

Poster Session <Exhibition Hall A>

Thursday, 26 April

HEDS11 10:30-12:00

| HEDSp-1   | Poster | HEDSp-5   | Poster | HEDSp-10  | Poster | HEDSp-15  | Poster |
|---|--------|---|--------|---|--------|---|--------|
| <p><b>Exploration of Efficient Laser Driven Plasma Acceleration Using an Intense Mid-Infrared Laser Pulse</b></p> <p>Eisuke Miura<sup>1</sup>, Shin-Ichi Masuda<sup>2</sup>, Eiji Takahashi<sup>3</sup></p> <p><sup>1</sup>AIST, Japan, <sup>2</sup>Osaka University, Japan, <sup>3</sup>RIKEN, Japan</p> <p>We discuss the feasibility of efficient laser-driven plasma acceleration using an intense mid-infrared laser pulse through particle-in-cell simulations. The number of accelerated electrons is enhanced using a 1.5 μm laser pulse.</p>   |        | <p><b>Stabilization of LWFA injector electron beam using pulse solenoid</b></p> <p>Yusuke Tanizawa, Akihiro Ueno, Gakuju Toran, Hirokazu Takeuchi, Masahiro Yano, Yasuo Sakai, Junpei Ogino, Takamitsu Otsuka, Keiichi Sueda, Hirokazu Nakamura, Jin Zhang, Naveen Pathak, Alexey Zhidkov, Shinichi Masuda, Tomonao Hosokai, Ryouuke Kodama</p> <p>XXXXX</p> <p>We proposed a pulse-driven solenoid capable of focusing high-energy electrons and evaluated the relation between the applied voltage and the selected energy of the electron beams.</p>   |        | <p><b>Investigation of Discharged plasma guiding channel for staged laser wakefield acceleration</b></p> <p>Yasuo Sakai, Tomonao Hosokai, Naveen Pathak, Alexey Zhidkov, Akihiro Ueno, Hakuju Toran, Hirokazu Takeuchi, Yusuke Tanizawa, Masahiro Yano, Takamitsu Otsuka, Junpei Ogino, Keiichi Sueda, Hirokazu Nakamura, Jin Zhang, Shinichi Masuda, Ryouuke Kodama</p> <p>Osaka University, Japan</p> <p>Aiming to produce an optical guiding channel to produce GeV class electron beam acceleration, optimum discharged plasma condition including discharge system will be investigated.</p>   |        | <p><b>Terahertz Radiation from Laser Created Plasma by Applying a Transverse Static Electric Field</b></p> <p>Takuta Fukuda<sup>1</sup>, Zhan Jin<sup>2</sup>, Noboru Yugami<sup>1</sup>, Yasuhiko Sentoku<sup>3</sup>, Hitoshi Sakagami<sup>4</sup>, Hideo Nagatomo<sup>5</sup>, Ryouuke Kodama<sup>1</sup></p> <p><sup>1</sup>Utsunomiya University, Japan, <sup>2</sup>Photon Pioneers Center, Osaka University, Japan, <sup>3</sup>ILE Osaka University, Japan, <sup>4</sup>National Institute for Fusion Science, Japan</p> <p>We have observed that a significantly increased THz emission intensity in the forward direction when the transverse static electric field is applied to the plasma.</p>   |        |
| <p><b>HEDSp-2</b></p> <p><b>Probing ultrafast motion of critical surface pushed by multi-pico-second relativistic radiation pressure</b></p> <p>Yugo Ochiai<sup>1</sup>, Sadaoki Kojima<sup>2</sup>, Shunsuke Inoue<sup>2</sup>, Masayasu Hata<sup>1</sup>, Natsumi Iwata<sup>1</sup>, Yasunobu Arikawa<sup>1</sup>, Alessio Morace<sup>1</sup>, Shouhei Sakata<sup>1</sup>, Seung-ho Lee<sup>1</sup>, Kazuki Matsuo<sup>1</sup></p> <p><sup>1</sup>Institute of Laser Engineering, Osaka University, Japan, <sup>2</sup>Advanced Research Center for Beam Science, Institute for Chemical Research, Kyoto University, Japan</p> <p>The ultrafast motion of critical surface is important key to understand during multi-picosecond interaction.</p> <p>We designed frequency-resolved optical gating to observed the ultrafast plasma motion with high temporal-resolution (~150 fs) and wavelength resolution (~0.2 nm).</p>  | Poster | <p><b>HEDSp-6</b></p> <p><b>Measurement of high-order harmonics generated from relativistic plasma in gas target</b></p> <p>Akito Sagisaka<sup>1</sup>, Alexander S. Pirozhkov<sup>1</sup>, Timur Zh. Esirkepov<sup>1</sup>, Tatiana A. Pikuz<sup>2,3</sup>, Anatoly Ya. Faenov<sup>3,4</sup>, Sergei V. Bulanov<sup>1,5</sup>, Koichi Ogura<sup>1</sup>, Hideyuki Kotaki<sup>1</sup>, Yukio Hayashi<sup>1</sup>, Yuji Fukuda<sup>1</sup>, James K. Koga<sup>1</sup>, Kiminori Kondo<sup>1</sup>, Tetsuya Kawachi<sup>1</sup>, Hiromitsu Kiriya<sup>1</sup>, Masaki Kando<sup>1</sup></p> <p><sup>1</sup>National Institutes for Quantum and Radiological Science and Technology, Japan, <sup>2</sup>PPC and Graduate School of Engineering, Osaka University, Japan, <sup>3</sup>Joint Institute for High Temperatures, Russian Academy of Sciences, Russia, <sup>4</sup>Open and Transdisciplinary Research Initiatives, Osaka University, Japan, <sup>5</sup>Institute of Physics ASCR, v.v.i. (FZU), ELI-Beamlines Project, Japan</p> <p>High-order harmonics generated from relativistic plasma driven by Ti:sapphire laser in helium gas target are measured.</p> | Poster | <p><b>HEDSp-11</b></p> <p><b>Performance of High energetic X-ray detector by using X-ray generator</b></p> <p>Yukio Hayashi, Hideyuki Kotaki, Nobuhiko Nakanii, Kai Huang, Michiaki Mori, Masaki Kando</p> <p>KPSI, QST, Japan</p> <p>We make the X-ray spectrometer for betatron X-rays measurement. Recently, the spectrometer was tested with an X-ray generator. In the conference, we will explain the result of this test.</p>  | Poster | <p><b>HEDSp-16</b></p> <p><b>Experimental investigation of electron and proton acceleration scaling to ultra-high intensity pulses</b></p> <p>Nicholas P. Dove<sup>1</sup>, Mamiko Nishiuchi<sup>1</sup>, H. Sakaki<sup>1</sup>, M.A. Alkhimova<sup>2</sup>, A. Ya. Faenov<sup>3,4</sup>, Y. Fukuda<sup>1</sup>, H. Kiriya<sup>1</sup>, A. Kon<sup>1</sup>, K. Kondo<sup>1</sup>, T. Miyahara<sup>1,5</sup>, K. Nishitani<sup>1,5</sup>, K. Ogura<sup>1</sup>, T.A. Pikuz<sup>3,4</sup>, A.S. Pirozhkov<sup>1</sup>, A. Sagisaka<sup>1</sup>, M. Kando<sup>1</sup></p> <p><sup>1</sup>National Institutes for Quantum and Radiological Science and Technology, Japan, <sup>2</sup>National Research Nuclear University (MEPhI), Russia, <sup>3</sup>Osaka University, Japan, <sup>4</sup>Joint Institute for High Temperatures, Russian Academy of Sciences, Russia, <sup>5</sup>Kyushu University, Japan</p> <p>We investigated electron and proton acceleration using the ultra-high intensity J-KAREN-P laser. The electron temperature is found to be spot size dependent, and protons show the most favourable intensity scaling when increasing laser energy.</p>         | Poster |
| <p><b>HEDSp-3</b></p> <p><b>Gamma-ray Generation from Plasma-based resonant Wiggler</b></p> <p>Bifeng Lei, Jingwei Wang, Vasily Kharin, Matt Zepf, Sergey Rykovanov</p> <p>Helmholtz Institute Jena, Germany</p> <p>A flexible gamma-ray radiation source based on the resonant laser plasma wakefield wiggler is proposed. The wiggler is achieved by inducing centroid oscillations of a short laser pulse in a plasma channel. The photon generation</p>   | Poster | <p><b>HEDSp-7</b></p> <p><b>Interaction of multi-PW class laser pulses with underdense plasmas</b></p> <p>Masahiro Yano, Alexei Zhidkov, Ryouuke Kodama</p> <p>XXXXX</p> <p>For the first time the interaction of multi-PW laser pulses with underdense plasma, in the regime of strong relativistic wave-breaking, is investigated via 3D particle-in-cell simulation</p>  | Poster | <p><b>HEDSp-12</b></p> <p><b>Detection of alpha particles from 7Li(p,α)4He/19F(p,α)16O reactions by etching of CR-39 using potassium hydroxide ethanol solution</b></p> <p>Yosuke Nishiura<sup>1,2</sup>, Shunsuke Inoue<sup>1,2</sup>, Kensuke Teramoto<sup>1,2</sup>, Sadaoki Kojima<sup>2</sup>, Yoshihide Nakamiya<sup>2</sup>, Masaki Hashida<sup>1,2</sup>, Shuji Sakabe<sup>1,2</sup></p> <p><sup>1</sup>Department of Physics, Graduate School of Science, Kyoto University, Japan, <sup>2</sup>Advanced Research Center for Beam Science, Institute for Chemical Research, Kyoto University, Japan</p> <p>By etching of CR-39 using A solution, we have demonstrate the discrimination between protons and alpha particles to know the availability of this method to the applications of laser accelerated ions</p> | Poster | <p><b>HEDSp-17</b></p> <p><b>Recent progress on multi-stage laser wakefield acceleration at LAPLACIAN</b></p> <p>T. Otsuka<sup>1,2</sup>, J. Ogino<sup>2</sup>, K. Sueda<sup>2</sup>, N. Nakanii<sup>3</sup>, M. Mori<sup>3</sup>, H. Kotaki<sup>3</sup>, H. Kai<sup>3</sup>, Y. Sakai<sup>2</sup>, N. C. Pathak<sup>2</sup>, S. Masuda<sup>2</sup>, H. Nakamura<sup>4</sup>, A. G. Zhidkov<sup>2</sup>, Z. Jin<sup>2</sup>, A. Ueno<sup>4</sup>, H. Toran<sup>1</sup>, M. Kando<sup>3</sup>, T. Hosokai<sup>2</sup>, R. Kodama<sup>2,4,5</sup></p> <p><sup>1</sup>Department of Optical Engineering, Graduate School of Utsunomiya University, Japan, <sup>2</sup>Photon Pioneers Center, Osaka University, Japan, <sup>3</sup>National Institutes for Quantum and Radiological Science and Technology, Japan, <sup>4</sup>Graduate School of Engineering, Osaka University, Japan, <sup>5</sup>Institute of Laser Engineering, Osaka University, Japan</p> <p>Multistage acceleration scheme has been proposed for improving stability and repeatability. To achieve GeV-class electron with multistage acceleration scheme, we constructed platform for multistage LWFA.</p> | Poster |
| <p><b>HEDSp-4</b></p> <p><b>Investigation of plasma parameters from Cu wire/Al foil combined target heated by high intensity LFEX laser pulse</b></p> <p>Daniil Golovin<sup>1</sup>, Akifumi Yogo<sup>1</sup>, Tatiana Pikuz<sup>2,3</sup>, Anatoly Faenov<sup>2,3</sup>, Maria Alkhimova<sup>3,4</sup>, Igor Skobelev<sup>3,4</sup>, Sergey Pikuz<sup>3,4</sup>, Yuki Abe<sup>1</sup>, Yasunobu Arikawa<sup>1</sup>, Keisuke Koga<sup>1</sup>, Kazuki Okamoto<sup>1</sup>, Satoru Shokita<sup>1</sup>, Hiroaki Nishimura<sup>1</sup></p> <p><sup>1</sup>Institute of Laser Engineering, Osaka University, 2-6 Yamada-oka, Suita, Osaka 565-0871, Japan, Japan, <sup>2</sup>Graduate School of Engineering, Osaka University, Suita, Osaka 565-0871, Japan, Japan, <sup>3</sup>Joint Institute for High Temperatures, Russian Academy of Sciences, Moscow 125412, Russia, Russia, <sup>4</sup>National Research Nuclear University (MEPhI), Moscow 115409, Russia, Russia</p> <p>In our research we propose and applied two channels focusing spectrometer with spatial resolution (FSSR), to observe X-ray radiation of plasma from the target, heated by high-intensity LFEX laser.</p> | Poster | <p><b>HEDSp-8</b></p> <p><b>Laser-driven quantum beam and applications</b></p> <p>H.F. Lowe<sup>1,2</sup>, S. Patankar<sup>2,3</sup>, S. Giltrap<sup>2</sup>, N. H. Stuart<sup>2</sup>, T.S. Robinson<sup>2</sup>, E.T. Gumbrell<sup>3,4</sup>, R.A. Smith<sup>2</sup></p> <p><sup>1</sup>KPSI, QST, Japan, <sup>2</sup>Imperial College London, U.K., <sup>3</sup>LLNL, USA, <sup>4</sup>AWE Aldermaston, U.K.</p> <p>We will show the estimation of the characteristics of the X-ray beam generated by extremely short period undulatorand design of quadrupole magnets and with magnets to transfer very low emittance electron beam into undulator.</p>   | Poster | <p><b>HEDSp-13</b></p> <p><b>How to measure the parameters of a nonlinear electrodynamics model by focusing axially-symmetric polarized laser in vacuum</b></p> <p>Takumi Hara, Ryouuke Kodama</p> <p>XXXXX</p> <p>In this paper, we show that the two parameters that characterize nonlinear electrodynamics models could be measured by focusing the axially-symmetric polarized laser in vacuum.</p>   | Poster | <p><b>HEDSp-18</b></p> <p><b>Langevin Equation for Complex Plasmas</b></p> <p>Driss Oumbarek</p> <p>SOLEIL, France</p> <p>XXXXX</p>   | Poster |
|   |        | <p><b>HEDSp-9</b></p> <p><b>On the effect of high intensity laser prepulse on laser wakefield acceleration</b></p> <p>Hakuju Toran</p> <p>XXXXX</p> <p>In this poster, I will explain the effect of laser prepulse on electron injection of staging acceleration using laser wakefield acceleration.</p>  | Poster | <p><b>HEDSp-14</b></p> <p><b>Asymmetry Terahertz Radiation from a Thin Foil Irradiated by Ultrashort Relativistic Laser Pulse</b></p> <p>Shota Tajima<sup>1</sup>, Zhan Jin<sup>2</sup>, Takuya Fukuda<sup>1,3</sup>, Ryouuke Kodama<sup>1,2,3</sup></p> <p><sup>1</sup>Graduate School of Osaka University, Japan, <sup>2</sup>Photon Pioneers Center, Osaka University, Japan, <sup>3</sup>Graduate School of Utsunomiya University, Japan, <sup>4</sup>Institute of Laser Engineering, Osaka University, Japan</p> <p>XXXXX</p>  | Poster |   |        |

Poster Session <Exhibition Hall A>

Thursday, 26 April

LSSEp4 10:30-12:00

SLPCp8 10:30-12:00

**LSSEp4-1** *Poster*

**Development of Polarization Imaging Camera by Femtosecond Laser Microfabrication**

Takuya Okamoto, Yuya Yamada, Takafumi Ohfuchi, Naoaki Fukuda, Takuya Okamoto, Yuya Yamada, Takafumi Ohfuchi, Naoaki Fukuda, Toshio Takiya  
*Hitachi Zosen Corporation, Japan*  
Our research group developed a new polarization imaging camera equipped with micro-array waveplates manufactured using femtosecond laser microfabrication. Demonstration result indicated that the developed camera is useful for detecting transparent substances.

**LSSEp4-2** *Poster*  
**Energy Production and Transmission**

**Recyclable metal air cell using sintered Zn pastes with reduced Zn nanoparticles by pulse laser ablation in liquids**

Taku Saiki<sup>1</sup>, Ryuuta Ishii<sup>1</sup>, Seiji Taniguchi<sup>2</sup>  
<sup>1</sup>Kansai University for Laser Engineering, Japan, <sup>2</sup>Institute for Laser Technology, Japan  
Zn-paste Mg air cell was fabricated for energy cycle using solar-pumped pulse lasers and metals. Zn oxide were reduced to Zn nanoparticles by using high-repetitive laser pulses. Pastes with the reduced Zn nanoparticles were sintered.

**LSSEp4-3** *Poster*  
**Energy Production and Transmission**

**Introduction of a New Thermal Storage Power Station**

Akihiko Nishimura<sup>1</sup>, Yusuke Takenaka<sup>1</sup>, Kunio Saegusa<sup>1</sup>, Seiji Hiroki<sup>1</sup>, Toru Fujino<sup>2</sup>, Tamio Amano<sup>2</sup>, Toru Okazaki<sup>3</sup>, Kazuo Yoshida<sup>3</sup>  
<sup>1</sup>Japan Atomic Energy Agency, Japan, <sup>2</sup>IML-Tokyo Sokki Kenkyujo, Japan, <sup>3</sup>The Institute Applied Energy, Japan  
A new thermal storage power station is introduced. Molten salt is used for heat storage. Heat resistant FBG sensors produced by picosecond laser processing are presented for structure monitoring.

**LSSEp4-4** *Poster*  
**Infrastructure (Nondestructive Testing)**

**Proposal of In-Service Monitoring using a Deformed Steel Bar Combined with Heat Resistant FBG Sensors**

Yuhei Nishio<sup>1</sup>, Akihiko Nishimura<sup>2</sup>, Yusuke Takenaka<sup>2</sup>, Hiroshi Suzuki<sup>2</sup>, Manabu Kanematsu<sup>1</sup>  
<sup>1</sup>Tokyo University of Science, Dep. Architecture, Japan, <sup>2</sup>Japan Atomic Energy Agency, Japan  
Proper measurement method under high temperature is required for understanding fire resistance of reinforced concrete structure. The authors attempt to install heat resistant FBG sensors in reinforced concrete for monitoring steel bar deformation.

**LSSEp4-5** *Poster*  
**Infrastructure (Nondestructive Testing)**

**Preliminary Investigation toward Inspection of Anchorage Strength for Buried Bolt by Laser Hammering Method**

Katshiro Mikami, Noboru Hasegawa, Toshiyuki Kitamura, Hajime Okada, Shuji Kondo, Masaharu Nishikino, Tetsuya Kawachi  
*National Institutes for Quantum and Radiologically Science and Technology, Japan*  
A buried bolt in tunnel is an essential part, for example, a roof panel is bolted by chemical anchor bolt. As a preliminary investigation, bolts buried into polyurethane forms were evaluated.

**LSSEp4-6** *Poster*  
**Remote Sensing**

**Estimation of the second-order spatial correlation properties of a one-dimensional rough surface from polarization sensitive bistatic measurements**

Jonathan Alejandro Franco, Oscar G. Rodríguez-Herrera  
*Universidad Nacional Autónoma de México (UNAM), Mexico*  
We present a scatterometer to estimate the second-order spatial correlation properties of a one-dimensional rough surface from polarization sensitive bistatic measurements with promising applications in remote sensing.

**LSSEp4-7** *Poster*  
**Laser-Induced Breakdown Spectroscopy**

**Broadening and Shift of Emission Lines in Femtosecond Laser Induced Plasma Filament**

Alexey Ilyin<sup>1,2</sup>, S. S. Golik<sup>1,2</sup>, K. A. Shmirko<sup>1,2</sup>, A. Yu. Mayor<sup>1,2</sup>, D. Yu. Proshchenko<sup>2,3</sup>  
<sup>1</sup>Institute of Automation and Control Processes, Russia, <sup>2</sup>Far Eastern Federal University, Russia, <sup>3</sup>Maritime State University, Russia  
Temporal behavior of emission lines (N I and O I) width and shift is investigated with subnanosecond resolution. Filament was induced by femtosecond pulses (800 nm, 1 mJ, 48 fs, 1 kHz) in air.

**LSSEp4-8** *Poster*  
**Laser-Induced Breakdown Spectroscopy**

**Investigation of the spectral and temporal characteristics of plasma radiation in the case of breakdown on the surface of aqueous solutions generated by single laser pulses of femtosecond duration**

Sergey Golik<sup>1,2</sup>, A. A. Ilyin<sup>1,2</sup>, D. Yu. Proshchenko<sup>1,2</sup>, A. Yu. Mayor<sup>1,2</sup>, Yu. S. Tolstonogova<sup>1,2</sup>, M. Yu. Babiy<sup>1</sup>, A. V. Borovskiy<sup>1</sup>, T. M. Agapova<sup>1</sup>  
<sup>1</sup>Far Eastern Federal University, Russia, <sup>2</sup>Institute of Automation and Control Processes, Russia

Spectral and temporal characteristics of plasma were studied in the femtosecond LIBS of aqueous solutions to determine the optimal excitation and registration parameters

**SLPCp8-1**

**Investigate of the laser cladding process by blue diode laser**

Ritsuko Higashino<sup>1</sup>, Masahiro Tsukamoto<sup>1</sup>, Yuji Sato<sup>1</sup>, Nobuyuki Abe<sup>1</sup>, Kohei Asano<sup>1</sup>, Takahisa Shobu<sup>2</sup>, Yoshinori Funada<sup>3</sup>  
<sup>1</sup>Joining and Welding Research Institute, Osaka University, Japan, <sup>2</sup>Japan Atomic Energy Agency, Japan, <sup>3</sup>Industrial Research Institute of Ishikawa, Japan  
In order to clarify the mechanism of copper layer formation, the layer formation process when forming a copper layer using a blue direct diode laser was observed using in situ X ray observation technique.

**SLPCp8-2**

**Pure copper layer formation on stainless steel plate with blue diode laser induced coating system**

Takahiro Hara<sup>1</sup>, Masahiro Tsukamoto<sup>2</sup>, Kohei Asano<sup>1</sup>, Yuji Sato<sup>2</sup>, Ritsuko Higashino<sup>2</sup>, Yoshinori Funada<sup>3</sup>, Nobuyuki Abe<sup>2</sup>  
<sup>1</sup>Graduate School of Engineering, Osaka University, Japan, <sup>2</sup>Joining and Welding Research Institute, Osaka University, Japan, <sup>3</sup>Industrial Research Institute of Ishikawa, Japan  
The pure copper layer was formed on the stainless steel plate with blue direct diode laser induced coating system in order to clarify the coating mechanism.

**SLPCp8-3**

**Simple estimation method to calculate absorbed power distribution for selective laser melting**

Tomomasa Ohkubo<sup>1</sup>, Yuji Sato<sup>2</sup>, Toshi-Taka Ikeshoji<sup>3</sup>, Ei-ichi Matsunaga<sup>1</sup>, Masahiro Tsukamoto<sup>2</sup>  
<sup>1</sup>Department of Mechanical Engineering, Tokyo University of Technology, Japan, <sup>2</sup>Joining and Welding Research Institute, Osaka University, Japan, <sup>3</sup>Fundamental Technology for Next Generation Research Institute, Kindai University, Japan  
We propose a simple estimation model to calculate absorbed power distribution including depth direction using ray-tracing. A surrounding box which has cyclic boundaries enable to reduce the calculation cost.

**SLPCp8-4**

**Selective laser melting of NdFeB magnetic powers**

Chung-Yo Chen<sup>1</sup>, Chung-Wei Cheng<sup>1</sup>, Mi-Ching Tsai<sup>2</sup>, Tsung-Wei Chang<sup>2</sup>, Wen-Cheng Chang<sup>3</sup>, An-Chen Lee<sup>1</sup>  
<sup>1</sup>Department of Mechanical Engineering, National Chiao Tung University, Taiwan, <sup>2</sup>Department of Mechanical Engineering, National Cheng Kung University, Taiwan, <sup>3</sup>Department of Physics, National Chung Cheng University, Taiwan  
This study utilized a self-developed multi-beams SLM system to fabricate NdFeB structures from Nd<sub>2</sub>Fe<sub>14</sub>B powders. The advantages are that the distance between the multi-beams, pulse duration, repetition rate, and scanning strategy can all be controlled.

**SLPCp8-5**

**Bead-on welding of copper film using 100W blue diode laser**

Kento Morimoto<sup>1</sup>, Masahiro Tsukamoto<sup>2</sup>, Shin-ichiro Masuno<sup>2</sup>, Yuji Sato<sup>2</sup>, Kazuyuki Azumi<sup>1</sup>, Yoshihiko Hayashi<sup>1,2</sup>, Nobuyuki Abe<sup>2</sup>  
<sup>1</sup>Osaka Fuji Corporation, Japan, <sup>2</sup>Joining and Welding Research Institute, Osaka University, Japan  
Bead-on welding for the pure copper film was carried out using a blue diode laser. The bead was formed on the pure copper film without pore and crack by using the blue diode laser.

**SLPCp8-6**

**Influence of intensity distribution on surface quality in high speed laser welding of aluminum alloy**

Martin Ruthandi Maina<sup>1</sup>, Yasuhiro Okamoto<sup>1</sup>, Akira Okada<sup>1</sup>, Matti Närhi<sup>2</sup>, Jarno Kangastupa<sup>2</sup>, Jorma Vihinen<sup>3</sup>  
<sup>1</sup>Nontraditional Machining Laboratory, Okayama University, Japan, <sup>2</sup>Corelase Oy, Finland, <sup>3</sup>Laser Application Laboratory, Tampere University of Technology, Finland  
Experimental and numerical investigations were performed in high speed laser welding of aluminium alloy. In order to achieve deep penetration with stable welding phenomena and ensure good surface quality, adjustable ring-mode fiber laser was used.

**SLPCp8-7**

**Experimental characterization of the interaction dynamics of cw-laser radiation with metal samples in the 10<sup>8</sup>W/cm<sup>2</sup> regime**

Dominic Heunoske, Sebastian Schäffer, Marcel Goesmann, Jens Osterholz, Mathias Wickert  
*Laser technologies, Fraunhofer EML, Germany*  
At Laser intensities above 10<sup>8</sup>W/cm<sup>2</sup> material evaporates and affects the energy transfer from laser to metal sample. A systematic experimental study was performed using high-speed cameras, time- and space- resolved emission spectroscopy and interferometry

**SLPCp8-8**

**Laser metal bumping with SUS316L molten powder jet by blue diode laser for steel / carbon fiber reinforced thermoplastics joint**

Kiyokazu Yasuda<sup>1</sup>, Yuki Uchida<sup>1</sup>, Rennosuke Tamura<sup>1</sup>, Takahiro Hara<sup>2</sup>, Yuji Sato<sup>2</sup>, Masahiro Tsukamoto<sup>2</sup>  
<sup>1</sup>Division of Materials and Manufacturing Science, Osaka University, Japan, <sup>2</sup>Joining and Welding Research Institute, Osaka University, Japan  
Laser Metal Bumping (LMB) was conducted with multi-fiber focused blue LD lasers. The surface morphology on mild steels by LMB turned to be from bead-like to isolated bump type, effective for strengthening steel / CFRTP joints.

Poster Session <Exhibition Hall A>

Thursday, 26 April

SLPCp8 10:30-12:00

**SLPCp8-9**

**Effect of laser peening on aluminum alloy 7075**

Ryotaro Oka<sup>1</sup>, Shin Toyokura<sup>1</sup>, Manabu Heya<sup>2</sup>, Miho Tsuyama<sup>1</sup>, Hitoshi Nakano<sup>1</sup>  
<sup>1</sup>Department of Electrical and Electronic Engineering, Faculty of Science and Technology, Kindai University, Japan, <sup>2</sup>Department of Electronic Information and Communication Engineering, Faculty of Engineering, Osaka-Sangyo University, Japan  
 This study is to clarify various characteristics when laser peening treatment is performed on aluminum alloy 7075 which is usually used for aircraft parts.

**SLPCp8-10**

**Control of plasma confinement layer for improving laser peening effect**

Akihiro Hata<sup>1</sup>, Naoya Ehara<sup>1</sup>, Manabu Heya<sup>2</sup>, Miho Tsuyama<sup>1</sup>, Hitoshi Nakano<sup>1</sup>  
<sup>1</sup>Electrical and Electronic Engineering, Faculty of Science and Technology, Kindai University, Japan, <sup>2</sup>Electronic information and Communication Engineering, Faculty of Engineering, Osaka-Sangyo University, Japan  
 Water which has high acoustic impedance and high laser transmittance is chosen as the plasma confinement layer. In this study, the water temperature is varied to improve the laser peening effect.

**SLPCp8-11**

**Effect of control of acoustic impedance in plasma confinement layer on laser peening**

Miho Tsuyama<sup>1</sup>, Naoya Ehara<sup>1</sup>, Kazuma Yamashita<sup>1</sup>, Manabu Heya<sup>2</sup>, Hitoshi Nakano<sup>1</sup>  
<sup>1</sup>Faculty of Science and Engineering, Kindai University, Japan, <sup>2</sup>Faculty of Engineering, Osaka-sangyo University, Japan  
 The present study aimed to control the plasma confinement layer on laser peening. The plasma confinement layer contributes to the increase in the shock wave pressure by suppressing the expansion of the laser-produced plasma.

**SLPCp8-12**

*Canceled*

**SLPCp8-13**

*Canceled*

**SLPCp8-14**

**Formation behavior of laser induced periodic surface structures in various media**

Tomoki Kobayashi<sup>1</sup>, Tomohiro Wakabayashi<sup>2</sup>, Yuichi Takushima<sup>3</sup>, Jiawang Yan<sup>1</sup>  
<sup>1</sup>Mechanical Engineering, Keio University, Japan, <sup>2</sup>Yazaki corporation, Japan, <sup>3</sup>Optoquest, Japan  
 Laser-induced periodic surface structure (LIPSS) was formed on the stainless tool steel by irradiating a picosecond pulsed laser in various types of media. Different surface morphologies were observed on the material surface, depending on the types of media.

**SLPCp8-15**

**Analytical approach to hydrophobic properties of micro patterns carbonized by 355nm UV laser**

Gyeongju Je<sup>1</sup>, Bosung Shin<sup>1,2</sup>, Hyesu Kim<sup>1</sup>, Junhan Park<sup>1</sup>  
<sup>1</sup>Cogno-Mechatronics Engineering, Pusan National University, Korea of republic, <sup>2</sup>Optics & Mechatronics Engineering, Pusan National University, Korea of republic  
 Carbonized patterning using 355nm UV laser was conducted to impart hydrophobicity on polyimide film and analyzed contact angle according to the properties of patterns.

**SLPCp8-16**

**Femtosecond laser coloration with nanoparticles formed on titanium plate**

Shogo Nishino<sup>1,2</sup>, Masaki Hashida<sup>1,2</sup>, Hitoshi Sakagami<sup>3</sup>, Yuki Furukawa<sup>1,2</sup>, Sadaoki Kojima<sup>2</sup>, Shunsuke Inoue<sup>1,2</sup>, Shuji Sakabe<sup>1,2</sup>  
<sup>1</sup>Graduate School of Science, Kyoto University, Japan, <sup>2</sup>Advanced Research Center for Beam Science, Institute for Chemical Research, Kyoto University, Japan, <sup>3</sup>National Institute for Fusion Science, Japan  
 Coloration on titanium surface by femtosecond laser pulses is demonstrated and the correlation of color and formed nanoparticles on the surface is discussed. It has been found that color depends on particle size distribution.

**SLPCp8-17**

**Volumetric graphics of microbubbles in gold nanoparticle-dispersed glycerin using femtosecond laser pulses**

Taisei Chiba, Kota Kumagai, Yoshio Hayasaki  
 Center for Optical Research and Education (CORE), Utsunomiya University, Japan  
 We have demonstrated the generation of femtosecond laser-induced microbubbles in glycerin containing gold nanoparticles. Gold nanoparticles reduced the energy for the generation of microbubbles and the expansion of the generation region in the axial direction.

**SLPCp8-18**

**Micro and nano structured membranes for the use in AlGaIn/GaN- MEMS and pressure sensors, microfluidic applications and bioengineering**

Johann Karl Zehetner<sup>1</sup>, Stephan Kasemann<sup>1</sup>, Gabriel Vanko<sup>2</sup>, Jaroslav Dzubá<sup>2</sup>, Tibor Lalinsky<sup>2</sup>, Sylvia Nürmberger<sup>3</sup>  
<sup>1</sup>Research Centre for Microtechnology, University of Applied Sciences, Austria, <sup>2</sup>Institute of Electrical Engineering, Slovak Academy of Sciences, Slovak Republic, <sup>3</sup>Department of Trauma Surgery, Medical University of Vienna, Austria  
 By polarization determined femtosecond laser ablation combined with reactive ion etching we fabricated membranes in Si and SiC for pressure sensors and 300µm long needles on top of 10µm thick membranes for biomimetic microfluidic systems

**SLPCp8-19**

*Move to Session 4*

**SLPCp8-20**

**Three-dimensional Cu-based microfabrication using femtosecond laser induced internal writing**

Mizue Mizoshiri, Yukinari Kondo, Seichi Hata  
 Graduate School of Engineering, Nagoya University, Japan

Three-dimensional Cu-based microstructures were fabricated using femtosecond laser induced internal writing. Localized plasmon enhancement and heat accumulation were selectively used to sinter single and multi-layers of Cu<sub>2</sub>O NSs.

**SLPCp8-21**

*Canceled*

**SLPCp8-22**

**Ablation by double pulse irradiation by femtosecond laser with different delay time**

Masahito Katto<sup>1</sup>, Kensuke Nakajima<sup>2</sup>, Sho Kuronita<sup>2</sup>, Masahiro Tsukamoto<sup>3</sup>, Masanori Kaku<sup>2</sup>, Atsushi Yokotani<sup>2</sup>  
<sup>1</sup>CRCC, University of Miyazaki, Japan, <sup>2</sup>Faculty of Engineering, University of Miyazaki, Japan, <sup>3</sup>JWRI, Osaka University, Japan  
 We examined the ablation traces on the Si surface irradiated by the double pulses of fs-laser. In the near threshold range, energy deposition by 1st pulse was affected the 2nd pulse until the 250 ps. Above the threshold the HAZ did not grown after the time interval of 50 ns. These results were explained by the energy transfer from electrons to lattice and thermal diffusion.

**SLPCp8-23**

**Holographic laser processing using femtosecond second harmonic generation**

Ryo Onoda, Satoshi Hasegawa, Yoshio Hayasaki  
 Center for Optical Research and Education (CORE), Utsunomiya University, Japan  
 In order to perform efficient fabrication of diffractive optical elements based on refractive index modification inside a transparent material, holographic laser processing using femtosecond second-order harmonic generation was demonstrated.

**SLPCp8-24**

**Holographic complex-amplitude modulation for generating sub-diffraction-limit spot applied to laser material processing**

Satoshi Hasegawa<sup>1</sup>, Cao Hoai Vu<sup>1</sup>, Yusuke Ogura<sup>2</sup>, Jun Tanida<sup>2</sup>, Yoshio Hayasaki<sup>1</sup>  
<sup>1</sup>Center for Optical Research and Education (CORE), Utsunomiya University, Japan, <sup>2</sup>Graduate School of Information Science and Technology, Osaka University, Japan  
 We demonstrated the holographic complex-amplitude modulation for generating the sub-diffraction-limit spot applied to laser processing. The modulation is based on the regulation of the intensity and phase between the center and surrounding beams. In the presentation, a result of femtosecond laser processing using the sub-diffraction-limit spot will also be discussed.

**SLPCp8-25**

**Direct-writing properties of Cu-Ni-based thermoelectric micropatterns formed by femtosecond laser reductive sintering at low writing speed**

Kenta Nishitani, Seichi Hata, Junpei Sakurai, Mizue Mizoshiri  
 Department of micro-nano mechanical science and engineering, Graduate School of Engineering, Nagoya University, Japan  
 P-type Cu-Ni and n-type Cu<sub>2</sub>O thermoelectric micropatterns were selectively fabricated by femtosecond laser reductive sintering of CuO/NiO mixed nanoparticles. These micropatterns were formed at low writing speed without damage created by stage acceleration.

**SLPCp8-26**

**The study of multi-angle drilling by Nd:YAG nanosecond laser on 27G needle and electrochemical polishing**

Hsin Hao Su<sup>1</sup>, Wei Te Wu<sup>1</sup>, Chien Hsing Chen<sup>2</sup>, Jian Neng Wang<sup>3</sup>  
<sup>1</sup>Department of Biomechanics Engineering, National Pingtung University of Science and Technology, Taiwan, <sup>2</sup>Department of Physics, National Chung Cheng University, Taiwan, <sup>3</sup>Department of Civil and Construction Engineering, National Yunlin University of Science and Technology, Taiwan  
 In this study, a series of multi-angle holes were drilled in the 27G dental irrigation needle. We used a nano-second pulsed laser source. Therefore, we used electrochemical polishing technology to improve the HAZ situation.

**SLPCp8-27**

**Characterization a poly-silicon thin film formed by the laser annealing with a high-power blue laser diode**

Young-Hwan Choi, Hyun Yeol Ryu, Han-Youl Ryu  
 Physics, Inha University, Korea  
 We report on the crystallization of a-Si thin film by the annealing with a high-power blue laser diode, and the crystallinity of the annealed poly-Si was characterized by XRD, ellipsometry, and Raman measurements.

**SLPCp8-28**

**Piercing of PTFE sheet by short pulse CO<sub>2</sub> laser**

Hayato Goto<sup>1</sup>, Yuta Ishikawa<sup>1</sup>, Kazuyuki Uno<sup>1</sup>, Takahisa Jitsuno<sup>2</sup>  
<sup>1</sup>University of Yamanashi, Japan, <sup>2</sup>Institute of Laser Engineering, Osaka University, Japan  
 We pierced PTFE by a short pulse CO<sub>2</sub> laser. The short laser pulse with the pulse tail with the fluence of about 7.5 J/cm<sup>2</sup> produced a through hole.

**SLPCp8-29**

**Characterization of two-photon laser exposure patterns in photoresist via photoluminescence quenching**

Edy Yulianto, Subhashri Chatterjee, Vygantas Mizeikis  
 Research Institute of Electronics, Shizuoka University, Japan  
 We report on imaging of latent 3D photo exposure patterns in photoresist exposed via two-photon absorption prior to their development. This technique can be used to reveal useful features of photo exposure, such as spatial distribution, laser modification threshold etc.

Poster Session <Exhibition Hall A>

Thursday, 26 April

SLPCp8 10:30-12:00

XOPTp9 10:30-12:00

SLPCp8-30

**Post-fabrication spectral tuning of perfect-absorber metasurface structures fabricated by direct laser write technique**

Subhashri Chatterjee<sup>1</sup>, Edy Yulianto<sup>1</sup>, Ihar Faniayeu<sup>1,2</sup>, Vygantas Mizeikis<sup>1</sup>  
<sup>1</sup>Research Institute of Electronics, Shizuoka University, Japan, <sup>2</sup>Department of General Physics, Gomel State University, Belarus  
 We investigate possibilities to tune resonance wavelength of perfect absorber structures fabricated by Direct Laser Write (DLW) technique by varying thickness of the metallic film deposited conformally on the structures.

SLPCp8-31

Withdraw

SLPCp8-32

**Laser micro incising to wood surface - Perforations enable penetration of chemicals for wood modification -**

Satoshi Fukuta<sup>1</sup>, Masaki Nomura<sup>1</sup>, Koji Wakabayashi<sup>2</sup>  
<sup>1</sup>Industrial Research Center, Aichi Center for Industry and Science Technology, Japan, <sup>2</sup>Laser Technical Center, Laserx Co., Ltd., Japan  
 We proposed "Laser Micro Incising" for wood, a new technique applying short pulse laser. The perforations on wood surface processed by the laser enabled permeation of chemicals, and chemical modification of wood could be performed.

SLPCp8-33

**Measurement and analysis of material properties using laser induced breakdown spectroscopy**

Sangwoo Yoon, Jihoon Kim, Joohan Kim  
 Department of Mechanical Engineering, Seoul National University of Science and Technology, Korea

LIBS is generally used to measure elemental distribution, but the plasma signal from the ablation of the material has a lot of information about the material and can analyze spectroscopic signals to confirm the various properties of the specimen.

SLPCp8-34

Withdraw

SLPCp8-35

Canceled

SLPCp8-36

Canceled

SLPCp8-37

Canceled

XOPTp9-1

**Feasibility study of phase-contrast X-ray micro-CT using diffraction enhanced imaging**

Akio Yoneyama<sup>1,2</sup>, Rika Baba<sup>2</sup>, Kazuyuki Hyodo<sup>3</sup>  
<sup>1</sup>Saga Light Source, Japan, <sup>2</sup>Hitachi Ltd., Japan, <sup>3</sup>High Energy Accelerator Research Organization, Japan

We developed a phase-contrast X-ray micro CT system using diffraction enhanced imaging method. The results of feasibility observation of a polymer sphere show that the spatial resolution was about 3 um.

XOPTp9-2

**X-ray stroboscopic phase tomography with Talbot interferometer and white synchrotron radiation**

Yanlin Wu, Hidekazu Takano, Atsushi Momose  
 Tohoku University, Japan

Here, we report time-resolved X-ray phase tomography using Talbot interferometer combine with stroboscopic techniques, which are applicable when the process to be imaged is periodic with microsecond order temporal resolution.

XOPTp9-3

**Development of X-ray phase laminography microscope based on grating interferometry**

Hidekazu Takano<sup>1</sup>, Karol Vegso<sup>2</sup>, Masato Hoshino<sup>2</sup>, Yanlin Wu<sup>1</sup>, Atsushi Momose<sup>1,2</sup>  
<sup>1</sup>Tohoku University, Japan, <sup>2</sup>Japan Synchrotron Radiation Research Institute, Japan

An X-ray phase laminography microscope was demonstrated using 9 keV X-ray of SPring-8 37XU. The system was composed by an X-ray microscope using a FZP and by a Tolbot interferometer using X-ray transmission gratings.

XOPTp9-4

**Imaging thermoresponsive gold nanoparticles in solution by X-ray laser diffraction**

Akihiro Suzuki<sup>1</sup>, Takashi Kimura<sup>1</sup>, Ryo Iida<sup>2</sup>, Hideyuki Mitomo<sup>1,5</sup>, Yasumasa Joti<sup>3</sup>, Yoshitaka Bessho<sup>4</sup>, Ken-ichi Niikura<sup>5</sup>, Kuniharu Ijiro<sup>1,5</sup>, Yoshinori Nishino<sup>1</sup>

<sup>1</sup>Research Institute for Electronic Science, Hokkaido University, Japan, <sup>2</sup>Graduate School of Chemical Sciences and Engineering, Hokkaido University, Japan, <sup>3</sup>Japan Synchrotron Radiation Research Institute, Japan, <sup>4</sup>Academia Sinica, Taiwan, <sup>5</sup>Global Institution for Collaborative Research and Education, Hokkaido University, Japan, <sup>6</sup>Nippon Institute of Technology, Japan

By adding sample temperature control function to pulsed coherent X-ray solution scattering (PCXSS), we realized nanostructure imaging of gold nanoparticles, which self-assemble in solution due to temperature changes.

XOPTp9-5

**Parametric-Down Conversion of X-rays into the Optical Regime**

Aviad Schori<sup>1</sup>, Christina Bomer<sup>2</sup>, Denis Borodin<sup>1</sup>, Steve Collins<sup>3</sup>, Bilanka Detlefs<sup>4</sup>, Marco Moretti Sala<sup>4</sup>, Shimon Yudovich<sup>1</sup>, Sharon Shwartz<sup>1</sup>  
<sup>1</sup>Bar-Ilan University, Israel, <sup>2</sup>European XFEL, Germany, <sup>3</sup>Diamond Light Source, United Kingdom, <sup>4</sup>European Synchrotron Radiation Facility, France

We observed parametrically down converted x-ray signal photons that correspond to idler photons at optical wavelengths. The results demonstrate a new method for probing valence-electron charges and microscopic optical responses of crystals with atomic-scale resolution.

XOPTp9-6

**Study of silicon microstructures by x-ray high resolution diffractometry based on refractive optics**

Petr Ershov<sup>1</sup>, Alexander Barannikov<sup>1</sup>, Ivan Lyatun<sup>1</sup>, Dmitriy Zverev<sup>1</sup>, Sergey Kuznetsov<sup>2</sup>, Vyacheslav Yunkin<sup>2</sup>, Irina Snigireva<sup>3</sup>, Anatoly Snigirev<sup>1</sup>  
<sup>1</sup>Immanuel Kant Baltic Federal University, Russia, <sup>2</sup>Institute of Microelectronics Technology and High-Purity Materials, Russia, <sup>3</sup>European Synchrotron Radiation Facility, France

We propose and demonstrate the new X-ray optical diffractometry technique based on Compound Refractive Lenses(CRL) to study different Si microstructures. The unique results presented in that work, shows perspectives of future technique applications.

XOPTp9-7

**SwissFEL photon diagnostics for soft, tender and hard X-rays**

Christopher A. Arrell, Jens Rehanek, Pavle Juranic, the SwissFEL team  
 Paul Scherrer Institut, Switzerland  
 Photon diagnostics in use on the hard X-ray branch (Aramis) of SwissFEL and those planned for the tender X-ray and the future soft X-ray branch (Atheros) are presented.

XOPTp9-8

**Synchrotron radiation-based anomalous dispersion X-ray powder diffraction studies of Pb/Bi distributions in ferroelectric oxides**

Kun Lin<sup>1</sup>, Yili Cao<sup>1</sup>, Kenichi Kato<sup>2</sup>, Xianran Xing<sup>1</sup>  
<sup>1</sup>University of Science and Technology Beijing, China, <sup>2</sup>RIKEN SPring-8 Center, Japan

Synchrotron radiation-based anomalous dispersion X-ray powder diffraction technique was successfully used to reveal the ordered Pb/Bi distributions in a tungsten bronze oxide Pb<sub>2</sub>BiNb<sub>3</sub>O<sub>15</sub> and disordered Pb/Bi distributions in perovskite oxides (1-x)PbTiO<sub>3</sub>-xBiFeO<sub>3</sub> and (1-x)PbTiO<sub>3</sub>-xBi(Zn<sub>1/2</sub>Ti<sub>1/2</sub>)O<sub>3</sub>.

XOPTp9-9

**X-ray Optics for High-speed X-ray Reflectivity and Diffraction Measurements of Surfaces, Interfaces and Thin Films**

Wolfgang Voegelé<sup>1</sup>, Etsuo Arakawa<sup>1</sup>, Toshio Takahashi<sup>1</sup>, Tetsuroh Shirasawa<sup>2,3</sup>, Hiroo Tajiri<sup>4</sup>, Masamitsu Takahashi<sup>5</sup>, Takuo Sasaki<sup>5</sup>, Tadashi Matsushita<sup>6</sup>

<sup>1</sup>Tokyo Gakugei University, Japan, <sup>2</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>3</sup>JST, PRESTO, Japan, <sup>4</sup>Japan Synchrotron Radiation Research Institute, Japan, <sup>5</sup>National Institutes for Quantum and Radiological Science and Technology, Japan, <sup>6</sup>Photon Factory, KEK, Japan

X-ray optics for time-resolved X-ray reflectivity or diffraction measurements from interfaces and thin films will be presented. It can be used to observe structural changes with a time resolution of milliseconds to seconds.

XOPTp9-10

**Theory and fabrication feasibility of ultra short focal length refractive lenses for hard X-Rays**

Lucia Alianeli, John Sutter, Kawal Sawhney  
 Diamond Light Source Ltd, United Kingdom

We discuss refractive lens designs, and materials currently used for synchrotron applications and the fabrication requirements to produce an aberration-free refractive lens for focusing to s = 20 nm, based on new designs.

XOPTp9-11

**X-ray refractive parabolic axicon lens**

Dmitriy Zverev<sup>1</sup>, Alexandr Barannikov<sup>1</sup>, Irina Snigireva<sup>2</sup>, Anatoly Snigirev<sup>1</sup>  
<sup>1</sup>Immanuel Kant Baltic Federal University, Russia, <sup>2</sup>European Synchrotron Radiation Facility, France

An X-ray axicon, as novel type of beam-shaping optical element is proposed and demonstrated. Under coherent X-ray illumination, the parabolic axicon generates Bessel-like beam along the optical axis and ring-shaped beam at the imaging distance.

XOPTp9-12

**Phase-contrast imaging using X-ray nanointerferometer based on Si refractive bilenses**

Dmitriy Zverev<sup>1</sup>, Victor Kohn<sup>2</sup>, Irina Snigireva<sup>3</sup>, Anatoly Snigirev<sup>1</sup>

<sup>1</sup>Immanuel Kant Baltic Federal University, Russia, <sup>2</sup>Russian Research Center Kurchatov Institute, Russia, <sup>3</sup>European Synchrotron Radiation Facility, France

We have demonstrated phase-contrast technique using X-ray nanointerferometer based on Si refractive bilenses. Proposed phase-contrast imaging technique will allow to study natural and advanced man-made nanoscale materials.

## Poster Session &lt;Exhibition Hall A&gt;

Thursday, 26 April

XOPTp9 10:30-12:00

**XOPTp9-13****Beryllium X-ray optical properties: from refractive lens to diffuser**

Ivan Lyatun<sup>1</sup>, Peter Ershov<sup>1</sup>, Svetlana Medvedeva<sup>1</sup>, Elena Kozlova<sup>2</sup>, Maxim Sheverdyayev<sup>2</sup>, Vladimir Volkov<sup>3</sup>, Alexandr Semenov<sup>2</sup>, Vladimir Gorlevsky<sup>2</sup>, Valery Savin<sup>1</sup>, Irina Snigireva<sup>4</sup>, Anatoly Snigirev<sup>1</sup>  
<sup>1</sup>Immanuel Kant Baltic Federal University, Russia, <sup>2</sup>A. A. Bochvar High-Technology Scientific Research Institute for Inorganic Materials, Russia, <sup>3</sup>Russian Academy of Sciences, Russia, <sup>4</sup>European Synchrotron Radiation Facility, France

Almost all beryllium grades are sintered materials, which have internal micro- and nanograin structure and relatively high BeO concentration. BeO forms a inhomogeneous internal structure in beryllium which leads to strong ultra-small angular X-ray scattering.

**XOPTp9-14****2D polymer refractive microlenses fabricated by additive technology**

Aleksandr Barannikov<sup>1</sup>, Ksenya Abrashitova<sup>1,2</sup>, Vladimir Bessonov<sup>2</sup>, Alexandr Petrov<sup>1,2</sup>, Natalya Kokareva<sup>2</sup>, Kirill Safronov<sup>2</sup>, Petr Ershov<sup>1</sup>, Nataliya Klimova<sup>1</sup>, Ivan Lyatun<sup>1</sup>, Vyacheslav Yunkin<sup>3</sup>, Maxim Polikarpov<sup>1</sup>, Irina Snigireva<sup>4</sup>, Andrey Fedyanin<sup>2</sup>, Anatoly Snigirev<sup>1</sup>  
<sup>1</sup>Immanuel Kant Baltic Federal University, Russia, <sup>2</sup>Lomonosov Moscow State University, Russia, <sup>3</sup>Russian Academy of Science, Russia, <sup>4</sup>European Synchrotron Radiation Facility, France

This paper is presents the new X-ray refractive lense manufacturing technology, wich gives the possibility to overcome the limits of other popular techniques.

**XOPTp9-15****Mini-Trasfocator for X-ray Microscopy**

Aleksandr Barannikov, Petr Ershov, Anatoly Lushnikov, Ivan Lyatun, Anton Narikovich, Igor Panormov, Maxim Polikarpov, Aleksandr Sinitsyn, Dmitry Zverev, Anatoly Snigirev  
 Immanuel Kant Baltic Federal University, Russia

We propose an X-ray Mini-Trasfocator for X-ray microscopy, introscopy and related applications. This device based on parabolic refractive lenses can be used for adjustment of the lens assembly by mechanical movement of the lenses one-by-one.

**XOPTp9-16****High-aspect-ratio X-ray optical devices fabricated from Pt-based metallic glass**

Wataru Yashiro<sup>1</sup>, Masanari Datekyu<sup>2</sup>, Masashi Nakao<sup>3</sup>, Yoshiki Kohmura<sup>2</sup>, Hidemi Kato<sup>2</sup>

<sup>1</sup>Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Japan, <sup>2</sup>Institute of Materials Research, Tohoku University, Japan, <sup>3</sup>Micro System Integration Center, Tohoku University, Japan, <sup>4</sup>RIKEN SPring-8 Center, Japan

In general, hard-X-ray optical devices essentially requires high-aspect-ratio structures because of weak interaction of hard X-rays with matters. Recently, we successfully fabricated high-aspect-ratio transmission gratings, and even an FZP, by Pt-based metallic glass imprinting.

**XOPTp9-17****Two-dimensional VLS gratings from Berlin (NOB GmbH)**

Heike Loechel  
 Neutron Optics Berlin, Germany

A new approach for 2-dimensional variable space (VLS) gratings was implemented at Neutron Optics Berlin GmbH for wavelength dispersive spectrometry and ultra-fast time-resolved monochromators. These diffractive optical elements provide new options in the XUV and X-ray range with up to 5000 lines/mm.

**XOPTp9-18****Development of Channel-cut Crystal X-ray Monochromators for Low-emittance X-ray Sources Using High-precision Plasma Etching**

Yuki Morioka<sup>1</sup>, Takashi Hirano<sup>1</sup>, Yasuhisa Sano<sup>1</sup>, Satoshi Matsuyama<sup>1</sup>, Taito Osaka<sup>2</sup>, Tetsuo Katayama<sup>2</sup>, Makina Yabashi<sup>2</sup>, Kazuto Yamauchi<sup>1</sup>

<sup>1</sup>Osaka University, Japan, <sup>2</sup>RIKEN SPring-8 Center, Japan, <sup>3</sup>Japan Synchrotron Radiation Research Institute, Japan

In order to eliminate subsurface damage on inner-walls of channel-cut crystal monochromators (CCMs) with narrow channel width, we newly prepared small rotation electrode and treated inner-walls of CCM with channel width of 8 mm.

**XOPTp9-19****Development of Fabrication Method of Speckle-free Channel-cut Crystal X-ray Monochromators with Sub-mm Channel Width**

Takashi Hirano<sup>1</sup>, Yuki Morioka<sup>1</sup>, Yasuhisa Sano<sup>1</sup>, Taito Osaka<sup>1,2</sup>, Satoshi Matsuyama<sup>1</sup>, Makina Yabashi<sup>2</sup>, Kazuto Yamauchi<sup>1</sup>

<sup>1</sup>Osaka University, Japan, <sup>2</sup>RIKEN SPring-8 Center, Japan

A speckle-free channel-cut crystal monochromators with a sub-mm channel width is highly demanded for self-seeded XFELs. Its fabrication method based on the local etching technique using atmospheric-pressure plasma was proposed and discussed.

**XOPTp9-20****Interface engineering of periodic multilayer EUV and x-ray mirrors**

JiaoLing Zhao, Meiping Zhu, Kui Yi, Hongji Qi, Hongbo He, Jianda Shao  
 Chinese Academy of Sciences, China

The interface of EUV and X-ray multilayer mirrors are investigated to improve the reflectivity and thermal stability, in which the barrier layer, reactive sputtering and co-sputtering are discussed.

**XOPTp9-21****The Commission of Mirror Holder for X-ray Nanoprobe**

BoYi Chen<sup>1</sup>, Gung-Chian Yin<sup>1</sup>, Chien-Yu Lee<sup>1</sup>, Ming-Ying Hsu<sup>1</sup>, Bi-Hsuan Lin<sup>2</sup>, Shao-Chin Tseng<sup>2</sup>, Xiao-Yun Li<sup>2</sup>, Huang-Yeh Chen<sup>2</sup>, Jian-Xing Wu<sup>2</sup>, Shih-Hung Chang<sup>3</sup>, Mau-Tsu Tang<sup>3</sup>

<sup>1</sup>Experimental Technique Group, National Synchrotron Radiation Research Center, Taiwan, <sup>2</sup>X-ray and IR imaging Group, National Synchrotron Radiation Research Center, Taiwan, <sup>3</sup>Beamline Group, National Synchrotron Radiation Research Center, Taiwan

The commission of X-ray nanoprobe endstation started to test the performance of each components and systems. Both of the focus ability of Montel mirrors and the stability are studied.

**XOPTp9-22****New figuring model based on surface slope profiles for X-ray optics**

Lin Zhou<sup>1</sup>, Hao Hu<sup>1</sup>, Ci Song<sup>1</sup>, Shanyong Chen<sup>1</sup>, Guipeng Tie<sup>1</sup>, Mourad Idrir<sup>2</sup>

<sup>1</sup>National University of Defense Technology, China, <sup>2</sup>NLSL II, Brookhaven National Laboratory, USA

Surface slope profiles are widely used in the metrology of X-ray optics instead of surface height profiles. Nevertheless, the theoretical and experimental model currently used in deterministic optical figuring processes is based on surface heights, not on surface slopes.

**XOPTp9-23****Measurement of a spherical mirror with sub-50 pm repeatability by three-dimensional nanoprofiler using normal vector tracing Method**

Yui Toyoshi, Ryo Kizaki, Hiroki Shiraji, Takao Kitayama, Jungmin Kang, Kazuya Yamamura, Katsuyoshi Endo  
 Osaka University, Japan

We developed a non-contact nanoprofiler that measures normal vectors of surface. We introduce a measurement of a spherical mirror with radius of curvature of 1000 mm. The repeatability of it were less than 50 pm.

**XOPTp9-24****Development of nanofocusing system for X-ray free electron Laser (Study of nanobeam characterization)**

Takato Inoue<sup>1</sup>, Satoshi Matsuyama<sup>1</sup>, Shogo Kawai<sup>1</sup>, Hirokatsu Yumoto<sup>2</sup>, Yuichi Inubushi<sup>2</sup>, Takahisa Koyama<sup>2</sup>, Kensuke Tono<sup>2</sup>, Taito Osaka<sup>3</sup>, Haruhiko Ohashi<sup>2</sup>, Makina Yabashi<sup>3</sup>, Tetsuya Ishikawa<sup>3</sup>, Kazuto Yamauchi<sup>1</sup>

<sup>1</sup>Osaka University, Japan, <sup>2</sup>Japan Synchrotron Radiation Research Institute, Japan, <sup>3</sup>RIKEN SPring-8 Center, Japan

Ideal focusing can be realized if wavefront information of a focused beam can be measured and improved. We evaluated the single shot beam characterization method using speckle patterns due to the scattering of nanoscale particles.

**XOPTp9-25****Development of high-resolution X-ray imaging optical system using multilayer imaging mirrors**

Kentaro Hata<sup>1</sup>, Jumpei Yamada<sup>1</sup>, Satoshi Matsuyama<sup>1</sup>, Yasuhisa Sano<sup>1</sup>, Yoshiki Kohmura<sup>2</sup>, Makina Yabashi<sup>2</sup>, Tetsuya Ishikawa<sup>2</sup>, Kazuto Yamauchi<sup>1,3</sup>

<sup>1</sup>Department of Precision Science and Technology, Graduate School of Engineering, Osaka University, Japan, <sup>2</sup>RIKEN SPring-8 Center, Japan, <sup>3</sup>Center for Ultra-Precision Science and Technology, Graduate School of Engineering, Osaka University, Japan

We have developed an imaging optics based on Advanced KB mirrors with a graded multilayer film. A high resolution of about 35 nm x 50 nm (H x V) was achieved.

**XOPTp9-26****Development of adaptive X-ray focusing system based on a combination of a piezoelectric bimorph mirror and a mechanical mirror bender**

Hiroyuki Yamaguchi<sup>1</sup>, Takumi Goto<sup>1</sup>, Hiroki Hayashi<sup>1</sup>, Satoshi Matsuyama<sup>1</sup>, Junki Sonoyama<sup>2</sup>, Kazuki Akiyama<sup>2</sup>, Hiroki Nakamori<sup>3</sup>, Yasuhisa Sano<sup>1</sup>, Yoshiki Kohmura<sup>2</sup>, Makina Yabashi<sup>4</sup>, Tetsuya Ishikawa<sup>4</sup>, Kazuto Yamauchi<sup>1</sup>

<sup>1</sup>Osaka University, Japan, <sup>2</sup>TOYAMA, Japan, <sup>3</sup>JTEC Corporation, Japan, <sup>4</sup>RIKEN SPring-8 Center, Japan

We developed a hybrid deformable mirror based on a combination of a piezoelectric bimorph mirror and a mechanical mirror bender. We report the result of 2D focusing experiment using the mirrors at SPring-8.

**XOPTp9-27****Thermal Analysis for Ion Beam Processing of the Unimorph Deformable Mirror**

Zhanbin Fan<sup>1,2</sup>, Chaoliang Guan<sup>1,2</sup>, Guipeng Tie<sup>1,2</sup>, Shanyong Chen<sup>1,2</sup>

<sup>1</sup>National University of Defense Technology, China, <sup>2</sup>Hunan Key Laboratory of Ultra-precision Machining Technology, China  
 The variation law of temperature and thermal stress of the adhesive layer with different ion beam diameters and scanning times are obtained by simulation and test. The thermal effect of the ion beam is eliminated.

**XOPTp9-28****Figure correction of ellipsoidal x-ray mirrors by ion beam sputtering deposition**

Shunya Yokomae, Hiroto Motoyama, Hidekazu Mimura  
 The University of Tokyo, Japan

We developed a figure correction system for ellipsoidal x-ray mirrors employing ion beam sputtering deposition. After the process, figure error of the inner surface of a mirror was decreased from 202 nm to 96 nm.

## Poster Session &lt;Exhibition Hall A&gt;

Thursday, 26 April

XOPTp9 10:30-12:00

ICNN5p 13:00-14:30

**XOPTp9-29****Development of a high precision processing for master mandrel of soft X-ray ellipsoidal mirror**

Yuusuke Matsuzawa, Shinji Okawa, Hidekazu Mimura  
The University of Tokyo, Japan

Our research group is development of single nano-meter precision of the master mandrel for fabrication soft X-ray ellipsoidal mirror. We developed a processing method that is combination by small diameter tool and organic particles.

**XOPTp9-30****Imaging Quality of HHG Achromatic Microscope Using Wolter Mirrors**

Satoru Egawa<sup>1</sup>, Hiroto Motoyama<sup>1</sup>, Atsushi Iwasaki<sup>2</sup>, Kaoru Yamanouchi<sup>2</sup>, Hidekazu Mimura<sup>1</sup>

<sup>1</sup>Department of Precision Engineering, School of Engineering, the University of Tokyo, Japan, <sup>2</sup>Department of Chemistry, School of Science, the University of Tokyo, Japan

We demonstrate a HHG (high-harmonic generation) achromatic imaging microscope using Wolter mirrors. Sub-micrometer spatial resolution was achieved. The future plan is to perform time-resolved imaging using polychromatic bright illumination.

**XOPTp9-31****Current X-ray mirrors and metrology of JTEC Corporation**

Hiroki Nakamori<sup>1,2</sup>, Hiromi Okada<sup>1</sup>, Shinya Aono<sup>1</sup>, Kazuto Yamauchi<sup>2</sup>, Takashi Tsumura<sup>1</sup>

<sup>1</sup>JTEC Corporation, Japan, <sup>2</sup>Osaka University, Japan

We fabricate ultraprecise X-ray mirrors for synchrotron radiation facilities. The mirrors are measured and fabricated by special techniques. We will report current metrology and X-ray mirrors.

**ICNN5p-1****Plasmonic Property of Two-Dimensional Transition Metal Nanodot Arrays**

Mi Jung, Sun-Ho Kim, Eudum Kim  
Chung-Ang University, Korea

Two-dimensional (2D) copper and nickel NDAs with ~ 85 nm diameter were fabricated on ITO substrates using ultra-thin nanoporous alumina mask with through-holes as a shadow mask. Plasmonic properties of 2D Cu and Ni NDAs

**ICNN5p-2****Enhanced Emission from Ultrastable CsPbBr<sub>3</sub>/SiO<sub>2</sub> Nanocrystals**

Zhengzheng Liu<sup>1</sup>, Zhiping Hu<sup>2</sup>, Tongchao Shi<sup>1</sup>, Zeyu Zhang<sup>1</sup>, Xin Xing<sup>1</sup>, Xiaosheng Tang<sup>2</sup>, Juan Du<sup>1</sup>, Yuxin Leng<sup>1</sup>

<sup>1</sup>Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China, <sup>2</sup>Chongqing University, China

Enhanced amplified spontaneous emission has been obtained from perovskite CsPbBr<sub>3</sub> quantum dots embedded in waterless silica spheres. In addition, the moisture resistance and photostability of quantum dots are effectively improved.

**ICNN5p-3****Enhanced Light-Coupling in Laser-Crystallised Silicon Thin-Film Solar Cells on Glass by Moth-Eye Anti-Reflection Foil**

Mohd Zamir Pakhuruddin  
School of Photovoltaic and Renewable Energy Engineering, University of New South Wales, Sydney 2052, Australia, Australia

Enhanced Light-Coupling in Laser-Crystallised Silicon Thin-Film Solar Cells on Glass by Moth-Eye Anti-Reflection Foil

**ICNN5p-4****UV Enhanced Non-Enzymatic Glucose Biosensor of ZnO Nanosheets**

Zi-Hao Wang<sup>1,2</sup>, Shi-Wei Luo<sup>2,3</sup>, Wei-Sheng Yeh<sup>1,2</sup>, Cheng-You Tai<sup>1,2</sup>, Chih-Chiang Yang<sup>2</sup>, Chien-Sheng Huang<sup>3</sup>, Yan-Kuin Su<sup>1,2</sup>

<sup>1</sup>National Cheng Kung University, Taiwan, <sup>2</sup>Kun Shan University, Taiwan, <sup>3</sup>National Yunlin University of Science and Technology, Taiwan

ZnO nanosheets were synthesized on glass substrates. Moreover, UV illumination increases the sensitivity by about 50%. In addition, these enhanced UV illumination are due to the localized surface plasmon resonance effect.

**ICNN5p-5****Supercell-Based High-Efficiency Reflector-Arrays Metasurface Based on Bridged Plasmonic Nanoparticles**

Enliang Wang<sup>1,2</sup>, Liang Yonghao<sup>1,2</sup>, Xie Changqing<sup>1</sup>

<sup>1</sup>Key Laboratory of Microelectronic Devices and Integrated Technology, Institute of Microelectronics, Chinese Academy of Sciences, China, <sup>2</sup>School of Microelectronics, University of Chinese Academy of Sciences, China

We provide a reflector-arrays metasurface consisting of Au nanowire-bridged dimer associated with an Au reflector substrate.

**ICNN5p-6****Polarization-Insensitive and Wide-Incident-Angle Optical Absorber with Periodically Patterned Graphene-Dielectric Arrays**

Xiu Juan Zou, Gaige Zheng  
NUIST, China

A polarization-insensitive and angle-independent graphene absorber (GA) with periodically patterned grating is demonstrated.

**ICNN5p-7****Design of An Ultra-Broadband Near-Infrared Cut Filter Based on Hydrogenated Amorphous Carbon**

Yusuke Kondo  
Osaka research institute of science and technology (ORIST), Japan

Hydrogenated amorphous carbon (a-C:H) is a promising candidate for the fabrication of near-infrared (NIR) optical filters. We succeeded in precisely controlling the refractive index and designed a multilayer system for ultra-broadband NIR cut filter.

**ICNN5p-8****Novel CQDs@Ni(OH)<sub>2</sub> Fluorescent Hybrid Materials for the H<sub>2</sub> Production via Photocatalytic Water Splitting**

Seshadri Reddy Ankireddy, Roopkumar Sangubotla, Kyusik Yun  
Gachon University, Korea

We are presenting hydrothermal preparation of CQDs@Ni(OH)<sub>2</sub> fluorescent hybrid materials for the H<sub>2</sub> Production via Photocatalytic Water Splitting. By the immobilization of Ni(OH)<sub>2</sub> on the surface of CQDs, more amount of H<sub>2</sub> was produced

**ICNN5p-9****Near-Unity Absorption of Graphene Monolayer with A Triple-Layer Waveguide Coupled Grating**

Haojing Zhang, Gaige Zheng  
NUIST, China

A design of absorber inspired by contact coupled gratings with an absentee layer is demonstrated.

**ICNN5p-10****1\*2 Hybrid Plasmonic Multimode Interference Power Splitter with Arbitrary Ratio**

Wencheng Yu, Wei Luo, Yuxiang Sheng, Peng Zhou, Hongye Zhou, Ye Tian  
Hunan City University, China

The power-splitting-ratio (PSR) of the 1\*2 multimode interference (MMI) device based on hybrid plasmonic waveguide are studied theoretically. An arbitrary PSR is achieved.

**ICNN5p-11****Observation of Whispering Gallery Mode At An Unbalanced Mach-Zehnder Interferometer by Plasmonic Waveguides**

Shun Kamada, Toshihiro Okamoto, Masanobu Haraguchi  
Tokushima University, Japan

We proposed an unbalanced Mach-Zehnder interferometer (MZI) by using Metal/Insulator/Metal type plasmonic waveguides for optical modulation or sensor devices. In this study, transmission properties of the unbalanced MZIs are evaluated both experimentally and numerically.

**ICNN5p-12****Generation of Surface Plasmon Polaritons in Graphene-Semiconductor Structure with Distributed Feedback**

Sergey Moiseev, Yuliya Dadoenkova, Aleksei Kadochkin, Igor Zolotovskii  
Ulyanovsk State Univ, Russia

The possibility of surface plasmon polariton generation in a waveguiding system containing semiconductor film and graphene single-layer is shown.

**ICNN5p-13****Synthesis of Carbon Quantum Dots from Aspartic Acid**

Yeji Kim, Roopkumar Sangubotla, Jongsung Kim  
Gachon university, Korea

Synthesis of Carbon Quantum Dots from Aspartic Acid. Aspartic acid is simple, and inexpensive. And change the functional group to thiol group detect lead by L-cysteine.

**ICNN5p-14****One-Step Green Synthesis of Carbon Dots from Indian Kino Via Hydrothermal Process**

Roopkumar Sangubotla, Yeji Kim  
Gachon University, Korea

Green synthesis of carbon dots from natural source via hydrothermal process and potentially applied for the epinephrine sensing in biological samples.

**ICNN5p-15****Microwave Synthesis of Highly Fluorescent N-doped Carbon Dots from Pamam Dendrimer**

Moniruzzaman Md, Seshadri Reddy Ankireddy  
Gachon University, Korea

Herein we report a simple microwave method for the synthesis of highly fluorescent N-Doped carbon dots (CQDs) and linked with DHLA for the ultra level sensing of Hg<sub>2+</sub> ions

**ICNN5p-16****Improving the Characteristics of Au/ZnO Schottky-Photodiodes by Inserting an Intrinsic NiO Layer**

Jun-Dar Hwang, H.Y. Chen  
Electrophysics, National Chiayi University, Taiwan

Conventionally, the Schottky-photodiodes (SPDs) of Au/ZnO presented an ohmic behavior. In this work, the intrinsic NiO (i-NiO) layer was inserted between Au/ZnO interface, i.e., Au/NiO/ZnO, to improve the characteristics of Au/ZnO SPDs.

**ICNN5p-17****Normally-Off HEMT with Simply Solution-Processed p-NiO As Gate Oxide Layer**

Liang Rong Shi  
Institute of Microelectronics, Taiwan

A p-NiO gate oxide layer with nanoscale thickness formed on AlGaN barrier layer can lift up the potential at the channel and achieved the normally-off device with high channel mobility.

Poster Session <Exhibition Hall A>

Thursday, 26 April

ICNN5p 13:00-14:30

LEDIAp2 13:00-14:30

**ICNN5p-18**

**The Luminance Improvement of MAPbBr<sub>3</sub> Light Emitting Diodes by Boiled NiOx Solution for Hole Transport Layer**

Hui Yu He  
*Institute of Microelectronics, Taiwan*  
We demonstrate efficient pure greenlight emitting diodes based on methylammonium lead bromide (MAPbBr<sub>3</sub>) hybrid perovskite with p-type NiO by boiled solution as the hole transporting layer (HTL). The LED exhibits a current efficiency and luminance of 5.7 cd/A and 116,295 cd/m<sup>2</sup>, respectively.

**ICNN5p-19**

**Indium-Gallium-Oxide Solar-Blind Photodetectors under Different Oxygen Concentrations**

Chih-Chiang Yang, Kuan-Yu Chen, Hsin-Chieh Yu, Zi-Hao Wang, Ching-Chien Hsu, Yan-Kun Su  
*Kun Shan University, Taiwan*  
Ultraviolet (UV) photodetectors (PDs) have been well-known research topics in the past decade and have been applied in many fields, such as flame detection, space-to-space communications, agricultural development, and medical science. Therefore, effectively and accurately

**ICNN5p-20**

**Numerical Investigation on the Non-uniform Optical Phased Array for Wide Angle Beam steering**

Dong-Ju Seo, Han-Youl Ryu  
*Inha University, Korea*  
The optical phased array based on the silicon photonics technology was investigated numerically. Wide-angle beam steering with low-noise can be achieved by optimizing the antenna arrangement of a nonuniform aperiodic phased array structure.

**ICNN5p-21**

**Selective Emitter for Micro-Combustion Based Thermophotovoltaic System**

Bo young Park, Keum Hwan Park, Young seock Kim  
*Korea Electronics Technology Institute, Korea*  
We made Thermophotovoltaic emitter for micro-combustion based TPV system.

**ICNN5p-22**

**Temperature Optimization of P-doping Layer in Quantum Dot Laser Diodes Grown on GaAs for Si Photonics Application**

Guen-Hwan Ryu<sup>1,2</sup>, Jae-Hoon Han<sup>2</sup>, Han-Youl Ryu<sup>1</sup>  
<sup>1</sup>*Inha University, Korea*, <sup>2</sup>*Korea Institute of Science and Technology, Korea*  
Laser diode structures with InAs/GaAs QDs were grown on GaAs substrates by MBE. It was found that the growth temperature of the p-doping layer plays a critical role in the LD performance.

**LEDIAp2-1**

**Algan-Based Deep UV Flip-Chip Light Emitting Diode with AlN/Al Reflector**

Tae Hoon Park, Tae Ho Lee, Tae Geun Kim  
*Korea University, Korea*  
AlGAN-based deep ultraviolet flip-chip light-emitting diodes using AlN/Al electrodes were studied, which shows the outstanding Ohmic behavior for both n- and p-AlGAN layers and high reflectance.

**LEDIAp2-2**

**The Effect of the Metallic Nano-Grating for 365nm Polarized UV-LED**

Eun-Kyung Chu<sup>1</sup>, Nam-Woo Kang<sup>1</sup>, Beom-Rae Noh<sup>1</sup>, Hee-Jung Choi<sup>1</sup>, Kwon Yung-Ju<sup>2</sup>, Kyoung-Kook Kim<sup>1</sup>  
<sup>1</sup>*Dept. of Advanced Convergence Technology, Korea*, <sup>2</sup>*Dept. of Nano Optical Engineering, Korea*  
The aluminum based metal nano-grating with a period of 100nm is fabricated on the sapphire substrate of the flip-chip by e-beam evaporator and inductively coupled plasma etching for 365nm polarized UV-LED.

**LEDIAp2-3**

**Wide Band Gap Transparent Conductive Oxides of Oxide/Metal/Oxide Triple-Layer Structure based on Fluorine Tin Oxide**

Si-Won Kim<sup>1</sup>, Gyu-Jae Yohn<sup>1</sup>, Soae Jeong<sup>1</sup>, Beom-Rae Noh<sup>1</sup>, So-Yeon Park<sup>2</sup>, Suyeon Son<sup>2</sup>, Kyoung-Kook Kim<sup>1</sup>  
<sup>1</sup>*Convergence Technology, Korea Polytechnic University, Korea*, <sup>2</sup>*Dept. of Nano Optical Engineering, Korea Polytechnic University, Korea*  
For wide bandgap TCOs, we fabricated OMO structure using FTO and Ag nano-layer. This TCO shows the lower resistivity of 6.43 x 10<sup>-4</sup> Ω?cm and the average optical transmittance of about 84% in deep UV

**LEDIAp2-4**

**Efficient Blue Micro-Light-Emitting Diodes Using SiOx-Based Glass Electrode**

Kyung Rock Son, Byeong Ryong Lee, Tae Ho Lee, Sang Hoon Oh  
*School of electrical Engineering, Korea University, Korea*  
The SiOx-based glass electrode that has a high transmittance and even a current path was applied as a transparent conducting electrode (TCE) of micro-light-emitting diodes to overcome their saturated efficiency, instead of conventional TCE material.

**LEDIAp2-5**

**Self-Standing ZnO Nanotube/SiO2 Core/Shell Arrays for High Photon Extraction Efficiency in III-Nitride Emitter**

Hee-Jung Choi<sup>1</sup>, Semi Oh<sup>2</sup>, Soo-Hyun Kang<sup>1</sup>, Kab Ha<sup>1</sup>, Eun-Kyung Chu<sup>1</sup>, Won-Seok Lee<sup>2</sup>, Soon-Hwan Kwon<sup>3</sup>, Kyoung-Kook Kim<sup>1</sup>  
<sup>1</sup>*Dept. of Advanced convergence Technology, Korea*, <sup>2</sup>*Dept. of Materials Science & Technology (GIST), Korea*, <sup>3</sup>*Dept. of Nano Optical Engineering, Korea*  
Self-standing ZnO nanotubes arrays were fabricated on the surface of a GaN-based emitter with an indium tin oxide (ITO) transparent layer using a hydrothermal method and temperature cooling down process.

**LEDIAp2-6**

**Improved Light Extraction Efficiency of GaN-Based Near Ultraviolet Light-Emitting Diodes Using TiO2/HfO2 DBR Electrode with Conductive Filaments**

Sanghoon Oh, Kyung Rock Son, Tae Geun Kim  
*School of Electrical Engineering, Korea University, Korea*  
We have reported a distributed Bragg reflector, having high reflectance, based p-type electrodes to reflect light absorbed by p-electrodes made of metal from ultraviolet micro-light emitting diodes emitting at 385 nm to improve light extraction.

**LEDIAp2-7**

**Thermal Annealing Effect of Ti Buffer Layer for the Growth of GAN Film**

Tzu-Ting Lin, Shih-Hao Chan, Shao-Ze Tseng, Sheng-Hui Chen  
*National Central University, Taiwan*  
Ti buffer layers were fabricated and annealed with various temperatures to achieve good crystalline properties in (002) on Si wafer. Then GaN thin films can be deposited on the Ti buffer layer with good crystallization.

**LEDIAp2-8**

**Characterizations and Growth of ZnO: B Films Grown by Low-Pressure Chemical Vapor Deposition on Glass Substrates**

Wei-Ming Lee<sup>1</sup>, Ying-Hsiang Wang<sup>1</sup>, Chin-Yi Tsai<sup>1</sup>, Shih-Wei Feng<sup>1</sup>, Chien-Hsun Chen<sup>2</sup>, Hsiang-Chen Wang<sup>3</sup>, Li-Wei Tu<sup>4</sup>  
<sup>1</sup>*Department of Applied Physics, National University of Kaohsiung, Kaohsiung, Taiwan, Taiwan*, <sup>2</sup>*Green Energy and Environment Research Labs, Industrial Technology Research Institute, Hsinchu, Taiwan, Taiwan*, <sup>3</sup>*Graduate Institute of Opto-Mechatronics, National Chung Cheng University, Taiwan, Taiwan*, <sup>4</sup>*Department of Physics and Center for Nanoscience and Nanotechnology, National Sun Yat-Sen University, Kaohsiung, Taiwan, Taiwan*  
The results of this work provide information for the LPCVD growth of ZnO films grown on glass substrates that could be potentially utilized for high-performance and low-cost transparent conductive oxides and their associated applications.

**LEDIAp2-9**

**A study on p-type Conductivity of Phosphorus-doped ZnO Thin Film using RF Sputtering and Annealing**

So-Yeon Park<sup>1</sup>, Si-Won Kim<sup>2</sup>, Gyu-Jae Yohn<sup>2</sup>, Hee-Jung Choi<sup>2</sup>, Yebin Im<sup>1</sup>, Kyoung-Kook Kim<sup>2</sup>  
<sup>1</sup>*Dept. of Nano Optical Engineering, Korea*, <sup>2</sup>*Dept. of Advanced convergence Technology, Korea*  
we have tried to grow phosphorus doped ZnO using RF sputtering and to use annealing. The p-type ZnO grown on sapphire substrate shows the electrical properties of concentration of 10<sup>17</sup>/cm<sup>3</sup> with mobility of 1.2 cm<sup>2</sup>/Vs.

**LEDIAp2-10**

**Photoluminescence Investigation of Near White Light-Emitting Zinc Stannate-Based Phosphors**

Mu-Tsun Tsai, Chih-Chuan Chan, Chien-Hung Lin  
*National Formosa University, Taiwan*  
We experimentally investigate the near white light emission of Zn<sub>2</sub>SnO<sub>4</sub> (ZTO)-based powders via a sol-gel process. The photoluminescence (PL) mechanism was discussed. Significant enhancement in PL intensity was demonstrated for the ZnO-rich ZTO phosphors.

**LEDIAp2-11**

**Highly Efficient Photonic Conversion Mediums Based on Polymer Complexes for Applications in Light Emitting Devices**

Petronela Horlescu, Corneliu S. Stan, Simona E. Bacaita  
*"Gheorghe Asachi" Technical University of Iasi/ Faculty of Chemical Engineering and Environmental Protection, Romania*  
New polymer complexes with impressive luminescent properties were prepared and investigated. Their facile preparation path both in bulk and thin films recommend them as photonic conversion mediums in light emitting devices.

**LEDIAp2-12**

**Numerical and Experimental Investigations for Deposited Nanosilver Tracks on Polyimide Films with Heterostructures**

Chia-Yen Chan<sup>1</sup>, XXXX<sup>1</sup>, Kuan-Cheng Shih<sup>2</sup>, Yu-Hsin Lin<sup>1</sup>  
<sup>1</sup>*Instrument Technology Research Center, National Applied Research Laboratories, Taiwan*, <sup>2</sup>*Kingley Rubber Industrial Co., Ltd., Taiwan*  
Numerical computations and experimental measurements have been complementarily performed to study the nanosilver solution ejected from a drop-on-demand piezoelectric inkjet printhead and the characteristics of the deposited nanosilver tracks on the Polyimide substrates with heterostructures.

**LEDIAp2-13**

**Effect of the Oxygen Concentration on Electrical Properties of GaN Crystals Grown with the Na-flux Point Seed Method**

K. Endo, T. Yamada, H. Kubo, K. Murakami, M. Imanishi, M. Yoshimura, Y. Mori  
*Osaka University, Japan*  
We investigated electrical properties of a GaN crystal grown with {10<sup>-1</sup>} plane in the Na-flux point seed method. The resistivity was 8.9x10<sup>-4</sup> Ω cm, which was much lower than that of crystals with (0001) plane.

**LEDIAp2-14**

**The Effect Of Nitrogen Pressure On Threading Dislocation Density During The Na-flux GaN Growth Using Point Seed Technique**

Yuki Sawada, Takumi Yamada, Kosuke Murakami, Keisuke Kakinoouchi, Kosuke Nakamura, Kanako Okumura, Tomoko Kitamura, Yasuhiro Unoki, Masayuki Imanishi, Masashi Yoshimura, Yusuke Mori  
*Osaka University, Japan*  
We investigated the relationship between dislocation density and nitrogen pressure. Dislocation density reduced with reduction of nitrogen pressure, reaching the order of 10<sup>4</sup> /cm<sup>2</sup> with 3.0-MPa pressure due to c-plane shrinking during growth.

## Poster Session &lt;Exhibition Hall A&gt;

Thursday, 26 April

LEDIAp2 13:00-14:30

LSCp6 13:15-13:45

ALPSP 13:00-14:30

**LEDIAp2-15****Reduction of Li Impurity in the Freestanding GaN Substrate Fabricated Using the Sapphire Dissolution Technique in the Na-Flux Growth**

Takumi Yamada, Masayuki Imanishi, Kosuke Murakami, Kosuke Nakamura, Mamoru Imade, Masashi Yoshimura, Yusuke Mori

Osaka University, Japan

In Na-flux sapphire dissolution technique for fabricating freestanding GaN substrates, incorporation of Li impurity in crystals can't be avoided. For reduction of Li impurity, GaN crystals were regrown on GaN substrates obtained by the technique.

**LEDIAp2-16****Sol-Gel-Derived Hole-Transporting NiOx Films for Perovskite CsPbBr3 Green Light-Emitting Diodes**Chun-Yuan Huang<sup>1</sup>, Shyh-Jer Huang<sup>2</sup>, Yi-Hsiu Hsieh<sup>1</sup><sup>1</sup>Nation Taitung University, Taiwan, <sup>2</sup>National Cheng Kung University, Taiwan

A novel perovskite light-emitting diodes (PeLED) with nickel oxide for efficient hole transport. Via adequately adjusting the thickness of NiOx, low turn-on voltage of 3.4 V and high luminance of 1200 cd/m<sup>2</sup> can be achieved.

**LEDIAp2-17****Optically Readable GaN-based Micro-LEDs Using NiO-based ReRAM as an N-Type Contact Layer for Micro-LED Display**Byeong Ryong Lee, Ju Hyun Park, Hyun Tae Kim, Kyung Rock Son, Tae Geun Kim  
Korea university, Korea

New driving technology of micro-light-emitting-diodes ( $\mu$ LEDs) display by combining resistive random access memory (RRAM) with lateral LED have been developed. Excellent unipolar RRAM behavior and superior  $\mu$ LED performance were shown.

**LEDIAp2-18****Optical and Device Characteristics of InGaN/GaN Light Emitting Diodes with Multilayer Graphene as Transparent and Current Spreading Electrodes**Ying-Hsiang Wang<sup>1</sup>, Wei-Ming Lee<sup>1</sup>, Shih-Wei Feng<sup>1</sup>, Hsiang-Chen Wang<sup>2</sup><sup>1</sup>Department of Applied Physics, National University of Kaohsiung, Taiwan, Taiwan, <sup>2</sup>Graduate Institute of Opto-Mechatronics, National Chung Cheng University, Taiwan, Taiwan

We demonstrated InGaN-based LEDs with graphene transparent conductive electrodes. The shorter response, rise, delay, and recombination times of the InGaN-based LEDs with graphene transparent conductive electrodes provide more efficient carrier injection, transport, relaxation, and recombination.

**LSCp6-1****Gamma-Ray Irradiation-Induced Absorption and Refractive Index Change in BK7 Glass**Youwei Lai<sup>1</sup>, J. Gabayno<sup>1,2</sup>, T. Ishimoto<sup>1</sup>, Yuki Iwasa<sup>1</sup>, K. Yamanoi<sup>1</sup>, T. Shimizu<sup>1</sup>, N. Sarukura<sup>1</sup><sup>1</sup>Institute of Laser Engineering, Osaka University, Japan, <sup>2</sup>Mapua University, Philippines

In this study, we investigate the effects of gamma-ray irradiation on the transmission and refractive index of BK7 glass as a means to assess the optical performance of glass to mitigate radiation induced damage.

**LSCp6-2****Structural and Optical Properties of ZnO-PVP Composites for Potential Phosphor-Based Applications**Verdad Agulto<sup>1</sup>, Melvin John F. Empizo<sup>1</sup>, Keisuke Kawano<sup>1</sup>, Yuki Minami<sup>1</sup>, Kohji Yamanoi<sup>1</sup>, Nobuhiko Sarukura<sup>1</sup>, Allan Christopher C. Yago<sup>2</sup>, Roland V. Sarmago<sup>3</sup><sup>1</sup>Institute of Laser Engineering, Osaka University, Japan, <sup>2</sup>Institute of Chemistry, University of the Philippines Diliman, Philippines, <sup>3</sup>National Institute of Physics, University of the Philippines Diliman, Philippines

Using spectroscopy and other techniques, we investigate the structural and optical properties of composites made of zinc oxide (ZnO) microrods and polyvinylpyrrolidone (PVP) polymer. The ZnO-PVP composites exhibit properties that have potential for phosphor-based applications.

**LSCp6-3****Improved Luminescence Lifetime Observed in Pr<sup>3+</sup>/Ce<sup>3+</sup>-codoped APLF Glass**Yuki Minami<sup>1</sup>, J. F. Gabayno<sup>1,4</sup>, M. J. F. Empizo<sup>1</sup>, M. Cadatal-Raduban<sup>2</sup>, K. Yamanoi<sup>1</sup>, T. Shimizu<sup>1</sup>, N. Sarukura<sup>1</sup>, T. Murata<sup>3</sup><sup>1</sup>Institute of Laser Engineering, Osaka University, Japan, <sup>2</sup>Institute of Natural and Mathematical Sciences, Massey University, New Zealand, <sup>3</sup>Faculty of Education, Kumamoto University, Japan, <sup>4</sup>Department of Physics, Mapua University, Philippines

We report the observed effects of co-doping APLF glass with Pr and Ce ions on the luminescence lifetime. Less than 10ns lifetime is achieved, shorter than previously obtained with either Pr or Ce-doped APLF.

**ALPSP-1****Vertically-oriented Graphene for Field-Effect Transistor Photodetector**

Jiawei Yang, Baolu Guan

Key Laboratory of Optoelectronics Technology, Ministry of Education, Faculty of Information Technology, Beijing University of Technology, China

In this paper, a field-effect transistor (FET) photodetector is demonstrated using vertically-oriented graphene sheets grown on the glass substrate, and the corresponding responsivity can reach 0.47A/W.

**ALPSP-2****Structure of non-temperable low-E glass determined by synchrotron radiation**Sang Joon Park<sup>1</sup>, Hyung Wook Cho<sup>2</sup>, Sangmo Kim<sup>2</sup>, Chung Wung Bark<sup>2</sup><sup>1</sup>Dept. Chemical and Biological Engineering, Gachon University, Korea, <sup>2</sup>Dept. Electrical Engineering, Gachon University, Korea

By using laser annealing, we found the enhancement of low-E properties and the reduction of unit cell volume was observed rather than the reduction of FWHM of Ag(111) on the metal layer.

**ALPSP-3****SERS on Antirabbit IgG: Preliminary results**Juan Carlos Martínez-Espinosa<sup>1</sup>, Teodoro Córdova-Fraga<sup>2</sup>, Gustavo Basurto-Islas<sup>2</sup>,Octavio Jimenez-Gonzalez<sup>2</sup>, Jacqueline Torres-Ramirez<sup>1</sup>, Ana Pamela Andrade-Pérez<sup>1</sup>,Jesús Bernal-Alvarado<sup>2</sup>, Angélica Hernández-Rayas<sup>2</sup>, Mauricio Sánchez-Barajas<sup>3</sup><sup>1</sup>Instituto Politécnico Nacional-UPIIG, México, <sup>2</sup>Departamento de Ingeniería Física – DCI, Universidad de Guanajuato campus León, México, <sup>3</sup>Hospital General de Zona con Medicina Familiar No 21 León Sur, Universidad de Guanajuato campus León., México

In this work we present preliminary results about the Surface enhanced Raman spectroscopy of the Goat IgG antirabbit antigen. We suggest continuing with this protocol by using others antigens for cancer study.

**ALPSP-4****High gain single crystal fiber amplifier for hybrid femtosecond laser system**

Elena Sall, Sergey Chizhov, Byunghak Lee, Bosu Jeong, Jun Wan Kim, Duchang Heo, Chur Kim, Seol Won Park, Guang-Hoon Kim

Korea Electrotechnology Research Institute, Korea

We report a comparative study of femtosecond pulses amplification in hybrid laser system with different single crystal fiber (SCF) amplifier modules. Two SCF modules from Fibercryst and Shasta Crystals were tested in double-pass scheme. High gain 71 and 62 respectively were achieved.

**ALPSP-5****Longitudinally Excited CO<sub>2</sub> Laser Driven by Fast-High Voltage Solid State Switch**Noor Shahira binti Masroon<sup>1</sup>, Shigeyasu Ohashi<sup>1</sup>, Masaya Tei<sup>1</sup>, Miyu Tanaka<sup>1</sup>, Kazuyuki Uno<sup>2</sup>, Hitoshi Nakano<sup>1</sup><sup>1</sup>Kindai University, Japan, <sup>2</sup>University of Yamanashi, Japan

Longitudinally excited CO<sub>2</sub> laser driven by fast-high voltage solid state switch has been developed, which consists of avalanche transistor circuit and series-connected of IGBTs. Simple, compact and affordable gas laser has been realized.

**ALPSP-6****Development of Nanosecond Pump Source for Optically Synchronized OPCPA**

Yasuhiro Miyasaka, Hiromitsu Kiriya, Maki Kishimoto, Michiaki Mori, Masaki Kando, Kiminori Kondo

<sup>1</sup>Kansai Photon Science Institute (KPSI), National Institutes for Quantum and Radiological Science and Technology (QST), Japan

We are developing a nanosecond green laser from Ti:sapphire oscillator pulses for reducing timing jitter of OPCPA. 1064nm pulses are generated by spectrum extension and amplified to 15mJ in LD-pumped regenerative amplifier at 10Hz.

**ALPSP-7****Reducing amplified spontaneous emission of a cryogenic disk amplifier through geometrical optimization of the gain medium**Reza Amani<sup>1</sup>, Jan Cvrček<sup>1,2</sup>, Jitka Černohorská<sup>1,2</sup>, Martin Smrž<sup>1</sup>, Akira Endo<sup>1</sup>, Tomáš Moček<sup>1</sup><sup>1</sup>HILASE Centre, Institute of Physics, Czech Academy of Sciences, Czech Republic, <sup>2</sup>Czech Technical University in Prague, Czech Republic

We report geometrical optimization of a cryogenic Yb:YAG disk towards reducing amplified spontaneous emission (ASE) in a 100 mJ, 1 kHz chirped pulse amplification chain with potential scalability to a pulse energy beyond 1 J.

**ALPSP-8****Temperature Dependence Evaluation of Absorption in YAG Cladding Materials for High Power Solid-State Lasers**Koichi Hamamoto<sup>1,2</sup>, Shigeki Tokita<sup>1</sup>, Hidetsugu Yoshida<sup>1</sup>, Noriaki Miyanağa<sup>1</sup>, Junji Kawanaka<sup>1</sup><sup>1</sup>Institute of Laser Engineering, Osaka University, Japan, <sup>2</sup>Mitsubishi Heavy Industries, Ltd., Japan

To suppress parasitic oscillation or amplified spontaneous emission in high power lasers, gain material with cladding is used. We evaluated temperature dependence of absorption properties of some YAG ceramics cladding materials.



Poster Session <Exhibition Hall A>

Thursday, 26 April

ALPSP 13:00-14:30

**ALPSP-9**

**Research of Diamond Transmission Gratings Used for High Power Laser Pulse Compression**

Shuweifan, Tianfei Zhu, Hongxing Wang  
*Institute of Wide Band Gap Semiconductors, School of Electronics and Information Engineering, Xi'an Jiaotong University, China*

The diamond transmission grating is designed based on rigorous coupled-wave theory. The simulation results demonstrate that the highest diffraction efficiency was over 99% at wavelength 800nm. Studies show the design has a larger process tolerance.

**ALPSP-10**

**Sub-100-fs Pulse Generation from a Tm:Ho:CALYO Laser Mode-Locked by SWCNTs**

Yongguang Zhao<sup>1,2</sup>, Yicheng Wang<sup>1</sup>, Zhongben Pan<sup>1,3</sup>, Ji Eun Bae<sup>4</sup>, Sun Young Choi<sup>4</sup>, Fabian Rotermund<sup>4</sup>, Wei Zhou<sup>2</sup>, Xiaodong Xu<sup>2</sup>, Deyuan Shen<sup>2</sup>, Jun Xu<sup>5</sup>, Xavier Mateos<sup>1,6</sup>, Pavel Loiko<sup>7</sup>, Uwe Griebner<sup>1</sup>, Valentin Petrov<sup>1</sup>  
<sup>1</sup>Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Germany, <sup>2</sup>Jiangsu Key Laboratory of Advanced Laser Materials and Devices, Jiangsu Normal University, China, <sup>3</sup>Institute of Chemical Materials, China Academy of Engineering Physics, China, <sup>4</sup>Department of Physics, Korea Advanced Institute of Science and Technology (KAIST), Korea, <sup>5</sup>School of Physics Science and Engineering, Institute for Advanced Study, Tongji University, China, <sup>6</sup>Fisica i Cristal·lografia de Materials i Nanomaterials (FICMA-FICNA)-EMaS, Dept. Químic a Física i Inòrganica, Universitat Rovira i Virgili (URV), Spain, <sup>7</sup>ITMO University, Russia

We report on a mode-locked Tm:Ho:CALYO laser employing SWCNTs as a saturable absorber. Transform-limited 96-fs pulses are generated at ~2077 nm for a repetition rate of ~82.5 MHz corresponding to an average output power of 54 mW.

**ALPSP-11**

**177 fs Pulses From Kerr-Lens Mode-Locked Yb:Lu<sub>2</sub>O<sub>3</sub> Ceramic Thin-Disk Laser**

Shotaro Kitajima<sup>1</sup>, Akira Shirakawa<sup>1</sup>, Hideki Yagi<sup>2</sup>, Takagimi Yanagitani<sup>2</sup>  
<sup>1</sup>Institute for Laser Science, University of Electro-Communications, Japan, <sup>2</sup>Takuma Works, Konoshima Chemical Co., Ltd., Japan

The first Kerr-lens mode-locked Yb:Lu<sub>2</sub>O<sub>3</sub> ceramic thin-disk laser was demonstrated. The shortest pulse duration was 177 fs with 3.2 W output power. The output power of 17 W with 588 fs pulses was also demonstrated.

**ALPSP-12**

**Measurement of Carrier Dynamics of the Graphite by Time-Resolved ARPES**

Kento Toume<sup>1,2</sup>, Katsuya Oguri<sup>1</sup>, Hiroki Mashiko<sup>1</sup>, Keiko Kato<sup>1</sup>, Yoshiaki Sekine<sup>1</sup>, Hiroki Hibino<sup>3,1</sup>, Akira Suda<sup>2</sup>, Hideki Gotoh<sup>1</sup>  
<sup>1</sup>NTT Basic Research Laboratories, Japan, <sup>2</sup>Tokyo University of Science, Japan, <sup>3</sup>Kwansei Gakuin University, Japan

We demonstrate the Tr-ARPES based on the high-order harmonic source with sub-10 fs pulse duration. We measured the Tr-ARPES spectra at the Dirac point of the graphite at various time delays.

**ALPSP-13**

**Electron Temperature of High-Pressure Argon Plasma by Focusing Femtosecond Laser**

Kohsuke Tsuchida, Norio Tsuda, Jun Yamada  
*Aichi Institute of Technology, Japan*

The electron temperature of high-pressure argon plasma generated by the femtosecond laser is obtained from the plasma emission by two methods. The measurement result and the theoretical calculation result are compared.

**ALPSP-14**

**Patterning Oxidation of Copper Substrate by Femtosecond Laser Irradiation**

Xi Yu<sup>1</sup>, Masaaki Sudo<sup>2</sup>, Fumihiro Itoigawa<sup>1</sup>, Shingo Ono<sup>1</sup>  
<sup>1</sup>Nagoya Institute of Technology, Japan, <sup>2</sup>IMRA America Inc., Japan

Patterning oxidation of copper substrate was performed by irradiating femtosecond laser pulses to surface of copper substrate. Shape transformation was observed by SEM, CLSM. Formation of copper oxide was confirmed by Raman, EDX, and XRD.

**ALPSP-15**

**Optical Properties of Saturable Absorber for Temporal Contrast Improvement of Ultra-High Intensity Laser**

Koichi Ogura, Yasuhiro Miyasaka, Yuji Fukuda, Akito Sagisaka, Alexander S. Pirozhkov, Hiromitsu Kiriya  
*Kansai Photo Science Institute, National Institutes for Quantum and Radiological Science and Technology, Japan*

We report on evaluation of optical properties of saturable absorber, including damage threshold, transmittance efficiency, transmission spectral bandwidth, beam profile and long-term operation for temporal contrast improvement using saturable absorber after compressor.

**ALPSP-16**

**Polarization and Laser Properties of Resonators with Corner-Cube and Axicon Retro-Reflectors**

Haik Chosrowjan<sup>1</sup>, Seiji Taniguchi<sup>1</sup>, Hidetsugu Yoshida<sup>2</sup>, Noriaki Miyanaga<sup>2</sup>  
<sup>1</sup>Institute for Laser Technology, c/o Technical Research Center, Kansai Electric Power Company, Japan, <sup>2</sup>Institute of Laser Engineering, Osaka University, Japan

Polarization properties from CCR and AL retro-reflected beams have been studied. Cryogenic Yb:YAG laser output characteristics when a flat mirror, CCR or AL is used as a high-reflection element in a resonator, have been elucidated.

**ALPSP-17**

**Amplification Property of Ce/Cr/Nd:YAG Ceramic Laser Using White-light Pump Source**

Taku Saiki<sup>1</sup>, T. Nakamachi<sup>1</sup>, T. Hayashi<sup>1</sup>, R. Matsushita<sup>1</sup>, T. Ichijui<sup>1</sup>, H. Furuse<sup>2</sup>, S. Motokoshi<sup>3</sup>, Y. Fujimoto<sup>3</sup>, M. Nakatsuka<sup>3,4</sup>  
<sup>1</sup>Department of Electrical and Electronic Engineering, Faculty of Engineering Science, Kansai University, Japan, <sup>2</sup>Kitami Institute of Technology, Japan, <sup>3</sup>Institute of Laser Engineering, Osaka University, Japan, <sup>4</sup>Institute for Laser Technology, Japan

Effective fluorescence lifetime of Nd ion for Ce<sup>3+</sup>/Cr<sup>3+</sup>/Nd:YAG ceramic was prolonged by increasing the temperature of the ceramic laser material owing to cross-relaxation effect. The ceramic laser material has worked as a CW laser amplifier.

**ALPSP-18**

**White-Light Whispering-Gallery-Mode Lasing from Lanthanide-Doped Upconversion NaYF<sub>4</sub> Hexagonal Microrods**

Ting Wang<sup>1</sup>, Huan Yu<sup>2</sup>, Chun kit Siu<sup>1</sup>, Jianbei Qiu<sup>2</sup>, Xuhui Xu<sup>1,2</sup>, Siu Fung Yu<sup>1</sup>  
<sup>1</sup>Department of Applied Physics, The Hong Kong Polytechnic University, China, <sup>2</sup>College of Materials Science and Engineering, Kunming University of Science and Technology, China

Through the proper tuning of sensitizer (Yb<sup>3+</sup>) and activators (Er<sup>3+</sup>, Tm<sup>3+</sup>) concentration in the host matrix, we realize white-light lasing from a Yb<sup>3+</sup>-Er<sup>3+</sup>-Tm<sup>3+</sup> tri-doped hexagonal β-NaYF<sub>4</sub> microrod under near-infrared excitation at room temperature.

**ALPSP-19**

**Assessment on Power-scaling of Ti:sapphire Lasers Pumped by Blue-diode Lasers**

Naoto Sugiyama, Hiroki Tanaka, Fumihiko Kannari  
*Department of Electronics and Electrical Engineering, Keio University, Japan*

Kerr-lens mode-locking of direct-diode-pumped Ti:sapphire laser is demonstrated using 478- and 520-nm LDs. The influence of the blue-pump-induced loss on Ti:sapphire lasers is measured.

**ALPSP-20**

**Power scaling of a passively Q-switched diode-pumped Pr<sup>3+</sup>:YLF laser**

Shogo Fujita, Hiroki Tanaka, Naoto Sugiyama, Fumihiko Kannari  
*Department of Electronics and Electrical Engineering, Keio University, Japan*

We demonstrate a Pr<sup>3+</sup>:YLF laser with to 6.7- and 3.7-W output power at 640 and 607 nm, respectively. Passive Q-switching is also obtained using Cr<sup>3+</sup>:YAG and Co<sup>2+</sup>:MgAl<sub>2</sub>O<sub>4</sub> saturable absorbers.

**ALPSP-21**

**Development of compact and high efficient UV laser system**

Y. Fujimoto<sup>1</sup>, M. Nakahara<sup>2</sup>, P. Binun<sup>2</sup>, S. Motokoshi<sup>3</sup>, O. Ishii<sup>4</sup>, M. Watanabe<sup>4</sup>, M. Yamazaki<sup>5</sup>, T. Shinozaki<sup>6</sup>, T. Sato<sup>2</sup>, H. Yanomori<sup>2</sup>  
<sup>1</sup>Chiba Institute of Technology, Department of Electrical and Electronic Engineering, Japan, <sup>2</sup>Kimmon Koha co., Ltd., Japan, <sup>3</sup>Institute of Laser Technology, Japan, <sup>4</sup>Production Engineering Section, Optical Glass Production Department, Sumita Optical Glass, Inc., Japan, <sup>5</sup>Glass Research Division, R&D Department, Sumita Optical Glass, Inc., Japan

This paper presents that we are developing a compact and high efficient continuous-wave UV laser system with a Pr-doped double-clad structured waterproof fluoro-aluminate glass fiber laser as a fundamental laser beam.

**ALPSP-22**

**Compact pulsed Yb-doped fiber laser and intra-cavity cascaded Raman spectrum generation**

Yanrong Song, Zikai Dong, Runqin Xu, Jinrong Tian  
*College of Applied Sciences, Beijing University of Technology, China*

A compact mode locked Yb-doped fiber laser is demonstrated with nonlinear polarization rotation technique. There are no physical filter and polarization controller. A broadband continuum spectrum is generated by intra-cavity cascaded Raman scattering effect.

**ALPSP-23**

**Off-peak Raman fiber laser at the wavelength of 1629 nm**

Anna Suzuki, Eisuke Fujita, Masaki Tokurakawa  
*Institute for Laser Science, University of Electro-Communications, Japan*

We report Raman fiber laser at 1629 nm with the maximum output power of 2W and spectral bandwidth of 2 nm. The operation was very stable with output power fluctuation of less than 1%.

**ALPSP-24**

**Research on Ohmic contact of VCSEL based on Cr/ Au alloy of non-magnetic materials**

Yanling Guo, Baolu Guan  
*Key Laboratory of Optoelectronics Technology, Ministry of Education, Faculty of Information Technology, Beijing University of Technology, China*

In this paper, the VCSEL based on the non-magnetic Cr/Au alloy eliminates the effect the magnetic sensitivity of the magnetic, and it has low ohmic contact resistivity of 2.5×10<sup>-6</sup> ohmic cm<sup>2</sup> and high reliability.

## Poster Session &lt;Exhibition Hall A&gt;

Thursday, 26 April

ALPSP 13:00-14:30

## ALPSP-25

**Clean pump generation for in-line phase sensitive amplification using carrier phase recovery and injection locking**Masato Kato<sup>1</sup>, Takeshi Umeki<sup>2</sup>, Koji Enbutsu<sup>2</sup>, Masaki Asobe<sup>1</sup><sup>1</sup>Tokai University, Japan, <sup>2</sup>NTT Device Technology Laboratories, NTT Corporation, Japan

Carrier phase of a QPSK signal was extracted by using multi-stage frequency mixing in a multiple QPM LiNbO<sub>3</sub> waveguide. We demonstrate residual intensity modulation can be suppressed by using injection locking.

## ALPSP-26

**Terahertz Time Domain Spectroscopy for Radiative Eigenmodes in Metallic Slit Array**Thanh Nhat Khoa Phan<sup>1</sup>, Dazhi Li<sup>2</sup>, Kosaku Kato<sup>1</sup>, Masahiko Tani<sup>3</sup>, Masashi Yoshimura<sup>1</sup>, Masaki Hashida<sup>4</sup>, Yanyu Wei<sup>5</sup>, Makoto Nakajima<sup>1</sup><sup>1</sup>Institute of Laser Engineering, Osaka University, Japan, <sup>2</sup>Institute for Laser Technology, Japan, <sup>3</sup>University of Fukui, Japan, <sup>4</sup>Advanced Research Center for Beam Science, ICR, Kyoto University, Japan, <sup>5</sup>School of Physical Electronics, University of Electronics Science and Technology of China, China

We studied the interaction between terahertz wave and the metallic slit array. Through calculation and experiment, we found various eigenmodes, which can help in improving the efficiency of Free Electron Laser based on Smith-Purcell effect.

## ALPSP-27

**Programmable Optical Linear Circuit using Wavelength-Division-Multiplexed Quantum States**

Akihito Omi, Aruto Hosaka, Masaya Tomita, Shintaro Niimura, Fumihiko Kannari

Department of Electronics and Electrical Engineering, Keio University, Japan

We propose a novel scheme of multistage quantum pulse gate realizing universal linear optical circuits. Arbitrary mode mixing can be realized by 4-f optical loop system and sum frequency generation.

## ALPSP-28

**Modal Analysis and Characterization of Photon-Number Statistics of Supercontinuum Laser Pulses**Shintaro Niimura, Aruto Hosaka, Masaya Tomita, Akihito Omi, Fumihiko Kannari  
Department of Electronics and Electrical Engineering, Keio University, Japan

We experimentally characterize second-order photon-number statistics in a supercontinuum pulse. By modal analysis of photon-number covariance matrix, we reveal mode structure of a supercontinuum pulse and find photon-number squeezed states from the noisy supercontinuum pulse.

## ALPSP-29

**Maker Fringe Measurements of Ultra-Precisely Processed N-Benzyl-2-Methyl-4-Nitroaniline Organic Crystal**Takashi Notake<sup>1</sup>, Masahiro Takeda<sup>2,3</sup>, Takuya Hosobata<sup>2</sup>, Yutaka Yamagata<sup>2,3</sup>, Hiroaki Minamide<sup>1</sup><sup>1</sup>Teraphotonics Team, RIKEN, Japan, <sup>2</sup>Ultra-high Precision Optics Technology Team, RIKEN, Japan, <sup>3</sup>Advanced Manufacturing Support Team, RIKEN, Japan

An ultra-high-precision lathe is applied to process fragile organic BNA crystals precisely. Nonlinear optical coefficients and the associated dispersions of BNA can be measured accurately by using the precisely processed thin BNA slab samples.

## ALPSP-30

**Fabrication of 1 & 4 inch size transparent Nd:YAG ceramics and Laser Oscillation**Yoshiaki Yamazaki<sup>1</sup>, Makoto Mikami<sup>1</sup>, Yuichi Kozawa<sup>2</sup>, Shunichi Sato<sup>2</sup><sup>1</sup>JX Nippon Mining & Metals Corporation Isohara Works, Japan, <sup>2</sup>Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Japan

We fabricated Nd:YAG ceramics with 1 and 4 inch diameters. The YAG ceramics were highly transparent with the transmittance of 84% including surface reflection. Laser oscillation of the Nd:YAG ceramics was achieved.

## ALPSP-31

**High-efficiency ring beam converter with axicon mirrors**Yuya Shimoji, Godai Miyaji  
Department of Applied Physics, Tokyo University of Agriculture and Technology, Japan

We have designed and fabricated a new beam converter from a Gaussian beam to a ring beam, which can efficiently generate a nondiffracting beam.

## ALPSP-32

**High aspect ratio nanometer size channel machining with phase corrected femtosecond Bessel beams.**Kosuke Iida, Yurina Michine, Hitoki Yoneda  
Institute for Laser Science, University of Electro-Communications, Japan

High aspect channel formations with diameter in submicron range are obtained with ultra-short-pulse Bessel (UB) beam and phase controlled UB machining system.

## ALPSP-33

**Absorption Enhancement in Solar Cells with Metamaterial Perfect Absorbers**Tomihisa Isegawa<sup>1</sup>, Takayuki Okamoto<sup>2</sup>, Wakana Kubo<sup>1</sup><sup>1</sup>Tokyo University of Agriculture and Technology, Japan, <sup>2</sup>RIKEN, Japan

Organic thin-film solar cells with metamaterial perfect absorbers are investigated. Metamaterial perfect absorbers confine incident light into the photoelectric conversion layer, resulting in an increase of absorption by a factor of 18%.

## ALPSP-34

**Selective coherent anti-Stokes Raman scattering microscopy employing dual-wavelength nanofocused ultrafast plasmon pulses**

Keita Tomita, Yasuhiro Kojima, Fumihiko Kannari

Department of Electronics and Electrical Engineering, Keio University, Japan

We demonstrate selective CARS measurements of graphene and multi-walled carbon nanotubes with nanofocused SPP pulses at 800 and 400 nm using an aluminum tapered tip.

## ALPSP-35

**Optical gain of multi stacked InGaAs quantum dots using VSL method**Keishiro Goshima<sup>1</sup>, Norio Tsuda<sup>1</sup>, Keisuke Inukai<sup>1</sup>, Takeru Amano<sup>2</sup>, Takeyoshi Sugaya<sup>2</sup><sup>1</sup>Electronics Engineering, Aichi Institute of Technology, Japan, <sup>2</sup>National Institute of Advanced Industrial Science and Technology (AIST), Japan

A Quantum dot laser (QD laser) is expected to have a low threshold current density, high thermal stability, and high modal gain. In our study we carried out the optical gain of multi-stacked QDs different thin barrier layers using a variable stripe length (VSL) method. Optical gain increased with decreasing barrier layer due to quantum mechanical coupling.

## ALPSP-36

**Single-shot Ultrafast Imaging with Burst Pulses of 100-ps Interval**

Hirofumi Nemoto, Takakazu Suzuki, Yuki Yamaguchi, Ryohei Hida, Fumihiko Kannari

Department of Electronics and Electrical Engineering, Keio University, Japan

We generate frequency chirped 100-ps-interval pulse trains for ultrafast burst imaging. Employing those pulses to sequentially timed all-optical mapping photography utilizing spectral filtering (SF-STAMP), we realize single-shot burst imaging with sub-nanosecond time window.

## ALPSP-37

**Development of rigid-endoscope optical coherence tomography system using two-dimensional KTN optical scanner**Masato Ohmi<sup>1</sup>, Eunjo Choi<sup>1</sup>, Takayuki Komatsu<sup>2</sup>, Shogo Yagi<sup>2</sup><sup>1</sup>Course of Allied Health Science, Graduate School of Medicine, Osaka University, Japan, <sup>2</sup>NTT Advance Technology Corporation, Japan

We developed novel rigid-endoscope OCT with KTN optical probe for a diagnosis in the orthopedic fields. System demonstrates that biological image was measured by using KTN scanner for having degree of freedom in sample arm.

## ALPSP-38

**Multifocal spectral-domain optical coherence tomography based on Bessel beam for Biological Imaging**Luying Yi, Liqun Sun  
State Key Laboratory of Precision Measurement Technology & Instruments, Department of Precision Instruments, Tsinghua University, China

The multifocal spectral-domain optical coherence tomography based on Bessel beam is proved not only to increase the depth of the imaging, but also to reduce the demand for high spectral resolution of spectrometer.

## ALPSP-39

**Velocity and Distance Simultaneous Measurement by Digital Processing of Self-Coupling Signal**Keiichi Shibata, Norio Tsuda, Jun Yamada  
Aichi Institute of Technology, Japan

The simultaneous measurement sensor of distance and velocity by using self-coupling effect of the semiconductor laser has been studied. The velocity and distance can have been simultaneously measured by digital signal processing of self-coupling signal.

## ALPSP-40

**A Simplified Heterodyne Surface Plasmon Resonance Sensor**Michihiro Uchiumi<sup>1</sup>, Fumiya Kai<sup>1</sup>, Ozora Ushijima<sup>1</sup>, Kohei Shimogama<sup>1</sup>, Kazuyoshi Koga<sup>1</sup>, Kyouichi Deki<sup>2</sup>, Nobuaki Tominaga<sup>2</sup><sup>1</sup>Inf. Syst. Crs, Div. of Hum. and Welfare Eng., Dept. Creative Eng., Natl Inst. Of Technol. Ariake Coll., Japan, <sup>2</sup>Environ. Sci. Crs, Div. of Environ. and Energy Eng., Dept. Creative Eng., Natl Inst. Of Technol. Ariake Coll., Japan

We developed a simplified surface plasmon sensor using a stabilized transverse Zeeman He-Ne laser. It is shown that the surface plasmon sensor with a simple configuration is sensitive.

## ALPSP-41

**Spectroscopic Ellipsometry-based Biosensor for Monitoring Microalgae Growth**Siti N. Alfath<sup>1</sup>, Riza A.N. Khasanah<sup>1</sup>, Asmida Herawati<sup>1</sup>, Edi Suharyadi<sup>1</sup>, Eko A. Suyono<sup>2</sup>, Iman Santoso<sup>1</sup>, Takeshi Kato<sup>3</sup>, Satoshi Iwata<sup>4</sup><sup>1</sup>Department of Physics, Universitas Gadjah Mada, Indonesia, <sup>2</sup>Faculty of Biology, Universitas Gadjah Mada, Indonesia, <sup>3</sup>Department of Electronics, Nagoya University, Japan, <sup>4</sup>Institute of Materials and System for Sustainability, Nagoya University, Japan

Monitoring microalgae growth has been successfully measured by spectroscopic ellipsometry based biosensor on the surface of gold and chromium thin film. The investigation shows the phase difference increased during the growth, representing the population increased.

Poster Session <Exhibition Hall A>

Thursday, 26 April

ALPSP 13:00-14:30

**ALPSP-42**

**Bidirectional Mode-locked Er: fiber Laser with Two Semiconductor Saturable Absorber Mirrors**

Yuya Hata<sup>1</sup>, Yoshiaki Nakajima<sup>1,2</sup>, Kaoru Minoshima<sup>1,2</sup>  
<sup>1</sup>The University of Electro-Communications (UEC), Japan, <sup>2</sup>Japan Science and Technology Agency (JST), ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS) Project, Japan

We developed a bidirectional mode-locked Er: fiber laser with two semiconductor saturable absorber mirrors and nonlinear polarization rotation. A symmetrical cavity configuration performed remarkable broad optical spectra in both directions with high relative stability.

**ALPSP-43**

**High-accuracy corrections of large and fast air refractive index fluctuations using two-color interferometry with optical frequency combs**

Yoshihisa Ikisawa<sup>1</sup>, Tomohiro Makino<sup>1,2</sup>, Yoshiaki Nakajima<sup>1,2</sup>, Guanhao Wu<sup>3</sup>, Kaoru Minoshima<sup>1,2</sup>  
<sup>1</sup>The University of Electro-Communications (UEC), Japan, <sup>2</sup>Japan Science and Technology Agency (JST), ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS) Project, Japan, <sup>3</sup>Tsinghua University, China

We significantly extended the applicable range of corrections of environmental air refractive index variations using two-color interferometry with optical frequency combs. The developed technique will enhance the practical applicability of high-accuracy optical distance measurements.

**ALPSP-44**

**10W amplification of 750-MHz Yb: fiber laser frequency comb for sub-100 fs pulse duration**

Hiroataka Ishii<sup>1</sup>, Bo Xu<sup>1,2</sup>, Yuxuan Ma<sup>1,3</sup>, Isao Matsushima<sup>1,2</sup>, Yoshiaki Nakajima<sup>1,2</sup>, Thomas Schibli<sup>4</sup>, Zhigang Zhang<sup>3</sup>, Kaoru Minoshima<sup>1,2</sup>  
<sup>1</sup>Department of Engineering Science, Graduate School of Informatics, The University of Electro-Communications (UEC), Japan, <sup>2</sup>Japan Science and Technology Agency (JST), ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS) Project, Japan, <sup>3</sup>State Key Laboratory of Advanced Optical Communication System and Networks, Peking University, China, <sup>4</sup>Dep. of Physics, University of Colorado at Boulder, USA

We developed a polarization-maintaining high power fiber amplifier based on a 750-MHz self-referenced Yb: fiber frequency comb. An average output power of 10 W was achieved.

**ALPSP-45**

**Dual-Comb Interferometry Based on Synthetic-Wavelength for High-Speed and High-Precision Distance Measurement**

Zebin Zhu<sup>1</sup>, Kai Ni<sup>2</sup>, Qian Zhou<sup>2</sup>, Guanhao Wu<sup>1,2</sup>  
<sup>1</sup>State Key Laboratory of Precision Measurement Technology and Instruments, Department of Precision Instruments, Tsinghua University, China, <sup>2</sup>Division of Advanced Manufacturing, Graduate School at Shenzhen, Tsinghua University, China

We propose a dual-comb ranging system based on synthetic-wavelength interferometry. It can realize absolute distance measurement with ~2.7m ambiguity range, ~3nm precision within ~10ms averaging time.

**ALPSP-46**

**Tunable single-frequency continuous-wave optical parametric oscillator in the near-IR and mid-IR**

Sophie Kröger<sup>1</sup>, Edlef Büttner<sup>2</sup>, Andreas Steiger<sup>3</sup>, Ralf Müller<sup>3</sup>  
<sup>1</sup>Hochschule für Technik und Wirtschaft, Germany, <sup>2</sup>APE Angewandte Physik & Elektronik GmbH, Germany, <sup>3</sup>Physikalisches Technische Bundesanstalt, Germany

A high power single-frequency continuous-wave optical parametric oscillator is presented; special compact resonator with new tuning concept.

**ALPSP-47**

**Broadband achromatic metalens in the visible**

Mu Ku Chen<sup>1,2</sup>, Pin Chieh Wu<sup>1,2</sup>, Vin-Cent Su<sup>4</sup>, Hui-Hsin Hsiao<sup>3</sup>, Yi-Chieh Lai<sup>1,2</sup>, Hsin Yu Kuo<sup>1,2</sup>, Bo Han Chen<sup>1,2</sup>, Yu Han Chen<sup>1,2</sup>, Din Ping Tsai<sup>1,2</sup>

<sup>1</sup>Research Center for Applied Sciences, Academia Sinica, Taiwan, <sup>2</sup>Department of Physics, National Taiwan University, Taiwan, <sup>3</sup>Institute of Biomedical Optomechatronics Taipei Medical University, Taiwan, <sup>4</sup>Department of Electrical Engineering, National United University, Taiwan

We demonstrated a high efficiency GaN based achromatic metalens working in transmission type. The working wavelength is from 400 to 660 nm. For optical imaging, we show the full-colour images taken by our achromatic metalens.

**ALPSP-48**

**Dependence of temporal Contrast on Optics Surface Roughness in the Stretcher and Compressor**

Hiromitsu Kiriya<sup>1</sup>, Yuji, Mashiba<sup>1,2</sup>, Yasuhiro Miyasaka<sup>1</sup>, Makoto R. Asakawa<sup>2</sup>  
<sup>1</sup>Kansai Photon Science Institute (KPSI), National Institutes for Quantum and Radiological Science and Technology (QST), Japan, <sup>2</sup>Faculty of Science and Engineering, Kansai University, Japan

Surface roughness of tens of nanometers on stretcher and compressor optics causes random spectral phase noise, which reduces the temporal coherence of the main pulse and generates a noisy structure around the main pulse.

**ALPSP-49**

**Surface Cleaning and Modification of Thin Target Films by CW laser for Laser-driven Heavy Ion Acceleration**

Kotaro Kondo<sup>1</sup>, Mamiko Nishiuchi<sup>1</sup>, Hironao Sakaki<sup>1</sup>, Nicholas P. Dover<sup>1</sup>, Hiromitsu Kiriya<sup>1</sup>, Masahiko Ishino<sup>1</sup>, Takumi Miyahara<sup>1,2</sup>, Yukinobu Watanabe<sup>2</sup>, Masaki Hashida<sup>3</sup>, Mitsuhiro Kusaba<sup>4</sup>, Masaki Kando<sup>1</sup>, Kiminori Kondo<sup>1</sup>  
<sup>1</sup>Kansai Photon Science Institute, National Institutes for Quantum and Radiological Science and Technology (QST), Japan, <sup>2</sup>Interdisciplinary Graduate School of Engineering Science, Kyushu University, Japan, <sup>3</sup>Institute for Chemical Research, Kyoto University, Japan, <sup>4</sup>Department of Electronics, Information and Communication Engineering, Osaka Sangyo University, Japan

A test bench has been developed for surface cleaning and modification of thin film targets by CW laser irradiation. QMS detects gas emissions during the irradiation and polyimide films are carbonized by irradiation in vacuum.

## Poster Session &lt;Exhibition Hall A&gt;

Friday, 27 April

IoT6p 10:30-12:00

LDCp9 10:30-12:00

**IoT6p-1****Internet of Things Implemented by Visible Light Communication (VLC)**

Jhao-Ting Wu<sup>1</sup>, Chi-Wai Chow<sup>1</sup>,  
Chien-Hung Yeh<sup>2</sup>  
<sup>1</sup>National Chiao Tung University, Taiwan, <sup>2</sup>Feng Chia University, Taiwan

Due to the shortage of traditional radio-frequency (RF) spectrum, using visible-light-communication (VLC) for Internet-of-Thing (IoT) is promising. We demonstrate pre-distortion 4-level-pulse-amplitude-modulation (PAM-4) to enhance the performance of the solar-cell receiver based VLC.

**IoT6p-2****High-speed low-coherence interferometry for real-time monitoring of laser processing and smart factory**

Katsuhiko Ishii, Masaharu Hoshikawa  
*The Graduate School for the Creation of New Photonics Industries, Japan*

We propose a real-time and high-temporal-resolution low-coherence interferometer using a chirped pulse laser and TD-DFT technique and show preliminary experimental results.

**IoT6p-3****High Accuracy Optical Arbitrary Angle Control with MEMS Mirror Using 8 kHz Visual Feedback**

Yoshinori Matsui<sup>1</sup>, Yukinobu Sugiyama<sup>2</sup>,  
Kazuhiro Nakamura<sup>1</sup>, Munenori Takumi<sup>1</sup>,  
Kazutaka Suzuki<sup>1</sup>, Haruyoshi Toyoda<sup>1</sup>  
<sup>1</sup>Central Research Laboratory, Hamamatsu Photonics K.K., Japan, <sup>2</sup>Solid State Division, Hamamatsu Photonics K.K., Japan

We proposed 2-D optical angle control module with MEMS mirror using 8kHz visual feedback control. We have achieved the convergence time to the target angle about 1.5 msec, and the temporal stability about 0.001 deg.

**IoT6p-4****Parasitic intensity modulation effect within PGC demodulation using arctangent algorithm: analysis and elimination**

Qiong Yao, Fuyin Wang, Shuidong Xiong,  
Qingkai Hou, Hong Luo, Xun Liang  
*National University of Defense Technology, China*

We analyze the influence of the parasitic intensity modulation within PGC-atan demodulation algorithm, and the corresponding measure was raised to greatly improve the output stability and fidelity.

**IoT6p-5****Elimination of the Low-frequency Noise for Optical Fiber Extrinsic Fabry-Perot Interferometric Sensors**

Fuyin Wang, Qiong Yao, Zhengliang Hu,  
Shuidong Xiong, Hong Luo, Lina Ma,  
Yongming Hu  
*National University of Defense Technology, China*

We report a robust low-frequency noise elimination scheme for miniature fiber EFPI sensors with promising low phase noise of -97.2 dB. The noise spectrum is uniformly flat nearly down to DC.

**IoT6p-6****A Study on Space Recognition Method by Using Optical Sensor Information Using Neural Network**

Kenji Ishihara, Ryohei Hanayama,  
Katsuhiko Ishii, Yoshihiro Takiguchi  
*The Graduate School for the Creation of New Photonics Industries, Japan*

Neural Network, Robot, Environment Recognition, Sensing, Photonics, and Computing.

**LDCp9-1****Fiber-Coupled High-Power RGB Laser Module for Underwater Optical Wireless Communication**

Ryosuke Nishi<sup>1</sup>, Koji Tojo<sup>1</sup>, Naoki Nishimura<sup>1</sup>,  
Takao Sawa<sup>2</sup>

<sup>1</sup>Shimadzu Corp., Japan, <sup>2</sup>JAMSTEC, Japan  
We developed fiber-coupled high-power RGB laser module for underwater optical wireless communication. The RGB laser module provides over 3.5-W laser output for each wavelength range of red, green, and blue.

**LDCp9-2****Experiment on Colour Mixing Using Tunable Red-Green-Blue Light-Emitting Diode Against Flux Luminous and Chromaticity Coordinates Values**

Revantino<sup>1,2</sup>, Rizki Armanto Mangkuto<sup>1</sup>,  
Abdul Rachman Sanjaya<sup>1</sup>, Jaka Kelana Putra<sup>1</sup>,  
F.X. Nugroho Soelami<sup>1</sup>

<sup>1</sup>Institut Teknologi Bandung, Indonesia,  
<sup>2</sup>Ministry of Industry of Republic of Indonesia, Indonesia

Experiment was conducted using light-emitting diode with tunability in red-green-blue components. Light intensity of each component was set by microcontroller within variation steps. Results showed variation of green component affected flux luminous and chromaticity values.

**LDCp9-3****Optically Tunable Liquid Crystal Broadband Linear-Polarization Rotator**

Ko-Ting Cheng<sup>1</sup>, Cheng-Kai Liu<sup>1</sup>,  
Chian-Yu Chiu<sup>1</sup>, Stephen M. Morris<sup>2</sup>,  
Min-Cheng Tsai<sup>1</sup>, Chii-Chang Chen<sup>1</sup>  
<sup>1</sup>National Central University, Taiwan, <sup>2</sup>University of Oxford, U.K.

A linear-polarization rotator based on the optically tunable pitch of chiral-azobenzene-doped liquid crystals has been investigated. The rotation angle is dependent on the pitch and the number of turns of the cholesteric LC helix.

**LDCp9-4****Proposal of Protective Filter Adjustment for RGB Lasers**

Yoshihisa Ishiba, Shinya Kajiri  
*Yamamoto kogaku co., Ltd., Japan*

We have reported on the details of protection filter which can adjust optical axis for RGB laser.

**LDCp9-5****Portable Camera Based 3D Imaging with Structured Light**

Ting-Yi Huang<sup>1</sup>, Wei Min Cheng<sup>1</sup>, Fan Tim<sup>2</sup>,  
J. Andrew Yeh<sup>1</sup>, Yuan Luo<sup>2</sup>

<sup>1</sup>National Tsing Hua University, Taiwan,  
<sup>2</sup>National Taiwan University, Taiwan

Three-dimensional (3D) image reconstruction has been developed for various applications. Here, we proposed a smart phone combined with structured light source to experimentally demonstrate 3D reconstructed images.

**LDCp9-6****UTILIZATION OF NANOCELLULOSE FROM BAGASSE AS CARBON SOURCE ON BCNO SYNTHESIS / SiO2 FOR WHITE LED LAMP**

I Putu Darma Ruswara, Dafi Adinegoro,  
Bambang Sunendar, Ahmad Nuruddin  
*Institut Teknologi Bandung, Indonesia*

White LED can be made by transmitting UV light source through phosphor material. Phosphor BCNO Silica is made of nanocellulose from bagasse using sol-gel method and calcination at 600° C and used for LED film.

**LDCp9-7****Effect of Luminance and Contrast on Psycho-physiological Response of Dentist in General Examination Room of a Dental Hospital**

Damarwulan Eka Agustina, Fariza A Alifah,  
Rizki A. Mangkuto, Suprijanto  
*Institut Teknologi Bandung, Indonesia*

Three variables yield significant effect on subjective error percentage: maximum face luminance, maximum ambient luminance, and contrast of oral-mannequin. The following values are suggested: Lf,max ? 3.42 cd/m2, La,max ? 2.24 cd/m2, Cm-f ? 9.66.

**LDCp9-8****Parametric Design for Optimising Dimensions and Specularity of Light Shelves**

Rialdi Eka Putra, Fathurrahman Feradi,  
Rizki Armanto Mangkuto,  
R. Triyogo Atmodipoero  
*Institut Teknologi Bandung, Indonesia*

This study aims to optimise the design parameters of light shelves in an open-plan space, to maximise daylight availability and minimise glare risk, using parametric design with genetic algorithm optimisation.

**LDCp9-9****Secure Transmission and analysis of Optical Scanned Holographic Images for Efficient Communication**

Meril Cyriac, Kanjana G, Anusree L,  
Leena Thomas, Nelwin Raj N.R,  
Roshan Varghese

*SCT College of Engineering, India*

A new approach for the secure transmission of optical scanning holographic image is proposed. The optically scanned holographic image is scrambled using different chaotic maps. This image is converted to a quick response code.

**LDCp9-10****Development of Portable Light Therapy Apparatus using LED for Improvement of Sleep and Wakefulness**

Tomonori Yusa<sup>1</sup>, Jun Miura<sup>2</sup>, Yasumori Sugai<sup>3</sup>,  
Yousuke Ito<sup>3</sup>, Yoshihisa Aizu<sup>1</sup>

<sup>1</sup>Muroran Institute of Technology, Japan,  
<sup>2</sup>Hokkaido Pharmaceutical University, Japan,  
<sup>3</sup>DENSEI COMMUNICATION Inc., Japan

We have developed a portable light therapy apparatus for improvement of sleep quality and wakefulness and performed some preliminary experiments. The experimental results demonstrate usefulness of developed portable light therapy apparatus.

## Poster Session &lt;Exhibition Hall A&gt;

Friday, 27 April

LDCp9 10:30-12:00

## LDCp9-11

**Understanding the Exposure-time Effect on Speckle Contrast Measurement for Laser Projection with Rotating Diffuser**Koji Suzuki, Shigeo Kubota  
*Oxide Corporation, Japan*

We measured speckle contrast for laser projection with a rotating diffuser. The exposure-time effect was observed at slow surface velocity. The exposure time won't affect speckle contrast of laser displays if temporally-averaging speed is fast.

## LDCp9-12

**Improvement of Image Blurring for Aerial Image formed by Dihedral Corner Reflector Array using Optimization Processing**Daisuke Miyazaki, Shinji Onoda  
*Osaka City University, Japan*

A method to improve blurring in an aerial image formed by a micro mirror array imaging element is proposed. A displayed image is optimized to minimize image blur using simulated annealing algorithm.

## LDCp9-13

**Forming a Thermal Aerial Image with AIRR**Kengo Fujii<sup>1</sup>, Erina Abe<sup>1</sup>, Ryosuke Kujime<sup>1,2</sup>, Hirotsugu Yamamoto<sup>1,2</sup>  
<sup>1</sup>*Utsunomiya University, Japan*, <sup>2</sup>*JST ACCEL, Japan*

This paper shows the possibility of forming a thermal aerial image with aerial imaging by retro-reflection (AIRR). Although far-infrared rays are absorbed by polymers, near-infrared lights can be retro-reflected and transmit through a beam splitter.

## LDCp9-14

**Aerial Imaging in a Cylindrical Water Tank with Omnidirectional**Erina Abe<sup>1</sup>, Sho Onose<sup>1</sup>, Hirotsugu Yamamoto<sup>1,2</sup>  
<sup>1</sup>*Utsunomiya University, Japan*, <sup>2</sup>*JST ACCEL, Japan*

This paper utilizes aerial imaging by retro-reflection (AIRR) for an omnidirectional aerial display. The omnidirectional aerial screen is formed inside a cylindrical water tank, which is aimed for experiments on fish by showing images.

## LDCp9-PDP1

**The Advantage of Centroid Wavelengths for Precise Evaluation of Laser Displays**Keisuke Hieda, T. Maruyama, F. Narusawa  
*HIOKI E.E. CORPORATION, Japan*

The accuracy of a measurement method for the chromaticity and photometric quantity of laser displays using centroid wavelengths was experimentally verified.

## PLD8p-1

**A real-time laser conditioning technique coupled with photothermal lens probe on 1064-nm mirror**Yi Zheng<sup>1</sup>, Z. Liu<sup>2</sup>, P. Ma<sup>2</sup>, F. Pan<sup>2</sup>, F. Geng<sup>2</sup>, J. Wang<sup>2</sup>, Q. Xu<sup>2</sup>  
<sup>1</sup>*Chengdu Novaphoton Co. Ltd., China*, <sup>2</sup>*Chengdu Fine Optical Engineering Research Ctr, China*

We have presented a novel adaptive laser conditioning (ALC) concept on 1064nm mirror that uses photo-thermal lens probe (PTLP) to detect defects in-situ and then carries out adaptive control of exposure fluence.

## PLD8p-2

**Study on the properties of thin films used in laser system**Cui Yun<sup>1</sup>, Fei Liang<sup>2</sup>, Yuan'an Zhao<sup>1</sup>, Meijing Zhu<sup>1</sup>, Kui Yi<sup>1</sup>, Jianda Shao<sup>1</sup>  
<sup>1</sup>*Shanghai Institute of Optics and Fine Mechanics, China*, <sup>2</sup>*Shanghai Univ., China*

Hafnia-silica (HfO<sub>2</sub>-SiO<sub>2</sub>) mixed coatings with a wide range of compositions were deposited on fused silica substrates by electron beam co-evaporation.

## PLD8p-3

**High-efficiency and low-damage lapping process optimization based on effective damage removal rate**Ci Song, Y. Lin, H. Hu, S. Chen, L. Zhou, G. Tie  
*National Univ. of Defense Technology, China*

The low-damage optics are applied widely in modern laser system, and its fabrication is always the popular issue. As one of the key points in the manufacturing process, the optimization of efficiency and damage challenges the lapping process.

## PLD8p-4

**Research on a new combined polishing technology and damage threshold improvement of KDP crystals**Hao Hu, G. Tie, C. Song, L. Zhou, S. Chen  
*National Univ. of Defense Technology, China*

Potassium Dihydrogen Phosphate(KDP) crystal is an excellent nonlinear optical material and is also the unique material used for high energy laser system.

## PLD8p-5

**Characterization of multiwavelength laser-induced damage in DKDP crystals**Jinming Wu<sup>1,2</sup>, Y. Zhao<sup>2</sup>, L. Wang<sup>1</sup>, X. Peng<sup>2</sup>, L. Yang<sup>2</sup>

<sup>1</sup>*Shanghai Univ., China*, <sup>2</sup>*Shanghai Institute of Optics and Fine Mechanics, China*

Nanosecond laser-induced damage (LID) in potassium dihydrogen phosphate (KH<sub>2</sub>P<sub>2</sub>O<sub>4</sub>) remains an issue for light- frequency converters in large-scale lasers system such as NIF (National Ignition Facility, in USA) and LMJ (Laser MegaJoule, in France).

## PLD8p-6

**Nonlinear optical characteristics of ADP crystals**Yafei Lian, X. Sun, M. Xu, L. Zhang  
*Shandong Univ., China*

A picosecond Nd:YAG laser (30 ps, 10-Hz pulse repetition rate) was used in the experiments. Nonlinear optical characteristics of crystals were investigated at  $\lambda = 532\text{nm}$ ,  $355\text{nm}$  and  $266\text{nm}$ .

## PLD8p-7

**Third-harmonic-generation nonlinear absorption coefficient of 70% deuterated DKDP crystal**Dongting Cai<sup>1</sup>, X. Ju<sup>2</sup>, B. Liu<sup>2</sup>  
<sup>1</sup>*Shandong Univ., China*, <sup>2</sup>*Univ. of Science and Technology Beijing, China*

The nonlinear optical absorption (NLA) of 70% deuterated DKDP crystals that were cut along different directions and annealed under different temperatures were measured at the third-harmonic-generation (THG) wavelength (355 nm) of a nanosecond Nd:YAG laser (pulse duration of 5.4 ns and repetition rate of 10 Hz) by using the Z-scan method.

## PLD8p-8

**Wide-bandgap nonlinear crystal with high damage resistance for femtosecond mid-infrared spectrometer using chirped-pulse upconversion**Yusuke Funamoto<sup>1</sup>, Y. Inagaki<sup>1,2</sup>, H. Hata<sup>1,2</sup>, T. Kamimura<sup>1</sup>, N. Umemura<sup>2</sup>, N. Hamada<sup>2</sup>, R. Nakamura<sup>2</sup>

<sup>1</sup>*Osaka institute of technology, Japan*, <sup>2</sup>*Osaka University, Japan*, <sup>3</sup>*Chitose Institute of Science and Technology, Japan*

For biochemical processes such as photoisomerization, bond formation and dissociation, and protein folding, femtosecond time-resolved mid-infrared (MIR) spectroscopy has been a powerful tool for gaining insight.

## PLD8p-9

**XANES investigation on surface electronic structure of KDP crystals irradiated with different fluences and retired components**Xiangcao Li, X. Ju, B. Liu  
*Univ. of Science and Technology Beijing, China*

The electronic structure of phosphorus is essential for understand the laser-induced damage since P atom is the body-centered atom and it is fundamental to the structure of KDP crystal.

## PLD8p-10

**Crystal growth and UV laser-induced damage resistance of a strontium tetraborate**Yasunori Tanaka<sup>1</sup>, K. Shikata<sup>1</sup>, Y. Takahashi<sup>1</sup>, R. Murai<sup>1</sup>, M. Imanishi<sup>1</sup>, Y. Mori<sup>1,2</sup>, M. Yoshimura<sup>1,2</sup>

<sup>1</sup>*Osaka University, Japan*, <sup>2</sup>*SOSHO CHOKO Inc., Japan*

One of borate materials, strontium tetraborate SrB<sub>4</sub>O<sub>7</sub> (SBO), was reported as a nonlinear optical crystal with high nonlinear coefficients and wide transparency range [1].

## PLD8p-11

**Research of diamond transmission gratings used for high-power laser pulse compression**Shuwei Fan, T. Zhu, H. Wang  
*Xi'an Jiaotong Univ., China*

As a milestone in the development of laser technique, chirp pulse amplification (CPA) technique is widely applied to produce ultrahigh power laser.

## PLD8p-12

**Carrier dynamics in dispersion compensation element induced by femtosecond laser**Xin Xing<sup>1</sup>, W. Yuan<sup>1</sup>, T. Kobayashi<sup>2</sup>, B. Xue<sup>2</sup>, J. Du<sup>1</sup>, Y. Leng<sup>1</sup>, Y. Zhao<sup>1</sup>, J. Shao<sup>1</sup>

<sup>1</sup>*Shanghai Institute of Optics and Fine Mechanics, China*, <sup>2</sup>*University of Electro-Communications, Japan*

With the widely application of high power femtosecond laser, optical thin film components are being one of the most critical components in the laser system.

## PLD8p-13

**Non-invasive and in situ measurement of a refractive index gradient profile of one-dimensional GRIN materials**Humbat Nasibov  
*TÜBİTAK ÜME, Turkey*

Refractive index (RI) distribution plays a crucial role in the propagation of light through any transparent medium except a vacuum.

## PLD8p-14

**Q-switched composite gold nanorod and Nd:YAG ceramic planar waveguide laser**

Wenda Cui, K. Han, C. Zhang, G. Lin, J. Li, W. Hua, H. Wang, Y. Pan, X. Xu

*National Univ. of Defense Technology, China*

The planar waveguide laser is a crucial device for high power solid state lasers and integrated optics. The RE-doped ceramics has been widely investigated because of its flexibility and easier manufacture of large homogeneous gain volume.

## PLD8p-15

**Experimental study on the processing effect of DUJ laser radiation to CFRP**Xingliang Song<sup>1,2</sup>, P. Sha<sup>1</sup>, H. Shi<sup>3,4</sup>, B. Liu<sup>1,2</sup>, Z. Feng<sup>1,2</sup>, J. Rui<sup>1</sup>, Y. Zhou<sup>1</sup>, S. Yuan<sup>2,4</sup>, J. Yang<sup>1</sup>, G. Xiong<sup>1</sup>, Y. Wang<sup>1</sup>

<sup>1</sup>*Academy of Opto-Electronics, CAS, China*, <sup>2</sup>*Univ. of Chinese Academy of Sciences, China*, <sup>3</sup>*Beijing Engineering Technological Research Ctr. for High-Efficient and Green CNC Machining Process, China*, <sup>4</sup>*Beihang Univ., China*

Carbon Fiber Reinforced Polymer(CFRP) is widely used in the industries of aerospace, automobile and sport. Due to its complex material component and structure, it is hard to assemble CFRP parts to others without damage.

## PLD8p-16

**Dynamical behavior of laser-produced copper plasma in uniform external magnetic field**Narayan Behera, R. K. Singh, A. Kumar  
*Institute for Plasma Research, HBNI, Gandhinagar, India*

An Nd:YAG laser ( $\lambda = 1064\text{nm}$ , 8 ns pulse width) of 150 mJ pulse energy is used to ablate copper target in the presence of 0 - 0.50 T transverse magnetic field.

## PLD8p-17

**The post-processing process and mechanism of coating based on laser shock wave**Wenwen Liu, H. Yang, J. Zhang, D. Zhu  
*Wenzhou Univ., China*

High power laser coatings are facing a series of more serious challenges including running on higher laser induced damage threshold (LIDT), higher repetitive frequency and higher stability.

## Poster Session &lt;Exhibition Hall A&gt;

Friday, 27 April

PLD8p 10:30-12:00

OMCp 13:00-14:00

**PLD8p-18****Photostability study of CdTe quantum dots using laser induced fluorescence Author Preference**

Ahmed El-Hussein Mohamed Kamel ElNewishy, S. Elfekey  
National Institute of Laser Enhanced Sciences, Egypt

Semiconductor quantum dots (QDs) having high quantum yields and unique photostability. This research studies the optical properties of the synthesized CdTe QDs with two different sizes using Laser induced fluorescence for investigating their photostability.

**PLD8p-19****Laser decoating of TiN from TiN-coated 316L stainless steel substrates: Effects of laser parameters on the decoating**

Jingxuan Wang, Y. Ye  
China Academy of Engineering Physics, China

Current environmental challenges require sustainable and extended use and re-use of materials. For example, the service life of engineering tooling can be extended by using thin film coatings such as titanium nitride (TiN).

**PLD8p-20****Laser-induced damage of indium tin oxide films and polyimide films at 1064nm**

Liping Peng<sup>1,2</sup>, X. Liu<sup>1,2</sup>, Y. Zhao<sup>1</sup>, Y. Liu<sup>3,2</sup>, Z. Cao<sup>3,2</sup>, M. Zhu<sup>1,2</sup>, J. Shao<sup>1,2</sup>

<sup>1</sup>Shanghai Institute of Optics and Fine Mechanics, China, <sup>2</sup>Univ. of Chinese Academy of Sciences, China, <sup>3</sup>Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, China

Laser damage performance of indium tin oxide (ITO) films and polyimide (PI) thin films were investigated. The ITO films with 25nm thickness were deposited on glass substrates by magnetic sputtering, and then PI film samples with thickness of 80nm were spin coated on the ITO.

**PLD8p-21****Study on the micro-etched morphology and electromagnetic properties of grain-oriented silicon steel by laser processing**

Zhang Jian  
WenZhou University, China

In order to effectively reduce the iron loss of grain-oriented silicon steel. In order to optimize the electromagnetic properties of grain-oriented silicon steel.

**PLD8p-22****Thermo-mechanical behavior of photovoltaic cell under laser irradiation**

Chen-Wu Wu  
Institute of Mechanics, China

The multiple physical responses of photovoltaic cell to laser irradiation are of fundamental meaning for developing laser power beaming technology as well as evaluating reliability of the solar panel subjected to unexpected laser exposure.

**PLD8p-23****Mechanism of laser resist removal phenomenon without causing laser damage**

Yuji Umeda<sup>1</sup>, K. Nuno<sup>1</sup>, T. Yamashiro<sup>1</sup>, Y. Hunamoto<sup>1</sup>, A. Nishiura<sup>1</sup>, D. Sima<sup>1</sup>, H. Tsukamoto<sup>1</sup>, N. Nishio<sup>1</sup>, H. Kuramae<sup>2</sup>, T. Nishiyama<sup>3</sup>, H. Horibe<sup>3</sup>, R. Nakamura<sup>4</sup>, T. Kamikura<sup>1</sup>

<sup>1</sup>Osaka Institute of Technology, Japan, <sup>2</sup>Department of Robotics, Osaka Institute of Technology, Japan, <sup>3</sup>Department of Applied Chemistry and Bioengineering, Graduate School of Engineering, Japan, <sup>4</sup>Science & Technology Entrepreneurship Laboratory, Osaka University, Japan

Resist removal using the laser irradiation has attracted a great deal of attention as one of the new removal technologies. Usually, when a laser beam is irradiated to the resist in the normal atmosphere, laser damage occurs to the Si wafer surface.

**OMCp-1****Polarization Control Based on Graphene Hyperbolic Metamaterials**

Tao Wang, L. Cheng  
Huazhong Univ of Science and Technology, China

Polarization manipulation of the electromagnetic wave is essential for numerous and extensive applications such as biological imaging, sensing, communication and microscopy.

**OMCp-2****Theoretical and Experimental Investigations of Photonic Jet Array From Rectangle Phase Diffraction Grating**

Cheng-Yang Liu<sup>1</sup>, T. Yen<sup>1</sup>, O. V. Minin<sup>2</sup>, I. V. Minin<sup>2</sup>

<sup>1</sup>Tamkang Univ, Taiwan, <sup>2</sup>Siberian State University of Geosystem and Technologies, Russian Federation

The generations of photonic jet array using rectangle phase diffraction grating at visible light region are demonstrated numerically and experimentally for the first time.

**OMCp-3****Dispersion of Quantum Dots into Gases Toward Their Optical Manipulation**

Mitsutaka Kumakura, A. Kinan, T. Moriyasu  
Univ of Fukui, Japan

To realize optical manipulation and measurement for isolated quantum dots (QDs) in gaseous phase, we are developing experimental apparatus for dispersing QDs into a gas by using droplets of organic solvents.

**OMCp-4****Multiplexed Volume Holographic Gratings for Simultaneous Generation of Airy and Dual Airy Beams**

Sunil Vyas, Y. Chia, Y. Luo  
National Taiwan Univ, Taiwan

Most of the generation techniques of structured light are inherently wavelength dependent. Holography has always played an important role in generating structured light. Volume holograms have ability to Bragg diffract only a narrow band of wavelengths.

**OMCp-5****Thermal Analysis for Ion Beam Processing of the Unimorph Deformable Mirror**

Zhanbin Fan, C. Guan, G. Tie, S. Chen  
National University of Defense Technology, China

The unimorph deformable mirror (DM) is favored in the field of synchrotron radiation due to its simple structure, dynamic surface figure and adaptive adjustment. The request of mirror surface accuracy on the synchrotron radiation beam focus can be up to sub-nanometer RMS.

**OMCp-6****Thermal Analysis for Ion Beam Processing of the Unimorph Deformable Mirror**

Fan Zhanbin, C. Guan, G. Tie, S. Chen  
National University of Defense Technology, China

The unimorph deformable mirror (DM) is favored in the field of synchrotron radiation due to its simple structure, dynamic surface figure and adaptive adjustment. The request of mirror surface accuracy on the synchrotron radiation beam focus can be up to sub-nanometer RMS.

**OMCp-7****Preparation of Low-Toxic Zn-Ag-In-Te Quantum Dots with Tunable Near-IR Emission Toward Optical Applications**

Tatsuya Kameyama<sup>1</sup>, K. Sugiura<sup>1</sup>, Y. Ishigami<sup>1</sup>, T. Yamamoto<sup>1</sup>, S. Kuwabata<sup>2</sup>, T. Okuhata<sup>3</sup>, N. Tamai<sup>3</sup>, T. Torimoto<sup>1</sup>

<sup>1</sup>Nagoya Univ., Japan, <sup>2</sup>Osaka Univ., Japan, <sup>3</sup>Kwansei Gakuin University, Japan

Semiconductor quantum dots (QDs) composed of ZnTe-AgInTe<sub>2</sub> solid solution ((AgIn)<sub>x</sub>Zn<sub>2</sub>(1-x)Te<sub>2</sub>, ZAITe) were synthesized by a thermal reaction of corresponding metal acetates and a Te precursor in 1-dodecanethiol.

**OMCp-8****Trapping and Manipulation of Individual Cells in the Crowd**

Qian Zhao  
The University of Science and Technology of China, China

Manipulating single cell with optical tweezers in vitro or in vivo plays an important role in biological research, whereas the manipulation of individual cells might be affected by the neighbor cells especially in the crowd environment.

**OMCp-9****Dynamic Shaping of Orbital-Angular-Momentum Beams with An Optimized Lee Method**

Xinyao Hu  
The University of Science and Technology of China, China

Shaping complex fields with a digital micromirror device (DMD) has attracted much attention recently due to its potential application in optical communication and microscopy.

**OMCp-10****Proposed Selective Optical Transport of Nanoparticles using Counter-Propagating Beams**

Takudo Wada, H. Ishihara  
Osaka Prefecture University, Japan

Optical manipulation is a technique for mechanically manipulating minute substances by using radiation force from laser beams.

Poster Session <Exhibition Hall A>

Friday, 27 April

OMCp7 13:00-14:00

BISCp6 13:00-14:30

**OMCp-11**

**Optical Forces on A Nonlinear Optical Rayleigh Particle Induced by Highrepetition-Rate Femtosecond Laser Pulses**

Bing Gu<sup>1</sup>, L. Gong<sup>1</sup>, G. Rui<sup>1</sup>, Y. Cui<sup>1</sup>, Z. Zhu<sup>2</sup>, Q. Zhan<sup>3</sup>  
<sup>1</sup>Southeast Univ, China, <sup>2</sup>Nanjing Normal University, China, <sup>3</sup>University of Dayton, United States

The principle of optical trapping is conventionally based on the interaction of optical fields with linear-induced polarizations.

**OMCp-12**

**Metalens for Structure Light**

Mu Ku Chen<sup>1</sup>, Cheng Hung Chu<sup>2</sup>, Hsin Yu Kuo<sup>1</sup>, Yu Han Chen<sup>1</sup>, Ren Jie Lin<sup>1</sup>, Jia-Wern Chen<sup>1</sup>, Din Ping K. Tsai<sup>1,2</sup>

<sup>1</sup>Department of Physics, National Taiwan University, Taiwan, <sup>2</sup>Research Center for Applied Sciences, Academia Sinica, Taiwan

Metalens have great ability in light focusing and can be tailored to exhibit varied functionalities in ultrathin optical applications.

**OMCp-13**

**Active Polarization Control of Optical Fields Localized on Gold Nano-Rectangles**

S. Hashiyada, T. Narushima, H. Okamoto  
 Institute for Molecular Science, Japan

We demonstrate here that control of local optical field near a single non-chiral gold nano-rectangle irradiated with linearly polarized light is possible from linearly polarized to nearly pure left- or right-handed circular polarization, by adjusting the angle of the incident polarization relative to the rectangle.

**OMCp-14**

**Optical Manipulation of Nonlinear Vibration of Graphene Mechanical Resonator**

Taichi Inoue, Y. Anno, Y. Imakita, K. Takei, T. Arie, S. Akita  
 Osaka Prefecture University, Japan

Graphene mechanical resonator (G-MR) has possibilities of high sensitive sensor because of excellent mechanical properties. In many cases, G-MR has been actuated in linear resume.

**OMCp-15**

**Optical Manipulation of Vibration Amplitude of Electrostatically Actuated Cantilevered MoS2**

Daiki Yoshikawa, Y. Miyamoto, K. Takei, T. Arie, S. Akita  
 Osaka Prefecture University, Japan

Transition metal dichalcogenide such as MoS2 is expected as high performance nano-electro-mechanical devices due to their unique electrical, optical and mechanical properties.

**OMCp-16**

**Hyper-Entanglement Preservation in Quantum Optical Circuits**

Vladimir Nikulin  
 Binghamton Univ, United States

Secure optical data links can be implemented using quantum communication (QC) protocols that offer physical-layer encryption without the mathematical complexity of traditional cryptography.

**OMCp-17**

**Novel Non-plasmonic Optical Trapping; Nano-Structured Semiconductor Assisted (NASSCA) Optical Tweezers**

Yuki Uenobo<sup>1</sup>, Tatsuya Shoji<sup>1</sup>, Ayaka Mototsuji<sup>1</sup>, S. Komoto<sup>1</sup>, T. Nagai<sup>1</sup>, Yasuyuki Tsuboi<sup>1</sup>, J. Saulius<sup>2</sup>, L. Denver<sup>2</sup>, Swinburne<sup>2</sup>  
<sup>1</sup>Osaka City University, Japan, <sup>2</sup>University of Technology, Australia

We have studied plasmonic optical tweezers (POT) for nanomaterials such as DNA and polymers. These nanomaterials would be efficiently trapped by a plasmon-enhanced optical force.

**OMCp-18**

**Raman Microspectroscopic Study on an Optically Formed Poly(N-isopropylacrylamide) Rich Microparticle: Molecular Weight Dependence of a Polymer Concentration in the Particle**

Kayo Fujiwara, T. Shoji, M. Matsumoto, T. Asoh, T. Nishiyama, H. Horibe, Y. Tsuboi  
 Osaka City University, Japan

Poly(N-isopropylacrylamide) solution, which is a representative thermoresponsive polymer, exhibits a phase separation with a formation of polymer-rich microparticles due to dehydration and aggregation of the polymer chains above a lower critical solution temperature (LCST).

**OMCp-19**

**Temperature at the Focal Point of Optical Trapping Beam: Evaluation Using Fluorescence Correlation Spectroscopy**

Kenji Setoura, S. Ito, K. Fujita, H. Miyasaka  
 Osaka Univ, Japan

Fluorescence correlation spectroscopy was applied to the evaluation of the local heating at the focal spot of nearinfrared laser for optical trapping.

**OMCp-20**

**Optofluidics Driven by Photothermal Effects of Single Gold Nanoparticles**

Kenji Setoura, S. Ito, H. Miyasaka  
 Osaka University, Japan

Gold nanoparticles (Au NPs) exhibit strong light absorption due to localized surface plasmon resonance (LSPR), and efficiently convert light energy into heat under illumination.

**OMCp-21**

**In-Situ Observation of Molecules in the Strong Coupling States**

Kei Murakoshi, F. Kato, H. Minamimoto  
 Hokkaido Univ, Japan

We have attempted to control molecular behavior of a small number of molecules which are strongly coupled with the localized light energy in the vicinity of the metal nano structures.

**OMCp-22**

**In-situ SERS Observation of Selective Molecule Optical Trapping**

Kei Murakoshi, N. Oyamada, H. Minamimoto  
 Hokkaido Univ, Japan

It is predicted by various theoretical studies that nanometer size molecules could be trapped in the strong electromagnetic field due to its steep spatial gradient of the filed intensity.

**OMCp-23**

**Optical control of orientation of nanosheet in colloidal state**

Yasutaka Suzuki<sup>1</sup>, Toshiaki Iwai<sup>2</sup>  
<sup>1</sup>Yamaguchi University, Japan, <sup>2</sup>Tokyo University of Agriculture and Technology, Japan  
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**BISCp6-1**

**Non-invasive glucose monitoring based on optical coherent tomography**

Tseng-Lin Chen<sup>1</sup>, Yu-Lung Lo<sup>1,2</sup>, Quoc-Hung Phan<sup>1</sup>

<sup>1</sup>Department of Mechanical Engineering, National Cheng Kung University, Taiwan, <sup>2</sup>Advanced Optoelectronic Technology Center, National Cheng Kung University, Taiwan

A novel technique based on optical coherence tomography (OCT) for noninvasive glucose monitoring is proposed. The feasibility of the proposed technique is demonstrated by detecting the glucose concentration of aqueous solution ranging from 0-4000 mg/dL with 0.02% lipofundin.

**BISCp6-2**

**Monitoring protein-related degeneration of Drosophila eyes with optical coherence tomography**

Chia-Heng Wu<sup>1</sup>, Meng-Tsan Tsai<sup>2</sup>

<sup>1</sup>Chang Gung Univ, Taiwan, <sup>2</sup>Department of Electrical Engineering, Chang Gung University, Taiwan

In this study, we propose to use optical coherence tomography (OCT) for the study of protein-related degeneration of Drosophila eyes. With OCT, the bristles of Drosophila eye can be identified and different mutant Drosophila were scanned with OCT for investigation of progress of protein-related degeneration.

**BISCp6-3**

**Parallel phase-shifting radial shearing interferometry and its numerical verification**

Syogo Mochida<sup>1</sup>, Takahito Fukuda<sup>1</sup>, Yasuhiro Awatsujii<sup>2</sup>, Kenzo Nishio<sup>3</sup>, Osamu Matoba<sup>4</sup>

<sup>1</sup>Department of Electronics, Graduate School of Science and Technology, Kyoto Institute of Technology, Japan, <sup>2</sup>Faculty of Electrical and Electronics, Kyoto Institute of Technology, Japan, <sup>3</sup>Advanced Technology Center, Kyoto Institute of Technology, Japan, <sup>4</sup>Department of Systems Science, Graduate School of System Informatics, Kobe University, Japan

We propose parallel phase-shifting radial shearing interferometry for single-shot measurement of wavefront from an object. We numerically simulated and demonstrated the wavefront measurement of two particles assumed as object wave by using the proposed technique.

**BISCp6-4**

**Motion-picture phase imaging by an integrated optical system of a parallel phase-shifting digital holographic microscope**

Kazuki Shimizu<sup>1</sup>, Takahito Fukuda<sup>1</sup>, Peng Xia<sup>2</sup>, Yasuhiro Awatsujii<sup>3</sup>, Kenzo Nishio<sup>4</sup>, Osamu Matoba<sup>5</sup>

<sup>1</sup>Department of Electronics, Graduate School of Science and Technology, Kyoto Institute of Technology, Japan, <sup>2</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>3</sup>Kyoto Institute of Technology, Faculty of Electrical Engineering and Electronics, Japan, <sup>4</sup>Advanced Technology Center, Kyoto Institute of Technology, Japan, <sup>5</sup>Department of Systems Science, Graduate School of System Informatics, Kobe University, Japan

The authors have designed and constructed an integrated optical system of parallel phase-shifting digital holographic microscope. Motion-picture phase imaging of a dynamic minute transparent specimen at 1,000 fps has been demonstrated by the microscope.

## Poster Session &lt;Exhibition Hall A&gt;

Friday, 27 April

BISCp6 13:00-14:30

**BISCp6-5****Digital holographic microscopy using speckle illuminations and two-wavelength method**

Hideki Funamizu<sup>1</sup>, Jun Uozumi<sup>2</sup>, Yoshihisa Aizu<sup>3</sup>  
<sup>1</sup>Yusei Onodera, Muroran Institute of Technology, Japan, <sup>2</sup>Faculty of Engineering, Hokkai-Gakuen University, Japan, <sup>3</sup>Muroran Institute of Technology, Japan

It has been known that spatial resolution of digital holographic microscopy (DHM) can be enhanced using speckle illuminations. In this study, we report the application of the two-wavelength method to DHM using speckle illuminations.

**BISCp6-6****Tomographic phase imaging of RBCs in blood coagulation structures using digital holographic microscopy**

Hideki Funamizu, Ryoji Goto, Yoshihisa Aizu  
 Muroran Institute of Technology, Japan

Blood coagulation is an important role in hemostasis. In this study, to observe the degree of blood coagulation, we demonstrate a tomographic phase imaging of aggregation structures of RBCs using digital holographic microscopy.

**BISCp6-7****Reconstruction of complex amplitude by lensless phase-shift digital holography through an opaque glass plate**

Akinori Igarashi, Wataru Watanabe  
 Ritsumeikan University, Japan

Optical imaging through diffusive or scattering media has attracted much attention. Digital holographic microscopy provides quantitative phase imaging through diffusive media. We experimentally reconstruct intensity and phase images of an object through an opaque ground glass screen by means of digital holography.

**BISCp6-8****Digital holographic size measurement of Daphnia pulex**

Kota Sunayama<sup>1</sup>, Hitoshi Miyakawa<sup>2</sup>, Yoshio Hayasak<sup>2</sup>

<sup>1</sup>Center for Optical Research and Education (CORE), Utsunomiya University, Japan, <sup>2</sup>Center for Bioscience Research and Education (CBRE), Utsunomiya University, Japan

Toxicity of chemical substances should be determined for protecting biological environment. A Daphnia pulex is one of the indicator organisms for searching the toxicity, because the shape is changed depending on the toxicity. Conventional method for its observation has been performed under suppression of its movement in a small thin room with an ordinary optical microscope.

**BISCp6-9****Incoherent holographic imaging of subsurface structures with volume holographic gratings**

Yu-Hsin Chia<sup>1</sup>, Hung-Chun Wang<sup>2</sup>, Yuan Luo<sup>3</sup>  
<sup>1</sup>Institute of Medical Device and Imaging, National Taiwan University, Taiwan, <sup>2</sup>Department of Power Mechanical Engineering, National Tsing Hua University, Taiwan, <sup>3</sup>Institute of Medical Device and Imaging, National Taiwan University, Taiwan

Under broadband illumination, a multiplane microscopy incorporating volume holographic gratings (VHG) to observe three-dimensional structures of biological samples is presented. Here, we experimentally demonstrate this microscopic imaging capability to obtain multiple depth-resolved images of fine structures from eight depths in one shot.

**BISCp6-10****In vivo time-series monitoring of dermal collagen fiber during skin burn healing using second-harmonic-generation microscopy**

Eiji Hase<sup>1,2</sup>, Ryosuke Tanaka<sup>2</sup>, Shu-ichiro Fukushima<sup>3</sup>, Takeshi Yasui<sup>1,3</sup>  
<sup>1</sup>Tokushima University, Japan, <sup>2</sup>JASRI/SPRING-8, Japan, <sup>3</sup>Osaka University, Japan

We applied second-harmonic-generation microscopy for in vivo imaging of healing process in animal skin burn and visualized decomposition, production, and growth of renewal collagen fibers as a series of time-lapse images in the same subject.

**BISCp6-11****In vivo visualization of dermal collagen fibers in human skin using a photonic-crystal-fiber-coupled, hand-held second-harmonic-generation microscope**

Yuki Ogura, Kosuke Atsuta, Eiji Hase, Takeo Minamikawa, Takeshi Yasui  
 Tokushima Univ., Japan

We constructed a hand-held second-harmonic-generation microscope for in vivo monitoring of collagen fibers in human skin by fiber delivery of ultrashort pulse light in a large-mode-area photonic-crystal-fiber and a compact microscopy setup.

**BISCp6-12****Analysis of collagen fiber orientation in biological tissues using polarization-resolved second-harmonic-generation microscopy**

Takuya Sakaue<sup>1</sup>, Eiji Hase<sup>2</sup>, Takeo Minamikawa<sup>3</sup>  
<sup>1</sup>Tokushima Univ, Japan, <sup>2</sup>Tokushima Univ, Japan, <sup>3</sup>JASRI/SPRING-8, Japan, <sup>4</sup>Takeshi Yasui, Tokushima Univ, Japan

We constructed continuously-polarization-resolved SHG microscopy based on rapid polarization rotation every 15 degrees with electric-optic Pockels cell, and applied it for the quantitative analysis of collagen fiber orientation in biological tissues.

**BISCp6-13****In situ monitoring of incised wound healing in animal model using second-harmonic-generation and third-harmonic-generation microscopy**

Shu-ichiro Fukushima<sup>1</sup>, Yuji Tanaka<sup>1</sup>, Eiji Hase<sup>2,3</sup>, Kazuma Takeichi<sup>2</sup>, Takeshi Yasui<sup>1,2</sup>  
<sup>1</sup>Osaka University, Japan, <sup>2</sup>Tokushima University, Japan, <sup>3</sup>JASRI/SPRING-8, Japan

We apply the combination of second-harmonic-generation microscopy with third-harmonic-generation microscopy for incised wound animal model, and visualize collagen dynamics during the wound healing process in time series in situ.

**BISCp6-14****Resonance Raman and fluorescence spectroscopy to evaluate increased brain kynurenine pathway activity in samples from patients with Alzheimer's**

Laura A. Sordillo, Lin Zhang, Lingyan Shi, Peter Sordillo, Robert Alfano  
 City College of New York, United States

Resonance Raman and fluorescence spectroscopy were used to assess increased kynurenine pathway activity in brain samples from Alzheimer's patients and age-matched controls. Increased activity was seen in areas of the brain involved in Alzheimer's disease.

**BISCp6-15****Development of dual-wavelength microscopic laser speckle contrast imaging system**

Cheng-Yu Lee<sup>1</sup>, Meng-Tsan Tsai<sup>1,2</sup>  
<sup>1</sup>Chang Gung University, Taiwan, <sup>2</sup>Chang Gung Memorial Hospital, Taiwan

Laser Speckle Contrast Imaging (LSCI), which used coherent light, has fully been used for observing blood flow due to its non-invasive, non-contact acquisition method. Generally, LSCI system uses just a single wavelength for measurement. In this research, first, considering the biological characteristics of different reflection rates and absorption, we use two lasers at 633nm and 855 nm and two CCD cameras to build a microscopic LSCI system.

**BISCp6-16****Polarization-resolved second-harmonic-generation imaging of dermal collagen fiber in pre-wrinkled skin of ultraviolet-B-exposed mouse**

Shu-ichiro Fukushima<sup>1</sup>, Makoto Yonetsu<sup>1</sup>, Eiji Hase<sup>2,3</sup>, Takeshi Yasui<sup>1,2</sup>  
<sup>1</sup>Osaka University, Japan, <sup>2</sup>Tokushima University, Japan, <sup>3</sup>JASRI/SPRING-8, Japan

We investigate orientation change of dermal collagen fiber in pre-wrinkled skin of ultraviolet-B-exposed mouse skin using polarization-resolved second-harmonic-generation microscopy, and confirm that change of collagen fiber orientation is a trigger of wrinkling in photo-aged skin.

**BISCp6-17****Effects of nitric oxide on cortical hemodynamic responses in the rat brain exposed to a shock wave**

Masaki Inaba<sup>1</sup>, Shunichi Sato<sup>2</sup>, Izumi Nishidate<sup>3</sup>  
<sup>1</sup>Tokyo University of Agriculture and Technology, Japan, <sup>2</sup>National Defense Medical College Research Institute, Japan, <sup>3</sup>Tokyo University of Agriculture and Technology, Japan

We examined how the nitric oxide synthesis inhibition altered hemodynamic responses to a laser-induced shock wave(LISW) by diffuse reflectance spectroscopy. The results suggested that hemodynamic abnormalities, or transient hyperemia/hyperoxemia followed by persistent oligemia/hypoxemia, caused by an LISW in the rat cortex was associated with an increased nitric oxide production and its vasodilatory/vasoconstrictory effects.

**BISCp6-18****Partial optical path length in the scalp in subject-specific head models for multi-distance probe configuration of near infrared spectroscopy**

Taku Yanagisawa<sup>1</sup>, Hiroshi Kawaguchi<sup>2</sup>, Eiji Okada<sup>3</sup>

<sup>1</sup>Department of Electronics and Electrical Engineering, Keio University, Japan, <sup>2</sup>National Institute of Advanced Industrial Science and Technology, Japan, <sup>3</sup>Department of Electronics and Electrical Engineering, Keio University, Japan

Light propagation in 45 subject specific head models was calculated to predict the spatial variability of the partial optical path length in the scalp and the weighting factor for the multi-distance probe configuration of NIRS.

**BISCp6-19****Measurement of head phantom by functional near infrared imaging using multi-distance probe configuration**

Koki Hayabusa, Eiji Okada

Department of Electronics and Electrical Engineering, Keio University, Japan

The topographic image of the head phantom including the local absorption change in gray matter and global absorption change in the scalp was measured by functional near infrared imaging system using multi-distance probe configuration.

**BISCp6-20****Diffuse light reflectometry for measuring scattering and absorption coefficients of a biological tissue**

MAEDA Daiki, Toshiaki Iwai

Tokyo University of Agriculture and Technology, Japan

The optical properties, a scattering and an absorption coefficients, of biological tissues will be used to estimate quantitatively change in bioactivity. Diffuse light reflectometry has been investigated to measure the optical properties of biological tissues from the viewpoints of applicability and practicality.

**BISCp6-21****Adjoint based Hessian evaluation for SPN modeled optical tomography**

Nishigandha Patil, Naren Naik

Indian Institute of Technology Kanpur, India

We present for the first time an adjoint based evaluation of the Hessian matrix for the SPN-approximation modeled forward operator in optical tomography. The Hessians so calculated are numerically validated with respect to finite difference calculations.



Poster Session <Exhibition Hall A>

Friday, 27 April

BISCp6 13:00-14:30

**BISCp6-22**

**Three-dimensional beam focusing control for lensless vascular endoscopes using local wavefront control**

Masaki Hisaka  
Osaka Electro-Communication Univ, Japan  
The focusing beam generated by an optical fiber bundle having locally optical delay has been investigated to simplify the structure of vascular endoscopes. We have demonstrated the beam focusing and scanning using a liquid lens.

**BISCp6-23**

**Application of scan-less two-dimensional confocal microscopy achieved by a combination of confocal slit with wavelength/space conversion**

Eiji Hase<sup>1,2</sup>, Takeo Minamikawa<sup>1,2</sup>, Yasuhiro Mizutani<sup>2,3</sup>, Tetsuo Iwata<sup>2,4</sup>, Hirotugu Yamamoto<sup>2,5</sup>, Takeshi Yasui<sup>2,6</sup>  
<sup>1</sup>Tokushima Univ., Japan, <sup>2</sup>JST, ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS), Japan, <sup>3</sup>Osaka Univ., Japan, <sup>4</sup>Tokushima Univ., Japan, <sup>5</sup>Utsunomiya Univ., Japan, <sup>6</sup>Tokushima Univ., Japan  
Scan-less confocal laser microscope is achieved by a combination of confocal slit with wavelength/space conversion and is applied it to several imaging to demonstrate its high potential.

**BISCp6-24**

**Multi-focal imaging system by using a programmable spatial light modulator**

Chen Yen Lin, Yuan Luo  
National Taiwan Univ, Taiwan  
We have demonstrated that the multiplexed gratings pattern displayed on the digital micro-mirror device (DMD) or LC-SLM at the Fourier plane can separate the diffraction light coming from different depths into different angular directions being recorded by different portions of the single image plane.

**BISCp6-25**

**Underwater image enhancement algorithm based on granular computing**

Yingjuan Xie, Xinnan Fan, Haiyan Xu, Zhuo Zhang, Junfeng Chen  
Hohai University, China  
We proposed an image enhancement algorithm based on granular computing to enhance underwater optical image in this paper. The simulation and experiment results verify the effectiveness of the algorithm.

**BISCp6-26**

**An edge detection method based artificial bee colony for underwater dam crack image**

Zhang zhuo, Fan xinnan, Xie yingjuan, Xu haiyan  
Hohai University, China  
In the proposed model, lateral inhibitory network is firstly presented to enhance edge contrast in complex underwater environment. Then, artificial bee colony is improved to optimize target edge. Experimental results show it is efficient and effective.

**BISCp6-27**

**Practical image quality evaluation for whole slide imaging scanner**

Ms Shakhawat Hossain, Toyama Nakamura, Masahiro Yamaguchi  
Tokyo Institute of Technology, Japan  
We propose a method for evaluation of image quality for whole slide imaging system by eliminating false detection due to tissue artefacts. The method enables more efficient and reliable detection of slides to rescans or to score scanned image.

**BISCp6-28**

**Speckle reconstruction based on oversampling smoothness algorithm**

Hui Chen, Yesheng Gao, Xingzhao Liu  
Shanghai Jiao Tong University, China  
Target object image would deteriorate into unrecognizable speckle pattern when encountering with scattering media. In this paper, a method combining correlation method and oversampling smoothness is proposed. It is used for target object reconstruction from scattered speckle pattern.

**BISCp6-29**

**Speckle reconstruction method based on machine learning**

Hui Chen, Yesheng Gao, Xingzhao Liu  
Shanghai Jiao Tong University, China  
Scattering media would deteriorate an object image into unrecognizable speckle pattern. Support vector classification and support vector regression is utilized to reconstruct the object image from speckle pattern.

**BISCp6-30**

**Fractality of biospeckle pattern observed in blood coagulation process**

Naomichi Yokoi<sup>1</sup>, Yoshihisa Aizu<sup>2</sup>, Jun Uozumi<sup>3</sup>  
<sup>1</sup>National Institute of Technology, Asahikawa College, Japan, <sup>2</sup>Muroran Institute of Technology, Japan, <sup>3</sup>Hokkai-Gakuen University, Japan  
It has been known that speckle images observed for living bodies illuminated by laser light sometimes show fractal appearances. In this study, we investigate fractality of biospeckle pattern observed in coagulation process of horse blood.

**BISCp6-31**

**Computational ghost imaging by using complementary illumination patterns**

Jung-Ping Liu  
Feng Chia University, Taiwan  
We proposed to use complementary illumination patterns to perform CGI. In addition, we applied Gerchberg-Saxton-like algorithm to optimize the reconstructed image. By this way, the signal-to-noise ratio (SNR) can be significantly reduced.

**BISCp6-32**

**Preliminary study on X-ray phase-contrast imaging with tilted-grid**

Myung-Joon Kwack, Sooyeul Lee, Seung-hoon Chae  
ETRI, Korea, Republic of  
We present preliminary experimental results of X-ray phase-contrast imaging with tilted-grid. Two-dimensional phase gradient information of a PMMA phantom is successfully defined by employing the tilted-grid in a conventional X-ray imaging setup.

**BISCp6-33**

Withdrawn

**BISCp6-34**

**Implementation of a Raspberry-Pi-based LED array microscope for multi-contrast images**

Hideobu Arimoto<sup>1</sup>, Wataru Watanabe<sup>2</sup>  
<sup>1</sup>AIST, Japan, <sup>2</sup>Ritsumeikan University, Japan  
The light emitting diode (LED) array microscope enables various multi-contrast imaging such as bright-field, dark-field and differential phase-contrast by various illumination patterns without any expensive optical components.

**BISCp6-35**

**Image acquisition with smartphone-based LED array microscope**

Kazuko Koda<sup>1</sup>, Shu Uenoyama<sup>1</sup>, Ryo Sugimoto<sup>1</sup>, Ryoji Maruyama<sup>1</sup>, Hideobu Arimoto<sup>2</sup>, Wataru Watanabe<sup>1</sup>  
<sup>1</sup>Ritsumeikan University, Japan, <sup>2</sup>AIST, Japan  
The light emitting diode (LED) array microscope enables various multi-contrast imaging such as bright-field, dark-field and differential phase-contrast (DPC) by various illumination patterns without any expensive optical components.

**BISCp6-36**

**Scan-less, line-filed, confocal phase imaging with dual-comb microscopy**

Eiji Hase<sup>1,2</sup>, Takeo Minamikawa<sup>1,2</sup>, Yasuhiro Mizutani<sup>2,3</sup>, Tetsuo Iwata<sup>2,4</sup>, Hirotugu Yamamoto<sup>2,5</sup>, Takeshi Yasui<sup>2,4</sup>  
<sup>1</sup>Tokushima Univ., Japan, <sup>2</sup>JST, ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS), Japan, <sup>3</sup>Osaka Univ., Japan, <sup>4</sup>Tokushima Univ., Japan, <sup>5</sup>Utsunomiya Univ., Japan  
We constructed the scan-less, line-field, confocal microscopy with the phase-contrast modality by a combination of wavelength-to-space-conversion optical frequency comb with dual-comb spectroscopy, and then demonstrate the proof-of-principle experiment of the scan-less confocal phase line-imaging.

**BISCp6-37**

**Visual search efficiency depending on spatial layout of stimuli in volumetric image**

T. Pladere, V. Konosonoka, K. Panke, G. Krumina  
University of Latvia, Latvia  
The spatial layout of stimuli in horizontal and vertical dimension had a bigger impact on visual search performance comparing to the third dimension on a volumetric multi-planar display, also reflected in the subjective difficulty evaluation.

**BISCp6-38**

**Real-time detection of 192Ir gamma-ray source positon using organic scintillator array sensor in HDR brachytherapy**

Young Beom Song, Bongsoo Lee, Sang Hun Shin  
Chung-Ang University, Korea, Republic of  
In this study, we fabricated an organic scintillator array sensor (OSAS) based the array of organic scintillators. The scintillator array of OSAS for detecting positions of 192Ir gamma-ray source was fabricated using four types of organic scintillators, which emit the scintillating lights of different wavelength, respectively.

**BISCp6-39**

**Electron beam addressable potentiometric sensor for ion distribution imaging with high resolution**

Wataru Inami, Yoshimasa Kawata  
Shizuoka Univ, Japan  
We have developed an electron beam addressable potentiometric sensor to improve the spatial resolution. Ion sensors are widely used in the fields of medical and life science, food and material development, environmental protection and so on. However, the spatial resolution of the ion distribution imaging sensor is limited by the diffraction limit of light or microfabrication technology.

**BISCp6-40**

**Design of add-on optics for optimization of cot endoscope camera for epiduroscopic surgery**

Khanh Phuong Tran  
Intelligent Systems Research Institute, Korea, Republic of  
This paper presents a method for designing an add-on lens assembly to optimize the performance of Chip-on-the-Tip (COT) endoscope. In particular, an add-on lens assembly is designed here attributes to a commercially available COT camera, NanEye, in such that provides a FOV of 110° and DOF of 1.5 mm to 8 mm under the refractive index of water.

**BISCp6-41**

**Disturbance location algorithm of the single-core fiber optic sensor based on frequency domain**

Haiyan Xu, Yingjuan Xie  
Hohai Univ, China  
A novel distributed fiber-optic sensor based on Wavelength Division Multiplex (WDM) for determining the position of disturbances is presented. Theory analysis and experiment results show that the proposed algorithm can realize the detection and location of the multipoint disturb signals rapidly and effectively.

**BISCp6-42**

**Design optimization of a single-mode microring resonator for label-free detection of biomarkers within a tunable spectral range of 2 nm**

Prabodh Panindre<sup>1</sup>, N. S. Susan Mousavi<sup>2</sup>, Sunil Kumar<sup>1,3</sup>  
<sup>1</sup>New York University, USA, <sup>2</sup>Institute for Research in Fundamental Sciences, Iran, <sup>3</sup>New York University Abu Dhabi, UAE  
The electromagnetic frequency domain parametric analysis using finite element numerical technique quantifies the effect of geometrical design parameters of microring resonator on its optical characteristics to optimize its performance for label-free detection of nano-biomarkers.

## Poster Session &lt;Exhibition Hall A&gt;

Friday, 27 April

BISCP6 13:00-14:30

LICp6 13:30-14:30

**BISCP6-43****Low dose of narrow-band ultraviolet B lamp for improving vitamin D synthesis with minimum skin damage**

Lin Yu-Hsuan<sup>1</sup>, Yi-Wen Chiu<sup>2,3</sup>, Ming-Yen Lin<sup>2,3</sup>, Siao-Ping Tsai<sup>2</sup>, Feng-Xuan Jian<sup>3</sup>, Shang-Jyh Hwang<sup>2,3</sup>, Kuo-Cheng Huang<sup>1</sup>  
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This study proposes that the UV irradiation with a wavelength of 310-320 nm can effectively improve the vitamin D synthesis and minimize the skin damage.

**BISCP6-44****Photostability study of CdTe quantum dots using laser induced fluorescence**

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Semiconductor quantum dots (QDs) having high quantum yields and unique photostability. This research studies the optical properties of the synthesized CdTe QDs with two different sizes using Laser-induced fluorescence (LIF) for investigating their photostability.

**BISCP6-45****Edge contrast enhancement at multiple planes using Forked Shaped defocus grating**

Sunil Vyas, Chen Yen Lin, Yuan Luo  
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We report on the implementation of spiral phase contrast imaging at multiple planes using forked-shaped defocus grating. The dual function of grating helps in simultaneous generation of multiple edge enhanced images corresponding to different depths.

**BISCP6-46****Orthogonal functional system for finite Fresnel transform**

Tomohiro Aoyagi, Kouichi Ohtsubo, Nobuo Aoyagi  
 Toyo University, Japan

The Fresnel transform has been studied mathematically and revealed the topological properties in Hilbert space. Main aim is to reveal the property of band-limited function. We seek the function that its total power is maximized in finite Fresnel transform plane, on condition that an input signal is zero outside the bounded region.

**BISCP6-47****Nanoscale three-dimensional imaging of biological tissue with X-ray holographic tomography**

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Enabling exploration of biological tissue in three-dimensions at sub-cellular scale is instrumental for advancing our understanding of biological systems and for finding better ways to cope with diseases. Over the last few years, remarkable advances in microscopy facilitated probing cells and tissues at the nanometer scale but many limitations are yet to be overcome. Here we present a novel technique which enables label-free volume imaging of biological tissue with pixel sizes down to 25 nm while maintaining extensive sample coverage. X-ray holographic nanotomography is a full-field 3D imaging technique which benefits from the deep penetration of X-rays and the powerful mechanism of phase contrast. By using cryogenic sample preservation, the tissue can be investigated close to the native state. The unprecedented data created by this technique opens new avenues in life sciences research.

**LICp6-1****A high-peak power passively Q-switched Nd:YAG/Cr4+:YAG compact laser with multiple-beam output**

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 National Institute for Laser, Plasma and Radiation Physics - INFLEPR, Romania

A diode-pumped, passively Q-switched, compact and monolithic Nd:YAG/Cr4+:YAG ceramic laser with four-beam output is presented. The energy of each laser pulse could be increased up to 5.9 mJ at pulse duration around 1 ns.

**LICp6-2****Development of high-brightness high-energy micro-MOPA**

Vincent Yahia, Takunori Taira  
 Institute for Molecular Science, Japan

Ultra-compact MOPA for high-energy laser pulses is developed. Gain aperture is used for production of near-gaussian pulses, with brightness of 18 PW/sr/cm<sup>2</sup>. We propose the end-pumped DFC medium as an alternative to side-pumped rod-type amplifier.

**LICp6-3****Study on laser threshold of CuO/Al nanowires composite**

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In this paper, the CuO nanowires cores were served as templates for the deposition of Al shells by subsequent magnetron sputtering to get the CuO/Al. The threshold laser ignition energy was performed of CuO/Al nanowires

**LICp6-4****Laser ignition in compact engines: two-stroke and Wankel**

Egor Y. Loktionov, Nikita A. Pasechnikov, Victor D. Telekh  
 Bauman Moscow State Technical University, Russia

We have investigated possible benefits of laser ignition in two-stroke and Wankel 1 hp scale model engines using different kinds of fuel mixtures: hydrogen, methane, propane, butane, gasoline and ethanol based.

**LICp6-5****Effect of discharge lengths on combustion characteristics in laser breakdown-assisted long-distance discharge ignition**

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Pressure histories of LBALDI with various electrode gaps were acquired for methane/air mixture in a vessel with constant volume. Faster combustion was observed for a longer electrode distance in the lean mixture.

**LICp6-6****Ultrafast shock evolution phenomena generated by laser ablation of Al-based metal films**

Yuan Gao, Wenzhi Qin, Zhihao Wang, Xiangbo Ji, Duo Tang, Yong Li, Liang Wang  
 Institute of Chemical Materials, CAEP, China

We investigate the ultrafast phenomena of Nd:YAG laser ablation of Al films with and without Ti layer by a time-resolved nanosecond-shadowgraph technique.

**LICp6-7****Q-switched laser oscillation in polycrystalline Yb:FAP anisotropic laser ceramics**

Yoichi Sato, Jun Akiyama, Takunori Taira  
 Institute for Molecular Science, Japan

Using polycrystalline Yb3+-doped fluoroapatite (Yb:FAP), we investigated the process control with quantum mechanics for anisotropic laser ceramics. Kilowatt-level sub-ns laser pulses were generated from orientation-controlled microdomains with the extraction density of 0.34 J/cm<sup>3</sup>.

**LICp6-8****Theoretical study on the mechanism of sub-ns giant-pulse laser induced air-breakdown due to cascade ionization**

Hwan Hong Lim, Takunori Taira  
 Institute for Molecular Science, Japan

We proposed a rate equation of free electron density induced by laser due to cascade ionization. The simulation results were used to analyze the pulse-width scaling law of air-breakdown threshold intensity for laser ignition application.

**LICp6-9****Optimization of CW operation in distributed face cooling**

Arvydas Kausas, Lihe Zheng, Takunori Taira  
 Institute for Molecular Science, Japan

A Distributed Face Cooling chip which consist or periodic Sapphire and Nd3+:YAG crystals is introduced. The chip is made of 11 crystals by surface activated bonding technology at room temperature. CW operation was compared to conventional Nd3+:YAG rod laser with same gain length. Twice the output power was obtained in DFC chip.

**LICp6-10****Single-crystal intermediate laser coating (SILC) for high-field polycrystalline ceramics laser**

Lihe Zheng, Takunori Taira  
 Institute for Molecular Science, Japan

LiDT fluence of new coating solution named single-crystal intermediate laser coating (SILC) on single crystal got one order higher enhancement compared with that on polycrystalline ceramics, opening new research field for high-field polycrystalline ceramics laser.

**LICp6-11****Development of Cr:YAG/Nd:YAG ceramics pulse laser chip**

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Ceramics laser medium was promising for a light source of new applications. We developed a transparent YAG ceramics. And mm3-size Cr:YAG/Nd:YAG composite were fabricated. A composite with mirror at both sides was excited by 808 nm Laser-Diode and Q-switched laser oscillation was confirmed.

**LICp6-12****Analysis of the amplifier for PW/sr/cm<sup>2</sup> class Micro-MOPA**

Taisuke Kawasaki, Vincent Yahia, Takunori Taira  
 Institute for Molecular Science, JAPAN

Thermal lens problem of PW/sr/cm<sup>2</sup>-class Micro-MOPA was discussed. In order to realize 100 Hz operation, we evaluated thermal lens effect in highly excited Nd:YAG-rod of 200mJ Micro-MOPA.