring electric fields, we obtain equifrequency contours of surface waves. In the metallic square lattice, the presence of the anisotropy from the equifrequency contours is experimentally confirmed.

[27P-86] Thermo-optic Tunable Silicon Grating Coupler

Linghai Liu, Bingqing Zhu, and Hon Ki Tsang
The Chinese University of Hong Kong, Hong Kong, China

We demonstrate a thermally tunable silicon grating coupler. The experimental result of ~10nm shift in center wavelength at about 410mW electrical power was in reasonable agreement with the expected ~16nm tuning range.

[27P-87] Selection of the Lasing Direction using S-bend in the Semiconductor Cavities

Kyung-Sook Hyun, Sang-Hyuk Jeong, Young Hoon Kim, Dae-Jin Kim, and Jinwoong Lee
Sejong University, Korea

The selection of lasing direction in micro cavity is demonstrated by using s-bend in the rectangular cavity. The parameter of S-bend section is calculated to minimize the propagation loss and optimized to serve good selectivity.

[27P-88] Proposal of a PLC-based 3-mode (2 LP modes) Demultiplexer

Keito Kataoka, Hirokazu Kubota, Yuji Miyoshi, and Masaharu Ohashi
Osaka Prefecture University, Japan

We propose a PLC-based 3-mode demultiplexer and numerically investigate three mode separation of the demultiplexer. Insertion loss is calculated by the numerical simulation.

[27P-89] Plasma Assisted Tunable Exciton States in Monolayer MoS_2

Younghee Kim, Young In Jhon, June Park, Jae Hun Kim, and Young Min Jhon
KIST, Korea

We performed photoluminescence (PL) and Raman spectroscopy for Cl_2 and H_2 plasma modified monolayer MoS_2 (1L-MoS_2) crystals. We demonstrated that PL intensities in 1L-MoS_2 can be tuned by treating Cl_2 and H_2 plasma.

[27P-90] Electrically Driven Quasicrystal Microcavity Laser Based on Organic Semiconductor

Xiao Chen, Yuanyuan Cai, Ning Li, Changwei Li, and Yiquan Wang
Minzu University of China, China

We design and fabricate an electrical pumping laser with a quasicrystal microcavity based on MEH-PPV layer sandwiched between two electrodes. The lasing performance is observed at 606 nm. The threshold current is around 0.8 mA.

[27P-91] Polarization Dependence and Optical Aharonov-Bohm Oscillations in a Single Local QR in a Large Droplet QD

Seongho Park[1], Takayuki Kiba[2], Akihiro Murayama[2], Jindong Song[3], and Kwangseuk Kyhm[1]
[1]Pusan National University, Korea, [2]Hokkaido University, Japan, [3]KIST, Korea

We analyzed time-resolved and magneto-micro-PL of a single droplet quantum dot in terms of polarization anisotropy, decay time, and diamagnetic coefficient in order to support the presence of localized state in a large droplet quantum dot.

[27P-92] Scale-Adaptive Compressive Tracking

Zhengping Wu, Yang Jie, and Haibo Liu
Wuhan University of Technology, China

Real-time Compressive Tracking(CT tracker) may drift away or fail especially when the object is under the complex environment, including cluttered background, similar color distribution, drastic illumination change and occlusion, etc. Built upon thesame framework of the CT tracker, this paper proposes a new scale-adaptive tracker. Two main components improve the robustness of our approach: 1) a novel object information measure method based on CT algorithm, and 2) a simple and feasible algorithmfor adjusting the scale of the tracked bounding window according to the amount of the object information. Numerous experiments with three state-of-the-art compressive trackers on challenging sequences demonstrate that the proposed algorithm performs well in terms of accuracy, robustness and speed under the complex environment.

[27P-93] Chaos Synchronization of a Star Network Based on Delayed Electro-Optical Systems

Hu Han Ping and Chen Xiaofeng
Huazhong University of Science and Technology, China

Chaos synchronization of a star network based on delayed electro-optical systems is discussed in this paper. The outer nodes of the star network are connected to a center node through a unidirectional optical injection signal from the center node toeach outer node. We design a special network coupling function through the Lyapunov stability theory, and set up the mathematical model of the proposed star network. We prove stable zero-lag chaos synchronization can be realized among all the nodes of our proposed star network mathematically. At last, chaos synchronization of the star network is numerical investigated. The simulation results are consisted with the results of theoretical analysis.

[27P-94] Optical Compensation for Elimination of Off-Axis Light Leakage in a Liquid Crystal Display

Seung-Won Oh and Tae-Hoon Yoon
Pusan National University, Korea

Optical compensation for wide viewing angle characteristics in a liquid crystal display (LCD) is essential for high-quality dark images, especially from the bisector direction of the crossed polarizers. We introduce achromatic compensation configurations for a perfect dark state in LCDs. To cancel out the effect of wavelength dispersion, we replaced each A plate in the conventional uniaxial configurations by a pair of orthogonal A plates.

[27P-95] A Study of Lens Array Compensation for Excimer Laser Beam Homogenizing

A. Hyeonjun Song[1], Hakjun Lee[2], Kwangwoo Cho[1], Daegab Gweon[2], and Hongjin Park[1]
[1]Laser Total Solution, Korea, [2]KAIST, Korea

In recent display industry, an interest of laser manufacturing process is increasing. It is important homogeneity of line beam because of manufacture. In this study, we propose a new lens array compensation system for beam homogenizing. To verify the performance of system, experiment are carried out.

[27P-96] Formation of Holographic Memory by Angle-multiplexing Recording in Liquid Crystal Composites

Akifumi Ogiwara[1] and Minoru Watanabe[2]
[1]Kobe City College of Technology, Japan, [2]Shizuoka University, Japan

Formation of holographic polymer-dispersed liquid crystal (HPDLC) memory for an optically reconfigurable gate array based on the angle-multiplexing recording is discussed by controlling the laser interference exposure in liquid crystal (LC) composites. The successive laser illumination system to record the various configuration contexts at the different region and angle in HPDLC memory is constructed by using the half mirror and photomask placed on the motorized stages under the control of a personal computer (PC). The effect of laser exposure energy on the formation of holographic memory is investigated by the measurement of diffraction intensity during the grating formation process. The reconstruction of configuration contexts for the various logical circuits is demonstrated by the laser illumination at different incident angle in the HPDLC memory.

[27P-97] Reference Functions in Grayscale and Noised Multiview Images

Vladimir Saveljev[1] and Sung-Kyu Kim[2]
[1]Hanyang University, Korea, [2]KIST, Korea

The previously proposed reference functions for synthesis and analysis of multiview images in autostereoscopic 3D displays are applied to the analysis of grayscale and noised images of a wireframe object.

[27P-98] Effect of the Coherence Length of Sunlight on the Absorption of V-shaped Organic Solar Cells

Kyungnam Kang[1], Changjoo Lee[2], Sungchul Kim[2], and Jungho Kim[1]
[1]Kyung Hee University, Korea, [2]Myongji University, Korea

We numerically investigate the effect of the coherence length of sunlight on the absorption of V-shaped organic solar cells. The absorbance and the spatial distribution of power dissipation are calculated with respect to partially coherent light.

Poster Session II (Exhibition Hall / Thursday, 27 August, 13:45~15:15)

[27P-99] Off-Axis Terahertz Digital Holography Using Continuous-Wave Terahertz Radiation

Takayuki Ogawa[1], Dahi Ibrahim[1,2], Takashi Masuoka[1], Takeshi Yasui[1,2], and Hirotsugu Yamamoto[2,3]

[1]The Tokushima University, Japan, [2]JST, Japan, [3]Utsunomiya University, Japan

We constructed an off-axis THz digital holography system equipped with a 0.1-THz CW-THz source and a mechanically-scanning THz pyroelectric detector, and then acquired THz digital hologram by it.

[27P-100] The Authenticity of Art: Analysis of the Optical Characteristics of Paintings

Seonhee Hwang, Kyujung Kim, and Eunhee Kim

Pusan National University, Korea

In this study, we designed a setup using two different light sources to prove the authenticity of paintings through analysis of optical characteristics.

[27P-101] Computer-generated Holograms Using Stereo Disparity with a Multi-matching Algorithm

Yan-Ling Piao[1], Ki-Chul Kwon[1], Jeong-Hyeon Lee[1], Sang-Keun Gil[2], and Nam Kim[1]

[1]Chungbuk National University, Korea, [2]Suwon University, Korea

Extracting depth information from stereoscope image is an important field in 3D imaging. In this paper, we proposed a method to record the computer-generated holograms based on high quality point cloud models which are generated by the disparity map from the stereoscopic image by use of a multi-matching algorithm.

[27P-102] Temperature-dependent Transport Properties in Vanadium Dioxide Thin Films

Jeongyong Choi[1], Bong-Jun Kim[2], Giwan Seo[3], and Yong Wook Lee[1]

[1]Pukyong National University, Korea, [2]Mobrik Co. Ltd., Korea, [3]KAIST, Korea

In VO_2, which is a promising strongly correlated material of electro-optics, temperature-dependent electrical transport properties were investigated by using ordinary Hall effect measurement. The interesting variation on the near boundary of insulator-to-metal transition was observed.

[27P-103] Organic Thin Film Photomemory with Isolated Photo-active Charge Storage

Mincheol Kim, Hyejeong Seong, Seungwon Lee, Hyukyun Kwon, Sung Gap Im, and Seunghyup Yoo

KAIST, Korea

Organic photomemory devices are demonstrated in a geometry similar to that of floating gate memory. Simultaneous application of gate bias and light triggers a threshold-voltage shift. The proposed devices show fast light programming with gate pulse as short as 50 msec.

[27P-104] Trans-scale Optical Simulation for OLEDs Involving Scattering Substrates

Eunhye Kim, Hyunsu Cho, Jin Chung, Jinouk Song, and Seunghyup Yoo

KAIST, Korea

Scatter-embedded substrate is a powerful platform for improving light extraction efficiency in OLED lighting. In this work, we propose trans-scale optical simulation for OLEDs involving scattering substrates. This simulation combines rigorous dipole model analyzing thin-film stacks with Monte-Carlo simulation based on Henyey-Greenstein phase function for tracing rays encountered with specific size of scatter. The simulation provides a useful tool to analyze and design OLEDs with bulk scatter.

[27P-105] Design of Holographic Head Mounted Display Using Holographic Optical Element

Han-Ju Yeom, Hee-Jae Kim, Seoung-Bok Kim, and Jae-Hyeung Park

Inha University, Korea

Recently, head mounted displays based on holographic optical elements have been reported. These head mounted displays can be implemented in a compact form factor but the image presented to each eye is still two-dimensional, which causes fatigue in stereoscopic three-dimensional image viewing condition. In this paper, we propose a holographic three-dimensional head mounted display which displays holographic three-dimensional images. We experimentally confirmed that holographic three-dimensional images are presented to each eye through a holographic optical element. In order to reduce the volume and weight of the system, we use one more holographic optical element and perform a simulation based on ray tracing through the two holographic optical elements.

[27P-106] Light-Field Camera Using Fast Switchable Micro-lens Array for Simultaneous 2D/3D Image Acquisition

Heewon Park[1], Min-Kyu Park[1], Mugeon Kim[1], Ki-Beom Son[1], Hyun Lee[2], and Hak-Rin Kim[1]

[1]Kyungpook National University, Korea, [2]ETRI, Korea

To make switchable light field camera, we developed fast switchable micro lens array which allows to capture both 3D image and 2D image by high frame rate.

[27P-107] Feasibility of 'Radiative Transfer Theory' for Simulation of Organic Light-Emitting Diodes with Scattering Media

Jinouk Song, Seunghyup Yoo, and Eunhye Kim

KAIST, Korea

We explore the feasibility of 'radiative transfer theory' for simulation of scattering media by comparing accuracy and simulation time with Monte-Carlo simulation. Simulation based on 'radiative transfer theory' agrees very well with Monte-Carlo simulation with about 1/20 simulation time. Hence, 'radiative transfer theory' is effective basis for trans-scale simulation and fast optimization of OLEDs with scattering media.

[27P-108] Study of Reflection-beam Shape Using Beam Splitter and CCD Camera

Binh X. Cao[1,2], Munju Bae[1], Jiyeon Park[1], Hyonkee Sohn[1], and Jiwhan Noh[1,2]

[1]Korea Institute of Machinery and Materials, Korea, [2]Korea University of Science and Technology, Korea

We report a new method for measuring a beam's shape at the focus point on a surface using an optical system and a CCD camera. An analytical model based on z-axis movement testing has been proposed, and experimental setups have been developed. Analysis of the obtained results allowed us precisely position the specimen for the focus point identification.

[27P-109] Probabilistically Coupled Multi-Population Rate Equations Model of 1.55 μm InAs/InP Quantum Dot Lasers

Zhiyuan Lin, Zhuoran Wang, Guohui Yuan, and Meng Yang

University of Electronic Science and Technology of China, China

A multi-mode model of 1.55 μm coupled quantum dot lasers (QDLs) is developed and simulated by fourth order Runge-Kutta method. Calculated results show that the coupled QDLs have significant advantages over the uncoupled ones.

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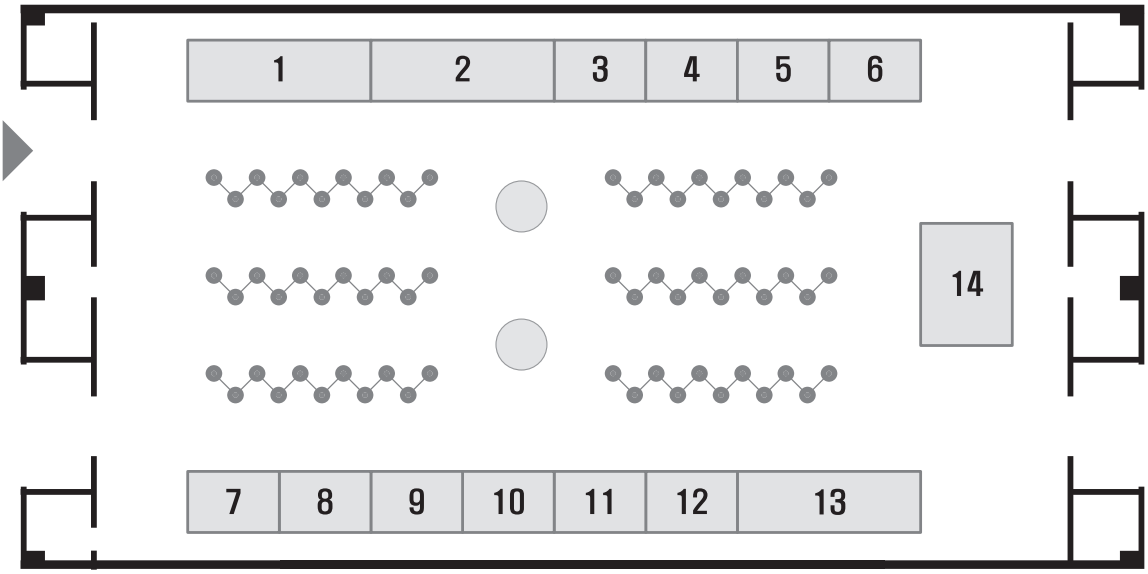
V. Exhibition Information

1. Layout of Exhibitions

Exhibition



NO	Company	NO	Company
1	Jinsung Instruments, Inc.	8	MJL Crystek, Inc
2	HBL Corporation	9	Opti rate Corporation
3	L2K Co., Ltd	10	RayVis
4	Quantum Design Korea	11	Laser Spectronix
5	NPI LASERS Co., Ltd	12	Qbic Laser System Inc.
6	KOS,Inc.	13	Korea Tourism Organization
7	OMA Company	14	EO TECHNICS Co., Ltd

2. Exhibitor Directory

Name of Company	**Jinsung Instruments, Inc.**		
Address	5F,A, LeardersTown, Man-Nyung dong, Seo-Gu, Dae-Jeon City, South Korea		
President	Ha-Won Lee	Web site	www.jinsunginst.com
Tel	+82-42-823-5300	Fax	+82-42-823-7447
Contents of Exhibit	Laser		

Jinsung Instruments is a leader of laser application and has been offering total solution including lasers, laser equipments and components, etc. since 1997. We have a lot of global partners who are providing laser solution like Thorlabs, Toptica Photonics AG, Picoquant GmBH, Ophir spiricon Inc, etc.

Name of Company	**HBL Corporation / ㈜한빛레이저**		
Address	32-48, yuseong-daero 1596 beon-gil, Yuseong-gu, Daejeon, Korea 대한민국 대전광역시 유성구 유성대로 1596번길 32-48		
President	KIM Jeong Moog / 김정묵	Web site	www.hblaser.co.kr
Tel	+82-42-879-3300	Fax	+82-42-862-6289
Contents of Exhibit	High Power Ultrafast Laser		

Est. Laser Laboratory in 2002. 20 researchers registered in Korea Industrial Technology Association. Technologies convergence based company that integrated with Human, Materials and Technology Resources. 10W high power femtosecond laser could be applied in the field of Display and Semiconductor industries on glass cutting and wafer dicing, etc.

2002년 기업부설연구소(한국산업기술진흥협회 등록)설립
기업부설연구소 연구인원: 20명, 전체직원의 14
인적, 물적, 기술자원이 집약된 기술기업
출품된 레이저는 고출력 10W 펨토초 레이저로 디스플레이, 반도체분야의 유리절단 및 웨이퍼다이싱에 적용예정

Name of Company	**L2K Co., Ltd**		
Address	530-ho, 187, Techno2-ro, Yuseong-gu, Daejon 305-500, Korea		
President	JAE PIL, JEON	Web site	http://www.L2K.KR
Tel	+82-42-934-7744	Fax	+82-42-934-7740
Contents of Exhibit	Ultra Short Pulsed (fs, ps) Laser, High Energy Laser, Beam Delivery & Control		

L2K Co., Ltd is leading company for Laser, Laser related components and Fiber Optic Components in the Scientific, Industrial and Security, Defense market. We have the huge experience of Laser application in these markets and can make a chance to meet the most suitable solution for each application.

Name of Company	**Quantum Design Korea**		
Address	#303 Dongshin Bldg., 204 Dogok-ro, Gangnam-gu, Seoul 135-857, Korea		
President	Ji Won Park	Web site	www.qdkorea.com
Tel	+82-2-2057-2710	Fax	+82-2-2057-2712
Contents of Exhibit	NeaSNOM (s-SNOM, nano FT-IR), Lynceetec (Digital Holographic Microscopy), Montana Instruments Cryostation (Optical Cryostat)		

The NeaSNOM is the only microscope on the market capable of imaging & spectroscopy in the visible, infrared and even terahertz spectral region at only 10 nm spatial resolution. This makes NeaSNOM the ideal tool for cutting-edge nanoanalytic applications such as chemical nano-composition (nano-FTIR-mode), nano-plasmonic fields, nanoscale stress/strain fields and free charge carrier distributions.

Name of Company	**NPI Lasers**		
Address	Floor 4, Cui-Ping Science Park, 37 Jiangjun Avenue, Jiangning District, Nanjing, China, 211100		
President		Web site	www.npilasers.com
Tel	+86-25-84989433	Fax	+86-25-84989433
Contents of Exhibit	We offer a full range of 2μm fiber laser products for both research and industrial customers. Our product line includes ultrafast lasers, amplifiers, broadband sources, narrow-linewidth and wavelength-tunable 2μm lasers. During CLEO-PR2015, we showcase highly-stable 1 picosecond mode-locked oscillator (ML-2000-Osci) together with a 3W high power amplifier (TDFA-2000-HP).		

NPI LASERS is a fiber laser company focused on delivering innovative mid-IR laser modules and systems. The goal of our company is to change the paradigm of fiber laser market by providing versatile, reliable and cost-effective products to serve the emerging applications in the mid-IR wavelength range.
Our product portfolio includes mode-locked oscillator, thulium-doped fiber amplifier, narrow-linewidth fiber laser, multi-channel CW laser as well as broadband light sources. Most of our products feature compactness and highly customizable parameters such as output power level and operating wavelength.
The NPI team consists of leading international experts in photonics research as well as executives with strong commercial track record. We share a combined industrial experiences of more than 60 years and this ensures that we understand your specific application needs, regardless of whether it is in the field of niche photonics research, industrial sensing and detection, advanced bio-medical procedures, or next-generation laser material processing.

Name of Company	**KOS,Inc**		
Address	O213, Green-zone,ITECO,#150,Jojeong-daero,Hanam-city,Gyeonggi-do,Korea		
President	Daehee-Choi	Web site	www.kosinc.co.kr
Tel	+82-2-486-7930	Fax	+82-2-486-7931
Contents of Exhibit	Monochromator , CCD Camera , Laser , Mini spectrometer , Filters		

* Application
Long Term Cell Observation System
Real Time Confocal Microscope System
In Vivo Whole-body Animal Imaging System
FRET Imaging System
FRAP Imaging System
Florescence Life Time Measument
Ca++ Ratio Imaging System

* Instruments
Cooled Digital CCD Camera
EM CCD and ICCD Camera
Digital Holographic Microscope
Image Analysis Software
Fluorescence Light Sourece
Polychrometer /Monochromator
Automatic Filter Wheel & Florescence Filters
Auto X. Y. Stage & Z motors
* June 3, 2014 Acquire Certificate of Research Institute By Korea Industrial Technology Association

Name of Company	**OMA Company**		
Address	1596-64 YUSUNGDAE-RO YUSUNG-GU DAEJEON KOREA. 305-811		
President	Jinho Lee	Web site	www.omacom.co.kr
Tel	+82-42-822-9501	Fax	+82-42-822-9504
Contents of Exhibit	Opto-Mechanics, Optical Power Meter, Auto-Collimator		

Hand-Held Optical Power/Energy Meter
BenchTop Optical Power/Energy Meter
OpticsCage+
Double Density Breadboard
Mirror/Lens Mounts
Beam Tube
Auto-Collimator

Name of Company	**MJL Crystek, Inc**		
Address	1117 Expotel 381, 44, 117beon-gil, Dunsan-daero, Seo-Gu, Daejeon, 302-834, Korea		
President	Jae Hyuk Choi	Web site	www.mjlinc.com
Tel	+82-42-471-8070	Fax	+82-42-471-8073
Contents of Exhibit	Laser(fiber Laser, HeNe/HeCd Laser, Tunable Laser, Femtosecond Laser, DPSS Laser, CO_2 Laser, Excimer Laser…), Laser Machining Head (Scanner Head, Welding Head), Optical Scanner (Scanner Mirror, Galvo Motor, Driver, Controller), F-theta Lens/ Beam Expander, Modulator, Test & Measurement, Optics & Crystal, Optomechanics & Motion control, Pulse Generator, Laser Dye, Telecom products (Tunable Laser Source, Modulator, Isolator, Lensed Fiber, Circulator, Microscope, Interferometer, Measurement, etc.)		

MJL Crsytek, Inc. is supplying a variety of lasers, optics and optical communication components throughout industries, research institutes, universities and medical field from 1990 to the present. We have constructed an effective system to offer the skills and information customers need at any time and have not handled roughly even a small part.

Name of Company	**RayVis**		
Address	#512. World Officetel, 1355-3, Seocho-dong, Seocho-gu, Seoul, 137-862, Korea		
President	Chaemyong Ryu	Web site	www.rayvis.co.kr
Tel	+82-2-3461-1103	Fax	+82-2-3461-1104
Contents of Exhibit	M sqaure: World Best Sealed Ti:Sap Wavelength tunable CW LASER APE: 피코, 펨토초 펄스폭 및 특성 측정기기 Lighthouse: 최고성능 및 가격, CW 그린펌프용 고체레이저 EKSPLA: 탑클래스 나노, 피코초레이저 및 OPO, 플래시램프파워		

The name of our company, RayVis is composed of 2 Latin words, RAY(Light) & VIS(Power) so it means 'Power of Light' and based on these words, the major business of our company is distribution & technical service of worldwide LASER systems & optical products to our industrial customers that manufactures various LASER processing equipments including the customers at Laboratories & Universities for scientific researches as well as medical customers.
There are three divisions in our company, which are Scientific, Medical and Industrial divisions. We have many regular customers at Samsung, LG & medical companies for industrial and GIST, KAIST, POSTECH, IBS, SNU, ETRI, etc. for scientific. Therefore we believe that we can do great work with you based on our experience with deep understanding on customer applications so far if we have a chance to introduce our good products to you. Also on the other side, we want to have a chance to learn about your product as well to learn more about you and we want to be a real partner to make a success with you.

Name of Company	**OptiGrate Corporation**		
Address	562 South Econ Circle, Oviedo, FL 32765, USA		
President	Dr. Alexei Glebov	Web site	www.OptiGrate.com
Tel	+1-407-542-7704	Fax	+1-407-542-7804
Contents of Exhibit	Holographic Volume Bragg Gratings (VBG)		

OptiGrate is a pioneer of commercial Volume Bragg Gratings and supplies VBGs to more than 500 customers on 6 continents for laser line narrowing, spectroscopy, laser pulse stretching and compression, etc. We are located in Oviedo (Florida, USA) where we design, develop and make all of our products.

Name of Company	**Qbic Laser System Inc.**		
Address	303-901, Seokcheon-ro 345, Ojeong-gu, Bucheon-si, Gyeonggi-do, 421-741, Korea		
President	Changkon Kim	Web site	www.qbiclaser.com
Tel	+82-32-325-4544	Fax	+82-32-323-4736
Contents of Exhibit	Optical Systems manufactured by Qbic Laser System Inc.		

. Laser Beam Homogenized Module
. Multiple Spot Generating Module
. Laser Beam Attenuator
. Fiber Coupled Diode Laser System
. Two Color Optical Pyrometer System
. MOPA (Master Oscillator Power Amplifier) Laser System

Name of Company	**EO TECHNICS Co., Ltd.**		
Address	91 Dongpyeonro Anyang Korea		
President	Kyu-Dong Sung	Web site	www.eotechnics.com
Tel	+82-31-422-2501	Fax	+82-31-422-2502
Contents of Exhibit	Laser Sources like fiber laser, diode lasers etc. Laser power meter & beam profilers		

EO Technics manufactures fiber lasers, diode lasers, ps and fs lasers.
Those lasers can be used in future applications.
EO Technics' laser applications are very numerous.
EO Technics also produces laser systems for marking, scribing, cutting, drilling, trimming and material processing.

VI. Sponsors and Supporting Organizations

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CoReLS

HEXASOLUTION
주식회사 헥사솔루션

FIBERPRO

OE SOLUTIONS

㈜오이솔루션

광통신 분야의 세계 선도기업을 꿈꾸다

Company Introduction

대표 이사	박용관, 추안구	업종	유무선통신 제조업
설립일	2003. 08. 07	주요 사업	광통신용 모듈의 개발, 제조 및 판매
상장일	2014. 02. 27	사업장	韓) 광주 북구첨단연신로 30번길 53 경기 안양시 동안구 학의로 282 美) Englewood Cliffs, NJ 07632
임직원	325명 (한국:308명/미국:17명)		
매출 규모	720억원 (2014년말 기준)	홈페 이지	http://www.oesolutions.com

Patent Applications

특허: 46건 (30건 출원 중)

- 반사 노이즈를 감소시키는 구조를 갖는 양방향 광 서브어셈블리
- 단일 파장을 이용한 광송수신 트랜시버
- SiOB를이용한TOCAN 평행광 패키지
- 광통신용 냉각형 투-캔과 이를 이용한 냉각형 보사
- 초고속 광송수신 모듈
- 스마트SFP(또는SFP+,XFP)트랜시버의 가변파장송신를 원격제어하는 방법
- 반사노이즈를 감소시키는 구조를 갖는 양방향 광 서브 어셈블리
- Scheme for Remote Control of the Slicing Level of a Receiver in a Smart SFP Transceiver

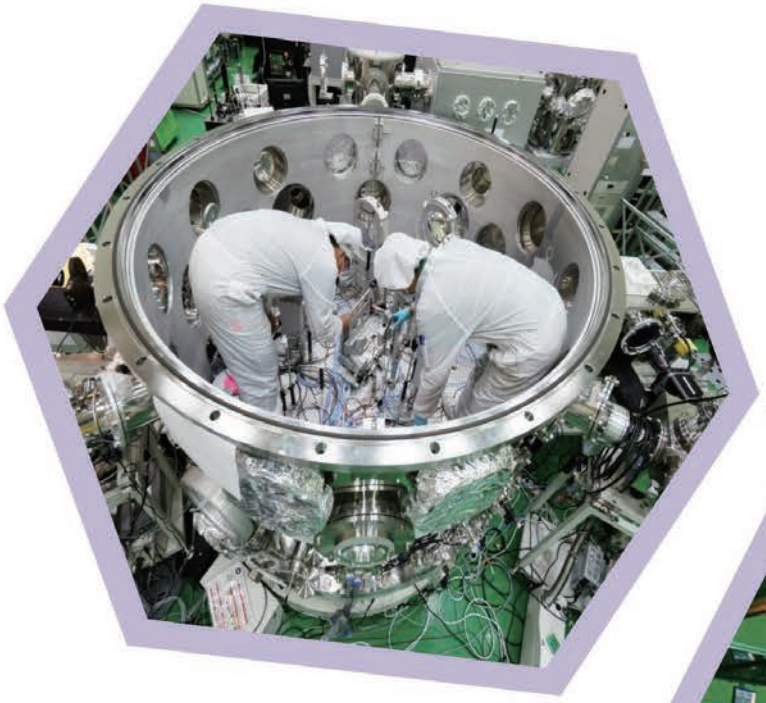
Customer

주요 거래처

CISCO, HUAWEI, ERICSSON, Alcatel-Lucent, Nokia Siemens Networks, SAMSUNG 삼성전자, FUJITSU, NEC, ciena, ARRIS

GIST Where Incredible Things Begin

No. 4 in QS World Univ. Rankings 2014 (citations per faculty)



apri

고등광기술연구소

ADVANCED PHOTONICS RESEARCH INSTITUTE

- Ultra-intense Laser Laboratory & IBS
- Quantum Beam Applications Laboratory
- Laser Application System Laboratory
- Spectroscopy Sensor Laboratory
- Biophotonics Laboratory
- Integrated Optics Laboratory

Further information:
E-mail: khj24@gist.ac.kr
Tel: 062-715-3417
Web: http://www. apri.gist.ac.kr

국립부경대학교 PUKYONG NATIONAL UNIVERSITY

LED-해양 융합기술 연구센터

해양 환경에서 사용되는 첨단 LED 기술은 우리 센터가 세계 일류를 창조합니다.

우리 센터는
* KOLAS 국제공인 시험인증 및 국가공인 검사 지원
* IECEx, ATEX 방폭 R&D 및 인증 지원
* LED-해양 융합 제품 설계 및 특성평가 지원
* LED-해양 융합 기술 및 신제품 공동개발
* 기업 애로기술 상담 지원
* LED융합 석·박사 고급인력 및 산업현장 인력 양성
* LED-해양 융합기술 산업생태계 조성을 수행합니다.

국제공인 시험인증 및 국가공인 검사 서비스

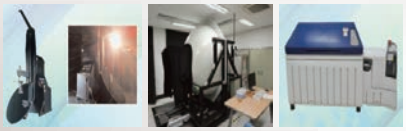
LED조명 분야 영남권 최초의 KOLAS

- KOLAS 국제공인 시험기관 인정
- KOLAS 국가공인 검사기관 인정
- 고효율 에너지 기자재 지정시험기관

KT-567 KI-115

LED융합 특화장비 활용 지원

- 미러타입 배광기, 적분구, 염수분무 시험기 외 154종 보유
- 장비안내서 다운로드 "http://www.led-marine.org/ 에서 장비 활 용지원 또는 QUICK MENU-시험연구장비 이용안내서" Click



LED방폭장비 활용 지원

- LED 내압방폭, 본질안전 방폭 등 개발 중
- LED 방폭조명 R&D 및 인증지원 실시 중
- 국제인증(IECEx, ATEX)시험장비 Full line-up 완료

공동연구개발 성과

LED 항해등

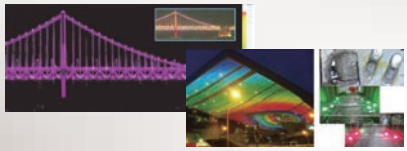
- 항해등용 Fresnel Lens 개발
- 광달거리 6해리, 소비전력 6Wx2단
- 로이드 인증 획득 (공동개발: 대양전기공업)
- 산업통산자원부 장관상 수상(2014년)

해양생물 생산 LED융합조명

- 친환경적 해양오염 회복 LED시스템 개발 및 현장 실증
- 해양생물생장용 다파장 LED조명장치
- 인큐베이터용 LED형광등 개발

"부산, 빛의 도시" 구현

- 부산시 야간경관 기본 계획(좋은 빛환경) 연구
- 부산시 빛공해환경영향평가 연구
- 광안대교·도로조명 실증연구
- 영화의 전당 '미디어 파사드' 고장 분석



보유기술 기업지원

LED조명 광학계 설계 지원

- 용도별 최적 배광, 광학부품 설계 및 제작 지원
- 실내·외 조명 설계 및 시뮬레이션 지원
- 광학 분석 및 스펙트럼 제어 최적화 지원

해양 LED융합 조명/전원·회로 설계 지원

- 기구설계(방수, 방진, 방염) 설계/제작 지원
- 방열 부품 설계/제작 지원
- 조명시스템, 전원·회로 설계/제작 지원

인력양성 지원

LED 융합 인력 양성

- 과학기술융합전문대학원 "LED융합공학 전공" 개설
- 전임교수 3명, 석사 16명, 박사 7명 재학
- 이론 및 장비실습 위주의 LED 융합 전문교육

주소 : 부산광역시 남구 용당동 신선로 365 부경대학교 용당캠퍼스 LED-해양 융합기술 연구센터
문의 : 051-629-7772~3 / minakim@pknu.ac.kr 홈페이지 : http://www.led-marine.org

기초과학연구원 Institute for Basic Science

광주과학기술원 Gwangju Institute of Science and Technology

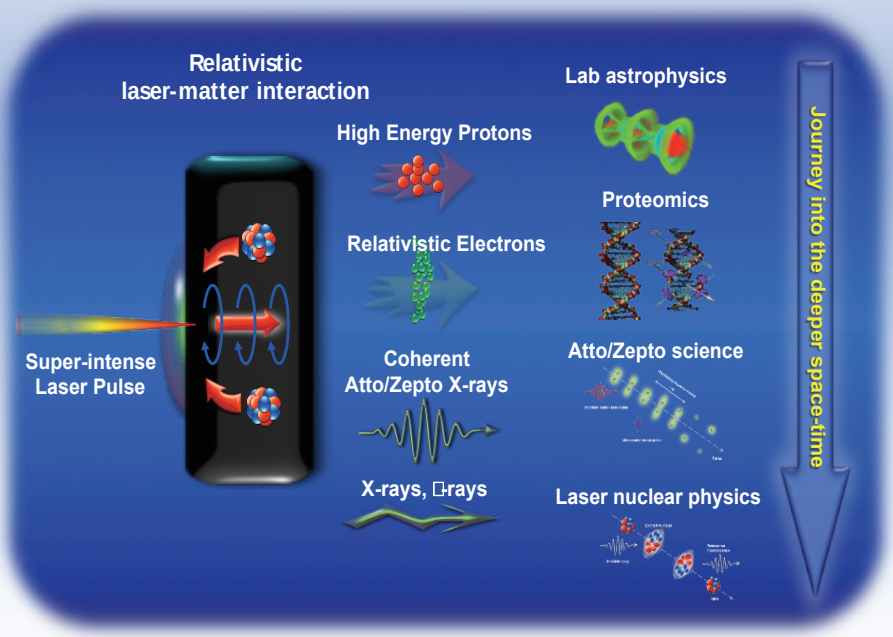
Center for Relativistic Laser Science

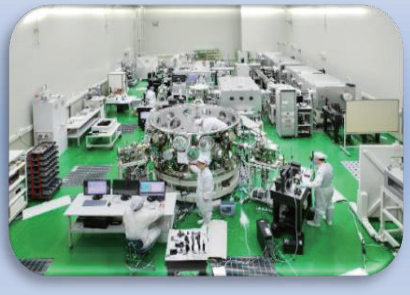
- Exploration of superintense laser-matter interactions -

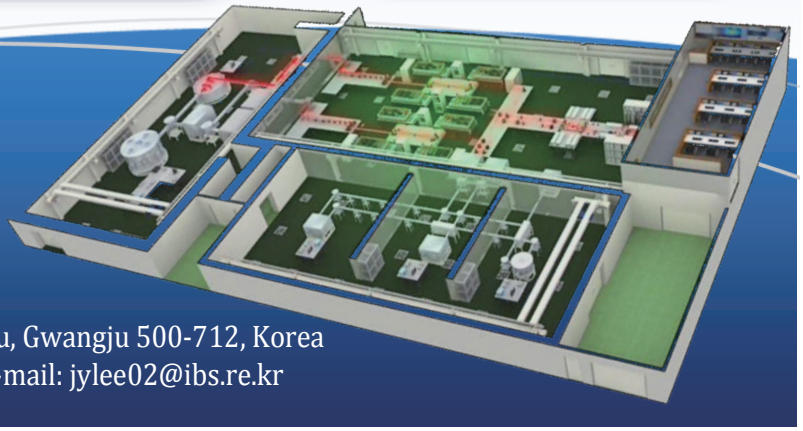
- Exploration of the interactions between ultra-intense laser field and matter in the relativistic regime by using femtosecond petawatt lasers
- Investigation of ultrafast (attosecond) atomic/molecular processes

Research topics

- **High-power femtosecond lasers**
- **Relativistic laser-plasma interactions**
- **Laboratory astrophysics**
- **High-energy density physics**
- **Attosecond science**







Center for Relativistic Laser Science (CoReLS)
Institute for Basic Science (IBS)
Addr.: UQBF, GIST, 123 Cheomdangwagi-ro, Buk-gu, Gwangju 500-712, Korea
Tel.: +82-62-715-4703; Fax: +82-62-715-4705; E-mail: jylee02@ibs.re.kr

Laser Quantum

INNOVATIVE RELIABLE INTELLIGENT

World Class Solid State and Ultrafast Laser Systems

Aerospace, Industrial & Medical

Fluorescence Imaging

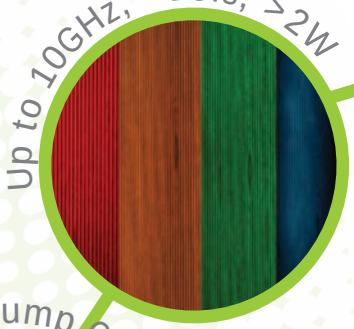
Frequency Combs

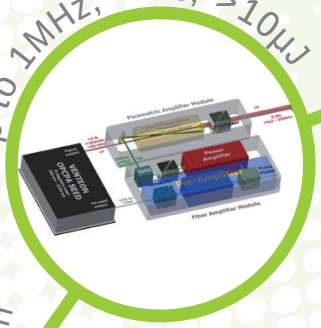
Spectroscopy

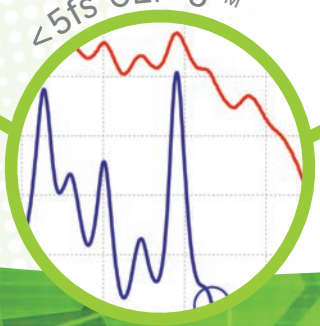
Microscopy

Ultrafast

OPCPA







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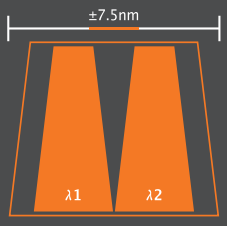
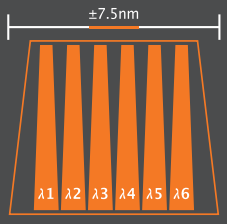
Layer 1 Wavelength Stack-up



[Fig. 1 Layer 1 W/L Stack-up]

- 2 Wavelengths within 15nm Spectrum
- 2X Fiber Link Capacity : λ 1 to λ 36
- λ Stability : +/-0.2nm

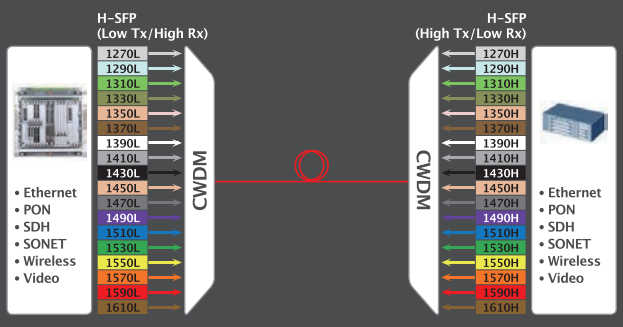
Layer 2 Wavelength Stack-up



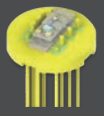
[Fig. 2 Layer 2 W/L Stack-up]

- 6 Wavelengths within 15nm Spectrum
- 6X Fiber Link Capacity : λ 1 to λ 108
- λ Stability : +/-0.2nm

36 Wavelengths Roll-out Architecture

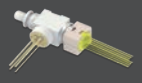


Cooled TO-Can

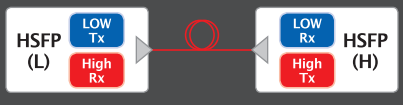


HSFP Transceiver

Cooled BOSA



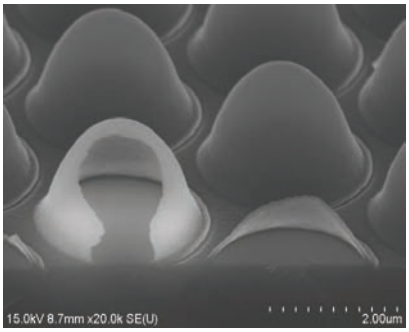
HSFP Block Diagram

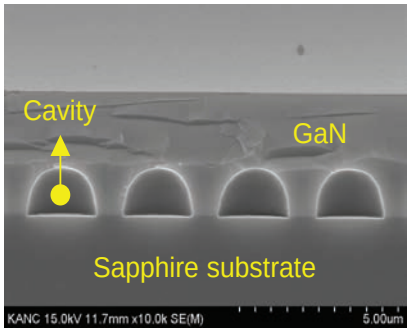


CES* - Beyond PSS

HEXASOLUTION 주식회사 헥사솔루션

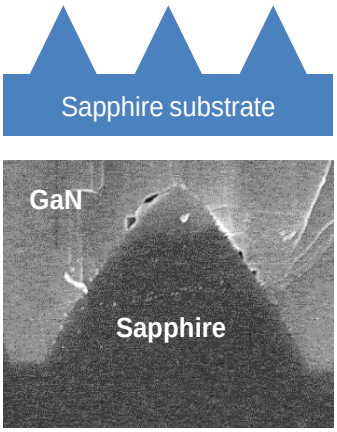
* CES : Cavity Engineered Substrate



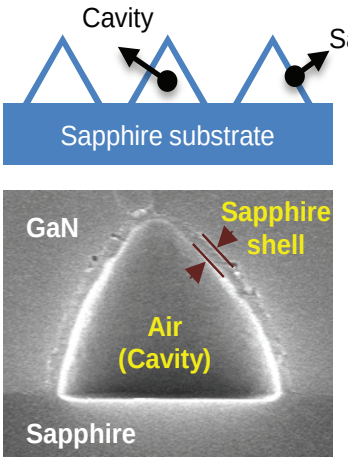


CES for flip chip LED

Great light extraction
Less wafer bowing
Low fabrication costs

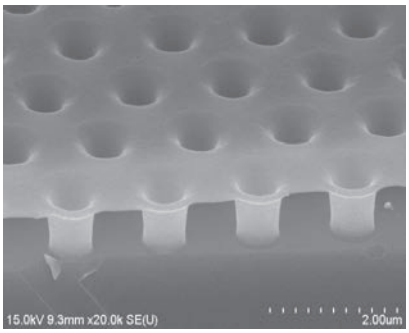


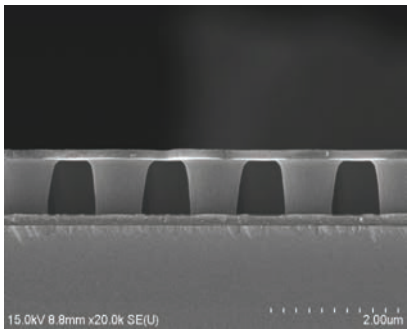
[PSS]



[CES]

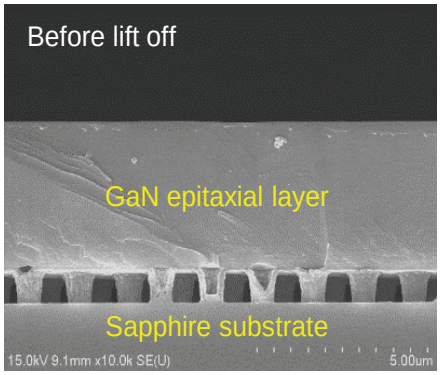
Improving optical output power, Reducing wafer bowing and fabrication costs.

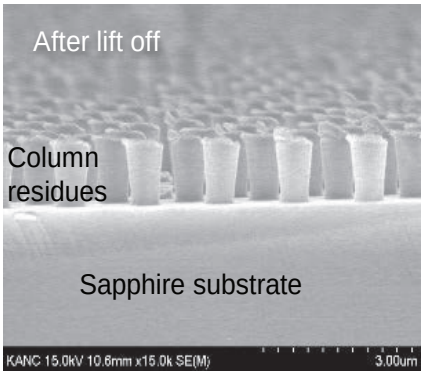




CES for vertical LED

A novel way to remove the sapphire substrate by mechanical force





Novel substrate for Mechanical Lift off .

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레 이 저 스 펙 트 라

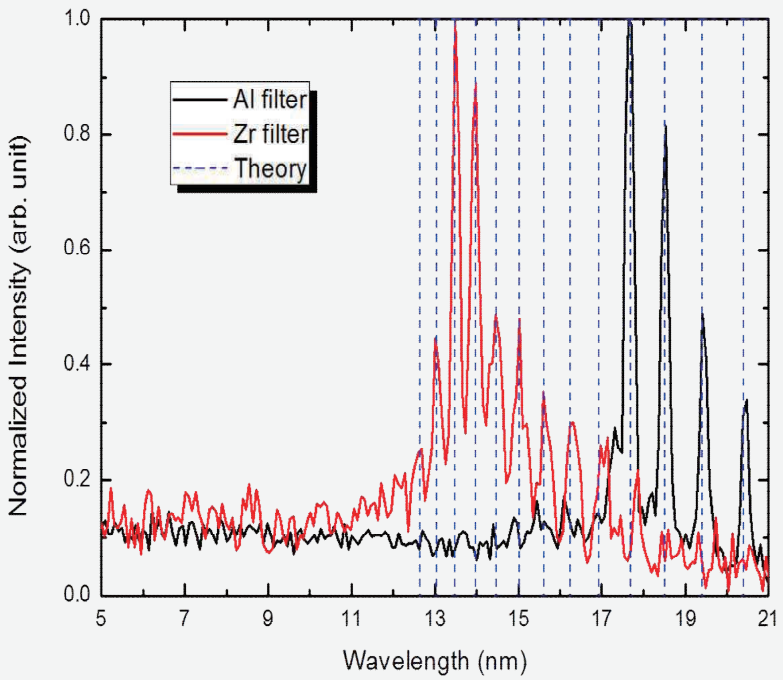
eXtra-Coherent EUV Light Source System between 10-30nm

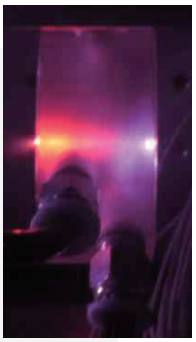
COHERENT EUV IMAGING, ACTINIC INSPECTION IN THE EUV LITHOGRAPHY

The eXtra is the extreme UV (EUV) spectra light source system* which is based on the high harmonic generation (HHG) in the laser-produced plasma to provide the coherent (laser-like) spectra between 10nm and 30nm. The system is configured with a kHz rep rate, femtosecond Ti:sapphire laser at wavelength around 800nm, and a gas cell with gas handling assembly under vacuum. The laser pulses are focused with intensity of 10^{14}-10^{15} W/cm^2 into the patent-pending gas cell to produce the gas plasma inside the cell. The generated EUV spectra are separated from the laser wavelength with an appropriate combination of the EUV beamsplitters and filters.

The EUV spectra generated depends on various parameters including the laser intensity, gases, gas pressure and cell manifold. The eXtra-13.5 is highly focused to a spectra 13.5nm which is the 59th harmonics of the laser wavelength 800nm, and exactly matched with the wavelength of the semiconductor EUV lithography. The system provides a compact, table-top solution for the actinic inspection and metrology applications in the EUV lithography. The Fig.1 shows its typical EUV spectra generated on the Ne gas pumped with 35fs Ti:sapphire laser pulses of 5mJ at 1kHz. The peak at 13.5nm is dominated with the Zr filter. The calibration was done with the spectra of Al filter. (*developed under research collaboration with KIST, Korea Institute of Science and Technology)

Fig.1





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- *EUV Sources*
- *Spectrometer*
- *EUV detector*

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