

# **2013 International Conference on Optical MEMS and Nanophotonics**

**(OMN 2013)**

**Kanazawa, Japan  
18 – 22 August 2013**



**IEEE Catalog Number: CFP13MOE-POD  
ISBN: 978-1-4799-1155-4**

# Optical MEMS & Nanophotonics 2013 Program

## MONDAY, AUGUST 19

8:45 Opening

### 8:55 MM-S1 Plenary Session

Session Chair: Minoru Sasaki (Toyota Technical Institute, Japan)

#### MM-S1.1

##### PLENARY TALK

CONTROLLING PHOTONS IN MESOSCOPIC SYSTEMS: PRECISION MEASUREMENTS  
IN FREQUENCY COMBS AND OPTOMECHANICS.....1

Chee Wei Wong

Columbia University, USA

#### MM-S1.2

##### PLENARY TALK

OPTICAL MEMS AND NANOPHOTONICS IN SAMSUNG ELECTRONICS .....3

Hyung Choi, Minseog Choi, Dongsik Shim and Sung Hyun Nam

Samsung Advanced Institute of Technology, Korea

### Coffee Break

### 10:15 MM-S2 Imaging Devices

Session Chair: Jer-Liang Andrew Yeh (National Tsing Hua University, Taiwan)

#### MM-S2.1

##### INVITED TALK

IMPLANTABLE MICRO CMOS IMAGING DEVICES FOR BIOMEDICAL APPLICATIONS.....5

Jun Ohta, Toshihiko Noda, Kiyotaka Sasagawa and Takashi Tokuda

Nara Institute of Science and Technology, Japan

#### MM-S2.2

FORWARD-VIEWING ENDOSCOPIC OCT CATHETER USING ASYMMETRICALLY

RESONANT FIBER SCANNER.....7

Hyeon-Cheol Park<sup>1</sup>, Yeong-Hyeon Seo<sup>1</sup>, Seung-Bum Yang<sup>1</sup>, Minseog Choi<sup>2</sup>, Seungwan Lee<sup>2</sup>,  
Woonbae Kim<sup>2</sup> and Ki-Hun Jeong<sup>1</sup>

<sup>1</sup>Korea Advanced Institute of Science and Technology (KAIST), Korea, <sup>2</sup>Samsung Advanced  
Institute of Technology (SAIT), Korea

<b>MM-S2.3</b>	
<u>TUNABLE CONFOCAL HYPERSPSPECTRAL IMAGING SYSTEM .....</u>	<u>9</u>
Phuong-Ha Cu-Nguyen <sup>1</sup> , Adrian Grewe <sup>2</sup> , Stefan Sinzinger <sup>2</sup> , Hans Zappe <sup>1</sup> and Andreas Seifert <sup>1</sup>	
<sup>1</sup> University of Freiburg, IMTEK, Germany, <sup>2</sup> Ilmenau University of Technology, Germany	

<b>MM-S2.4</b>	
<u>TUNABLE CAT'S EYE RETRO-REFLECTOR ARRAY AS AN OPTICAL IDENTIFICATION TAG.....</u>	<u>11</u>
Ming-chun Su, Chih-chieh Chang, Yu-cheng Yang and Jui-che Tsai National Taiwan University, Taiwan	

<b>MM-S2.5</b>	
<u>AN ELECTROTHERMAL/ELECTROSTATIC DUAL DRIVEN MEMS SCANNER WITH LARGE IN-PLANE AND OUT-OF-PLANE DISPLACEMENT.....</u>	<u>13</u>
Xiaoyang Zhang <sup>1</sup> , Lin Liu <sup>1</sup> , Wenxuan Liang <sup>2</sup> , Xingde Li <sup>2</sup> and Huikai Xie <sup>1</sup>	
<sup>1</sup> University of Florida, USA, <sup>2</sup> John Hopkins University, USA	

<b>MM-S2.6</b>	
<u>A MEMS INTERACTIVE LASER PROJECTION DISPLAY WITH A BUILT-IN LASER RANGE FINDER.....</u>	<u>15</u>
Sungho Jeon <sup>1</sup> , Hiroyuki Fujita <sup>2</sup> and Hiroshi Toshiyoshi <sup>1</sup>	
<sup>1</sup> The University of Tokyo, Japan, <sup>2</sup> Institute of Industrial Science, The University of Tokyo, Japan	

<b>MM-S2.7</b>	
<u>THERMOELECTRICALLY CONTROLLED VARIFOCAL MICROMIRROR FOR NEAR ABERRATION FREE IMAGING .....</u>	<u>17</u>
Li Li, Ran Li, Walter Lubeigt and Deepak Uttamchandani University of Strathclyde, UK	

**Lunch**

**13:30 MA-S1 Electrostatic Actuation**

Session Chair: Dan Marom (Hebrew University of Jerusalem, Israel)

<b>MA-S1.1</b>	
<u>A PHYSICAL MODELING AND LONG-TERM MEASUREMENT OF TILTING ANGLE DRIFT CAUSED BY DIELECTRIC SURFACE CHARGING IN MEMS MICROMIRRORS.....</u>	<u>19</u>
Mitsumasa Nakajima, Kei Kuwabara, Takako Ishihara, Tomomi Sakata, Mitsuo Usui, Naru Nemoto, Etsu Hashimoto, Joji Yamaguchi, Shingo Uchiyama and Yoshito Jin NTT Microsystem Integration Laboratories, Japan	

**MA-S1.2**  
A TIME-MULTIPLEXED ELECTROSTATIC DRIVE AND SAMPLE INTERFACE CIRCUIT FOR MEMS OPTICAL SCANNERS .....21  
 Satoshi Maruyama<sup>1</sup>, Toshifumi Konishi<sup>2,3</sup>, Katsuyuki Machida<sup>2,3</sup>, Noboru Ishihara<sup>3</sup>, Kazuya Masu<sup>3</sup>, Hiroyuki Fujita<sup>1</sup> and Hiroshi Toshiyoshi<sup>1</sup>  
<sup>1</sup>Institute of Industrial Science, The University of Tokyo, Japan, <sup>2</sup>NTT Advanced Technology Corp., Japan, <sup>3</sup>Tokyo Institute of Technology, Japan

**MA-S1.3**  
HIGH-REFLECTIVITY, BROADBAND MONOLITHIC SILICON PHOTONIC CRYSTAL MIRRORS ON TWO-AXIS MEMS SCANNER BY TRANSFER-PRINTING .....23  
 Jae-Woong Jeong<sup>1,2</sup>, Bryan Park<sup>1</sup>, Hohyun Keum<sup>2</sup>, Seok Kim<sup>2</sup>, John A. Rogers<sup>2</sup> and Olav Solgaard<sup>1</sup>  
<sup>1</sup>Stanford University, USA, <sup>2</sup>University of Illinois at Urbana-Champaign, USA

**MA-S1.4**  
HIGH CONTRAST, CRYOGENIC, LARGE MICROMIRROR ARRAY FOR MULTI-OBJECT SPECTROSCOPY .....25  
 Frederic Zamkotsian<sup>1</sup>, Michael Canonica<sup>2,3</sup>, Patrick Lanzoni<sup>1</sup> and Wilfried Noell<sup>2</sup>  
<sup>1</sup>Laboratoire d'Astrophysique de Marseille - CNRS, France, <sup>2</sup>Ecole Polytechnique Fédérale de Lausanne, Switzerland, <sup>3</sup>MIT, USA

**MA-S1.5**  
ASSEMBLY OF 3D MEMS MIRRORS AND SCANNERS USING COMPLIANT PUSH PADS .....27  
 Yi Chiu, Yan-Ting Wu and Hao-Chiao Hong  
 National Chiao Tung University, Taiwan

**Coffee Break**

**15:15 MA-S2 Lenses**  
 Session Chair: Hans Zappe (University of Freiburg, Germany)

**MA-S2.1**  
ALIGNMENT TOLERANCES OF MEMS ALVAREZ LENSES .....29  
 Yongchao Zou, Guangya Zhou, Yu Du and Fook Siong Chau  
 National University of Singapore, Singapore

**MA-S2.2**  
ARTIFICIAL COMPOUND EYE WITH FRACTAL ZONE PLATE ARRAYS .....31  
 Dongmin Keum and Ki-Hun Jeong  
 Korea Advanced Institute of Science and Technology, Korea

**MA-S2.3**

ASYMMETRIC MICROSTRUCTURES FOR HIGH LIGHT EXTRACTION AND LIGHT  
PATTERN MODULATION.....33

Jae-Jun Kim, Dongmin Keum and Ki-Hun Jeong  
Korea Advanced Institute of Science and Technology, Korea

**MA-S2.4**

FABRICATION AND CHARACTERIZATION OF THIN-FILM NANOSTRUCTURED  
LUENEURG LENS.....35

Chih-Hung Hsieh<sup>1</sup>, Jun Xu<sup>1</sup> Hanhong Gao<sup>1</sup>, Nicholas X. Fang<sup>1</sup> and George Barbastathis<sup>1,2</sup>  
<sup>1</sup>Massachusetts Institute of Technology, USA., <sup>2</sup>Singapore-MIT Alliance for Research and  
Technology (SMART) Centre, Singapore

**Excursion:**

**Group A: Nagamachi Samurai District**

**Group B: Kanazawa Castle Park**

# TUESDAY, AUGUST 20

## 8:40 TM-S1 Light Emissions

Session Chair: Wibool Piyawattanametha (Chulalongkorn University, Thailand)

### TM-S1.1

#### INVITED TALK

WAVELENGTH ENGINEERING OF VCSELS BASED ON MEMS TECHNOLOGIES.....37

Fumio Koyama

Tokyo Institute of Technology, Japan

### TM-S1.2

#### FABRICATION AND CHARACTERIZATION OF NANO-APERTURE VCSELS FOR

10 TB/IN<sup>2</sup> MAGNETIC STORAGE DENSITIES .....39

Sajid Hussain, C.S. Bhatia, Hyunsoo Yang and Aaron J. Danner

National University of Singapore, Singapore

### TM-S1.3

#### EXPERIMENTAL STUDY ON NANOSCALE TEMPERATURE MEASUREMENT METHOD

USING ROTATION OF NEAR-FIELD POLARIZATION.....41

Jumpei Nitta, Sho Kishimoto, Yoshihiro Taguchi, Toshiharu Saiki and Yuji Nagasaka

Keio University, Japan

### TM-S1.4

A MICROPLASMA CHIP FOR RADICAL MONITOR.....43

Ryoto Sato<sup>1</sup>, Daisuke Yasumatsu<sup>1</sup>, Shinya Kumagai<sup>1</sup>, Masaru Hori<sup>2</sup> and Minoru Sasaki<sup>1</sup>

<sup>1</sup>Toyota Technological Institute, Japan

<sup>2</sup>Nagoya University, Japan

### TM-S1.5

#### SURFACE PLASMON POLARITON BASED WAVELENGTH SELECTIVE IR EMITTER

COMBINED WITH MICROHEATER.....45

Takahiro Sawada<sup>1</sup>, Katsuya Masuno<sup>2</sup>, Shinya Kumagai<sup>1</sup>, Makoto Ishii<sup>2</sup>, Shouichi Uematsu<sup>2</sup>  
and Minoru Sasaki<sup>1</sup>

<sup>1</sup>Toyota Technical Institute, Japan

<sup>2</sup>Yazaki Corporation, Japan

## Coffee Break

## 10:35 TM-S2 Sensing

Session Chair: Guangya Zhou (National University, Singapore)

### TM-S2.1

#### INVITED TALK

POLYMER OPTICAL MEMS INTEGRATED ON VCSELS FOR BIOSENSING.....47

Véronique Bardinal<sup>1,2</sup>, Thierry Camps<sup>1,3</sup>, Benjamin Reig<sup>1,2</sup>, Jean-Baptiste Doucet<sup>1,2</sup>,  
Sami Abada<sup>1,2</sup> and E. Daran<sup>1,2</sup>

<sup>1</sup>CNRS, LAAS, France, <sup>2</sup>Université de Toulouse, LAAS, France, <sup>3</sup>Université de Toulouse,  
UPS, LAAS, France

### TM-S2.2

MONOLITHIC PHOTONIC CRYSTAL-BASED FIBER-TIP FABRY-PÉROT STATIC

PRESSURE SENSOR.....49

Xuan Wu, Catherine Jan and Olav Solgaard  
Stanford University, USA

### TM-S2.3

SELF-ALIGNED MICROBONDING TECHNIQUE FOR MAKING BUTT-COUPLED

GERMANIUM METAL-SEMICONDUCTOR-METAL WAVEGUIDE PHOTODETECTORS.....51

Wei-Ting Chen, Chih-Kuo Tseng, Ku-Hung Chen, Neil Na and Ming-Chang M. Lee  
Institute of Photonics Technologies, National Tsing Hua University, Taiwan

### TM-S2.4

A REVIEW OF MEMS SCANNER BASED ENDOSCOPIC OPTICAL IMAGING PROBE.....53

Wibool Piyawattanametha<sup>1,2</sup>

<sup>1</sup>National Electronics and Computer Technology Center, Thailand

<sup>2</sup>Chulalongkorn University, Thailand

### TM-S2.5

ALTERATION BY REPEATED ELECTROSTATIC MEMS ACTUATION OF THE

THERMOLUMINESCENCE OF THIN FILMS.....55

Merlin L. Mah, Philip R. Armstrong and Joseph J. Talghader  
University of Minnesota, USA

### TM-S2.6

RESONANT CAVITY COUPLED INFRARED DETECTORS WITH HIGH DETECTIVITY

OPERATING AT ROOM TEMPERATURE.....57

Anand S. Gawarikar, Ryan P. Shea and Joseph J. Talghader  
University of Minnesota, USA

## Lunch

## **13:35 TA-S1 Wavelength Selective Devices**

Session Chair: Joseph Talghader (University of Minnesota, USA)

### **TA-S1.1**

#### INVITED TALK

MINIATURIZED MOEMS SPECTROMETER TECHNOLOGY FOR GAS SENSING.....59

Jarkko Antila, Anna Rissanen, Rami Mannila, Jussi Mäkynen, Ismo Näkki  
and Mikko Tuohiniemi  
VTT Technical Research Centre, Finland

### **TA-S1.2**

WAVELENGTH SELECTIVE UNCOOLED INFRARED SENSOR USING  
TRIANGULAR-LATTICE PLASMONIC ABSORBERS.....61

Shinpei Ogawa<sup>1</sup>, Junya Komoda<sup>2</sup>, Kyohei Masuda<sup>2</sup>, Yousuke Takagawa<sup>2</sup>  
and Masafumi Kimata<sup>2</sup>  
<sup>1</sup>Mitsubishi Electric Corporation, Japan, <sup>2</sup>Ritsumeikan University, Japan

### **TA-S1.3**

VERTICAL FIELD ENHANCED NANOSTRUCTURE FOR QUANTUM WELL INFRARED  
PHOTODETECTOR THROUGH GERMANIUM SUBWAVELENGTH ARRAYS.....63

Wei Dong<sup>1,2</sup>, Toru Hirohata<sup>1</sup>, Kazutoshi Nakajima<sup>1</sup> and Xiaoping Wang<sup>2</sup>  
<sup>1</sup>Hamamatsu Photonics K. K., Japan  
<sup>2</sup>Zhejiang University, China

### **TA-S1.4**

MIRRORS AND ANTI-REFLECTIVE SURFACES IN SINGLE CRYSTAL SILICON BY  
PATTERNING OF THE SILICON SURFACE .....65

Sanja Hadzialic and Maaikje M. Visser Taklo  
SINTEF ICT, Norway

## **Coffee Break**

## **15:15 TA-S2 Micromirrors**

Session Chair: Hiroshi Miyajima (Olympus, Japan)

### **TA-S2.1**

DESIGN AND FABRICATION OF AN ELECTROMAGNETICALLY ACTUATED OPTICAL  
SWITCH WITH PRECISE TILT ANGLE CONTROL .....67

Victor Farm-Guoo Tseng, Jiping Li, Xiaoyang Zhang and Huikai Xie  
University of Florida, USA

### **TA-S2.2**

INTEGRATION OF ANGULAR RATE SENSOR ON LARGE DEFLECTION  
POLYMER-MEMS MIRROR .....69

Hirofumi Yamashita, Kyohei Terao, Hidekuni Takao, Fusao Shimokawa, Fumikazu Oohira  
and Takaaki Suzuki  
Kagawa University, Japan



**TA-S2.3**

MAGNETICALLY ACTUATED SWING-TYPE MICROMIRROR .....71

Hsu-Tang Chang, Chun-Wei Tsai, Shih-Hsiang Liu and Jui-che Tsai  
National Taiwan University, Taiwan

**TA-S2.4**

MEMS WAVELENGTH-SELECTIVE SWITCH INCORPORATING LIQUID CRYSTAL  
SHUTTERS FOR ATTENUATION AND HITLESS OPERATION.....73

Uri Arad<sup>1</sup>, Yossi Corem<sup>1</sup>, Boris Frenkel<sup>1</sup>, Valery Deich<sup>1</sup>, Jonathan Dunayevsky<sup>1</sup>, Roey Harel<sup>2</sup>,  
Peter Janosik<sup>2</sup>, Gil Cohen<sup>2</sup> and Dan M. Marom<sup>3</sup>

<sup>1</sup>Oclaro Corp., Israel <sup>2</sup>Oclaro Corp., USA, <sup>3</sup>Hebrew University, Israel

**Excursion:**

**Group A: Kanazawa Castle Park**

**Group B: Nagamachi Samurai District**

# WEDNESDAY, AUGUST 21

## 8:40 WM-S1 Bio-applications I

Session Chair: Ki-Hun Jeong (KAIST, Korea)

### WM-S1.1

#### INVITED TALK

CELL LEGO .....75

Hiroo Iwata

Kyoto University, Japan

### WM-S1.2

DIRECT NUCLEAR DELIVERY OF DNA MACROMOLECULES USING  
THE PHOTOTHERMAL NANOBLADE.....77

Ting-Hsiang Wu, Yi-Chien Wu, Enrico Sagullo, Michael A. Teitell and Pei-Yu Eric Chiou

University of California, Los Angeles, USA

### WM-S1.3

OPTOELECTRONIC TWEEZERS INTEGRATED WITH 3D MICROFLUIDIC  
NETWORKS .....79

Kuo-Wei Huang<sup>1</sup>, Yu-Chun Kung<sup>1</sup>, Yi-Chien Wu<sup>1</sup>, Yu-Jui Fan<sup>2</sup> and Pei-Yu Chiou<sup>1</sup>

<sup>1</sup>University of California at Los Angeles, USA, <sup>2</sup>National Taiwan University, Taiwan

### WM-S1.4

FLUOROMETRIC GAS-PHASE BIOSENSOR (BIO-SNIFFER) WITH UV-LED  
EMISSION LIGHT FOR FORMALDEHYDE VAPOR .....81

Ye Ming<sup>1</sup>, Tomoko Gessei<sup>1,2</sup>, Kumiko Miyajima<sup>1</sup>, Munkhbayar Munkhjargal<sup>1</sup>, Takahiro

Arakawa<sup>1</sup> and Kohji Mitsubayashi<sup>1</sup>

<sup>1</sup>Institute of Biomaterials and Bioengineering, Tokyo Medical and Dental University, Japan,

<sup>2</sup>Tokyo Metropolitan Industrial Technology Research Institute, Japan

### WM-S1.5

MICRO-SCANNING MIRRORS FOR HIGH-POWER LASER APPLICATIONS IN LASER  
SURGERY .....83

Thilo Sandner<sup>1</sup>, Simon Kimme<sup>1</sup>, Thomas Grasshoff<sup>1</sup>, Ulrich Todt<sup>1</sup>, Alexander Graf<sup>1</sup>,

Christian Tulea<sup>2</sup>, Achim Lenenbach<sup>2</sup> and Harald Schenk<sup>1</sup>

<sup>1</sup>Fraunhofer Institute for Photonic Microsystems (IPMS), AMS, Dresden, Germany,

<sup>2</sup>Fraunhofer Institute for Laser Technology (ILT), Aachen, Germany

## Coffee Break

## 10:35 WM-S2 Waveguides

Session Chair: George Barbastathis (MIT, USA)

### WM-S2.1

#### INVITED TALK

SILICON-ORGANIC HYBRID (SOH) TECHNOLOGY: A PLATFORM FOR EFFICIENT ELECTRO-OPTICAL DEVICES .....85

C. Koos<sup>1,2</sup>, J. Leuthold<sup>3</sup>, W. Freude<sup>1,2</sup>, L. Alloatti<sup>1</sup>, R. Palmer<sup>1</sup>, D. Korn<sup>1</sup>, J. Pfeifle<sup>1</sup>, P. C. Schindler<sup>1</sup> and M. Lauermann<sup>1,2</sup>

<sup>1</sup>Institute of Photonics and Quantum Electronics (IPQ), Karlsruhe Institute of Technology (KIT), Germany, <sup>2</sup>Institute of Microstructure Technology (IMT), Karlsruhe Institute of Technology (KIT), Germany, <sup>3</sup>ETH Zurich, Switzerland

### WM-S2.2

TRANSMISSION WIDTH (Q-FACTOR) TUNABLE SILICON-PHOTONIC MICRO-RING RESONATORS .....87

Mustafa Ordu, Yoshiaki Kanamori, Kazuhiro Hane  
Tohoku University, Japan

### WM-S2.3

OPTICAL MICRORING RESONATORS IN LITHIUM NIOBATE FOR CLASSICAL AND QUANTUM MICROWAVE PHOTONICS .....89

Deng Jun<sup>1,2</sup>, Sajid Hussain<sup>1</sup>, Soham Saha<sup>1</sup>, Ching Eng Png<sup>2</sup>, Mankei Tsang<sup>1</sup> and Aaron J. Danner<sup>1</sup>

<sup>1</sup>National University of Singapore, Singapore, <sup>2</sup>Institute of High Performance Computing, Agency for Science, Technology and Research, Singapore

### WM-S2.4

THERMALLY TUNABLE PHOTONIC DUAL-DISK RESONATOR WITH WIDE OPERATION RANGE .....91

Bo Li, Chong Pei Ho and Chengkuo Lee  
National University of Singapore, Singapore

### WM-S2.5

MICRO-CHANNEL DEVICE FOR SPECTRUM MEASUREMENT USING OPTICAL FIBER ALIGNED WITH BIAS SPRING WITH REVERSELY TAPERED PROFILE .....93

Hikaru Imura, Dinghuan Deng, Shinya Kumagai, Yasutake Ohishi and Minoru Sasaki  
Toyota Technical Institute, Japan

### WM-S2.6

SIDE-POLISHED FIBER OPTOFLUIDIC ATTENUATOR BASED ON ELECTROWETTING-ON-DIELECTRIC ACTUATION .....95

Anna Duduś, Robert Blue, Michele Zagnoni and Deepak Uttamchandani  
University of Strathclyde, UK

## Lunch

## 13:45 WA-S1 Bio-applications II

Session Chair: Chengkuo Lee (National University of Singapore)

### WA-S1.1

#### INVITED TALK

IMPLANTABLE DEVICES FOR OPTICAL NEURAL INTERFACES.....97

T.V.F. Abaya, M. Diwekar, S. Blair, P. Tathireddy, L. Rieth and F. Solzbacher  
University of Utah, USA

## 14:10 WA-P Poster Presentation

Session Chair: Chengkuo Lee (National University of Singapore)

### WA-P.1

2D MEMS SCANNER WITH A ROTATION-ANGLE DETECTOR FOR A TIME-OF-FLIGHT  
IMAGE SENSOR.....99

I. Aoyagi, K. Hamaguchi, Y. Nonomura and T. Akashi  
Toyota Central R&D Labs Inc., Japan

### WA-P.2

DUAL-AXIS POLYMER-MEMS MIRROR MADE OF PHOTSENSITIVE  
NANOCOMPOSITE .....101

Junya Suzuki<sup>1</sup>, Takuya Miura<sup>1</sup>, Kyohei Terao<sup>1</sup>, Hidekuni Takao<sup>1</sup>, Fusao Shimokawa<sup>1</sup>, Takahiro  
Namazu<sup>2</sup>, Fumikazu Oohira<sup>1</sup> and Takaaki Suzuki<sup>1</sup>  
<sup>1</sup>Kagawa University, Japan, <sup>2</sup>University of Hyogo, Japan

### WA-P.3

QUASI-STATIC MICROSCANNER WITH LINEARIZED SCANNING FOR AN ADAPTIVE  
3D-LASERCAMERA .....103

Thilo Sandner, Thomas Grasshoff, Markus Schwarzenberg and Harald Schenk  
Fraunhofer Institute for Photonic Microsystems (IPMS), Germany

### WA-P.4

SURFACE-MICROMACHINED MEMS CORNER CUBE RETRO-REFLECTOR ARRAY.....105

Yu-fan Chen, Hsu-tang Chang, Bo-jiun Chen and Jui-che Tsai  
National Taiwan University, Taiwan

### WA-P.5

A 3.3V OPERATED VARIABLE TRANSMISSION ATTENUATOR BASED ON  
SUBWAVELENGTH GRATING.....107

Hiroaki Honma<sup>1</sup>, Kazuhiro Takahashi<sup>1</sup>, Hiromu Ishii<sup>1</sup>, Makoto Ishida<sup>1,2</sup> and Kazuaki Sawada<sup>1,2</sup>  
<sup>1</sup>Toyohashi University of Technology, Japan, <sup>2</sup>Electronics-Inspired Interdisciplinary Research  
Institute (EIIRIS), Japan

### WA-P.6

ELECTROTHERMALLY ACTUATED LARGE DISPLACEMENT WAVEGUIDES.....109

Sean R. Samuelson and Huikai Xie  
University of Florida, USA

**WA-P.8**

GLASS REFLOW PROCESS FOR AN ELECTRICAL ISOLATION AND TEMPORARY SUPPORT OF TWO-DIMENSIONAL MICROSCANNER ..... 111

Minyoung Yun, Daehun Jeong, Seunghwan Moon and Jong-Hyun Lee  
Gwangju Institute of Science and Technology, Korea

**WA-P.9**

IMPROVEMENT IN SIDEWALL ROUGHNESS OF MEMS X-RAY OPTICS ..... 113

Masahiro Ikuta<sup>1</sup>, Yuichiro Ezoe<sup>1</sup>, Ikuyuki Mitsuishi<sup>1</sup>, Tomohiro Ogawa<sup>1</sup>, Takuya Kakiuchi<sup>1</sup>, Takaya Ohashi<sup>1</sup> and Kazuhisa Mitsuda<sup>2</sup>

<sup>1</sup>Tokyo Metropolitan University, Japan, <sup>2</sup>ISAS/JAXA, Japan

**WA-P.10**

ASSEMBLY OF A MEMS-BASED WOLTER TYPE-I X-RAY OPTIC TOWARD A FUTURE PLANETARY EXPLORATION MISSION ..... 115

Ikuyuki Mitsuishi<sup>1</sup>, Yuichiro Ezoe<sup>1</sup>, Tomohiro Ogawa<sup>1</sup>, Takuya Kakiuchi<sup>1</sup>, Masahiro Ikuta<sup>1</sup>, Takayuki Hayashi<sup>2</sup>, Toshiki Sato<sup>1</sup>, Takaya Ohashi<sup>1</sup>, Kazuhisa Mitsuda<sup>2</sup>, Kohei Morishita<sup>3</sup> and Kazuo Nakajima<sup>3</sup>

<sup>1</sup>Tokyo Metropolitan University, Japan, <sup>2</sup>ISAS/JAXA, Japan, <sup>3</sup>Kyoto University, JAPAN

**WA-P.11**

APPLICATION OF NANO-IMPRINT TECHNOLOGY TO GRATING SCALE FOR A ROTARY MICROENCODER ..... 117

Toshihiro Takeshita<sup>1</sup>, Takuma Iwasaki<sup>1</sup>, Eiji Higurashi<sup>2</sup>, Tatsuya Miyazaki<sup>1</sup> and Renshi Sawada<sup>1</sup>

<sup>1</sup>Kyushu University, Japan, <sup>2</sup>The University of Tokyo, Japan

**WA-P.12**

EVALUATION OF TRANSPARENT POLYIMIDE FILM AS BIOLOGICAL CELL CULTURE SHEET WITH MICROSTRUCTURES FOR BIOMEDICAL ENGINEERING ..... 119

Hiroataka Maenosono, Hirofumi Saito and Yasuhiro Nishioka  
Nihon University, Japan

**WA-P.13**

PHOTOCHEMICAL POLISHING OF SAPPHIRE SUBSTRATE BASED ON NONADIABATIC OPTICAL NEAR-FIELD ETCHING ..... 121

J. Suzuki<sup>1</sup>, K. Hirata<sup>2</sup>, K. Iwami<sup>1</sup>, A. Taguchi<sup>1</sup> and N. Umeda<sup>1</sup>

<sup>1</sup>Tokyo University of Agriculture and Technology, Japan, <sup>2</sup>Sigma Koki Co., Ltd., Japan

**WA-P.14**

INFRARED COLLECTING MICROLENS INTEGRATED WITH SI PHOTO CELL ..... 123

Takuro Aonuma, Shinya Kumagai and Minoru Sasaki  
Toyota Technical Institute, Japan

**WA-P.15**

COLLOIDAL PARTICLE SORTING WITH SCATTERING FORCE VIA PLANAR WAVEGUIDE ..... 125

Masahiro Motosuke and Hideharu Kotari  
Tokyo University of Science, Japan

**WA-P.16****NEAR-INFRARED PHOTOTHERMAL ACTIVATION OF MICROGELS INCORPORATING POLYPYRROLE NANOTRANSDUCERS THROUGH DROPLET MICROFLUIDICS ..... 127**Rongcong Luo<sup>1</sup> and Chia-Hung Chen<sup>1,2</sup><sup>1</sup>National University of Singapore, Singapore, <sup>2</sup>Singapore Institute for Neurotechnology (SiNAPSE), National University of Singapore**WA-P.17****HIGH SENSITIVE SILICON OPTICAL INDEX SENSOR BASED ON RING-ASSISTED MACH-ZEHNDER INTERFEROMETER ..... 129**

Tianhang Zhang, Bo Li, Chong Pei Ho and Chengkuo Lee

National University of Singapore, Singapore

**WA-P.18****EXPERIMENTAL VERIFICATION OF PHONONIC CRYSTAL SLAB BASED SILICON MICRORESONATORS ..... 131**Nan Wang<sup>1,2</sup>, Min Tang<sup>2</sup>, Fu-Li Hsiao<sup>3</sup>, Chong Pei Ho<sup>1</sup>, Moorthi Palaniapan<sup>1</sup>, Dim-Lee Kwong<sup>2</sup> and Chengkuo Lee<sup>1</sup><sup>1</sup>National University of Singapore, Singapore, <sup>2</sup>Institute of Microelectronics, Agency for Science, Technology and Research (A\*STAR), Singapore, <sup>3</sup>National Changhua University of Education, Taiwan**WA-P.19****FAST GUIDED MODE OF A PHOTONIC CRYSTAL WAVEGUIDE ..... 133**

Borriboon Thubthimthong, Kazuhiro Hane

Tohoku University, Japan

**WA-P.20****FLEXIBLE NANOPOROUS ANODIC ALUMINUM OXIDE(NP-AAO) TEMPLATE COATED WITH SELF-ASSEMBLED AU NANOCROWN ARRAY FOR NANOPHOTONIC SWITCHING ..... 135**Chitsung Hong<sup>1</sup>, Weileun Fang<sup>2</sup> and Bor-Yuan Shew<sup>1</sup><sup>1</sup>National Synchrotron Radiation Research Center (NSRRC), Taiwan,<sup>2</sup>National Tsing Hua University, Taiwan**WA-P.22****ULTRASENSITIVE BIOSENSORS USING FANO RESONANCES IN DOUBLE-LAYER GOLD NANOSTRUCTURES ..... 137**Kuang-Li Lee<sup>1</sup>, Jhih-Bin Huang<sup>2</sup>, Shu-Han Wu<sup>3</sup> and Pei-Kuen Wei<sup>1,2,3</sup><sup>1</sup>Academia Sinica, Taiwan, <sup>2</sup>National Taiwan Ocean University, Taiwan,<sup>3</sup>National Yang-Ming University, Taiwan**WA-P.23****SENSITIVITY-ENHANCED SERS SUBSTRATE FABRICATION BY NANOIMPRINTING COMPRESSED PDMS ELASTOMER ..... 139**

Wen-Kai Kuo, Jia-Nan Yan, Wing-Ming Chou and Hsin-Her Yu

National Formosa University, Taiwan

**WA-P.24**

DEVELOPMENT OF TUNABLE 3-D eSRR FOR THz APPLICATIONS ..... 141

Fusheng Ma, Yu-Sheng Lin, You Qian, Chong Pei Ho, Prakash Pitchappa  
and Chengkuo Lee  
National University of Singapore, Singapore

**WA-P.25**

COMPLEMENTARY METAMATERIAL INFRARED ABSORBER ..... 143

Prakash Pitchappa<sup>1,2</sup>, Chong Pei Ho<sup>1,2</sup>, Piotr Kropelnicki<sup>2</sup> and Chengkuo Lee<sup>1</sup>  
<sup>1</sup>National University of Singapore, Singapore, <sup>2</sup>Institute of Microelectronics (IME),  
Agency for Science, Technology and Research (A\*STAR), Singapore

**WA-P.26**

OPTIMAL DESIGN OF PHOTODETECTOR WITH MULTI-SLIT GRATING ..... 145

Ayumi Takeda, Takuma Aihara, Masashi Fukuhara, Yuya Ishii and Mitsuo Fukuda  
Toyohashi University of Technology, Japan

**WA-P.27**

POLARIZATION-INDEPENDENT PHOTODETECTOR WITH RING-TYPE GRATING ..... 147

Ayumi Takeda, Takuma Aihara, Masashi Fukuhara, Yuya Ishii and Mitsuo Fukuda  
Toyohashi University of Technology, Japan

**WA-P.29**

A MODIFIED PLASMON RULER EQUATION FOR QUASI-ORDERED PLASMONIC  
NANOISLANDS ..... 149

Minhee Kang and Ki-Hun Jeong  
Korea Advanced Institute of Science and Technology, Korea

**WA-P.30**

LOCAL FIELD EFFECT ON Nd<sup>3+</sup>-DOPED  $\alpha$ -NaYF<sub>4</sub> NANOCRYSTALS IN LIQUIDS ..... 151

Xiaojie Xue, Takenobu Suzuki and Yasutake Ohishi  
Research Center for Advanced Photonic Technology, Toyota Technical Institute, Japan

**Excursion: Kenrokuen Garden**

**Banquet: Kinjohro Restaurant**

# THURSDAY, AUGUST 22

## 8:40 ThM-S1 Deformable Devices

Session Chair: Hiroshi Toshiyoshi (University of Tokyo, Japan)

### ThM-S1.1

#### INVITED TALK

MEMS AND NEMS WITH INTEGRATED CAVITY OPTOMECHANICAL READOUT ..... 153

Vladimir Aksyuk<sup>1</sup>, Jie Zou<sup>1,2</sup>, Yuxiang Liu<sup>1,2</sup>, Houxun Miao<sup>1,2</sup>, Marcelo Davanco<sup>1,3</sup>  
and Kartik Srinivasan<sup>1</sup>

<sup>1</sup>National Institute of Standards and Technology, USA, <sup>2</sup>University of Maryland, USA,

<sup>3</sup>California Institute of Technology, USA

### ThM-S1.2

SILICON-RIM-REINFORCED SILICON NITRIDE MICROSCANNER WITH VERTICAL  
COMB ACTUATOR AND WAFER-LEVEL VACUUM PACKAGING ..... 155

Joo-Young Jin, Sunghyun Yoo, Jae-Sung Bae, and Yong-Kweon Kim  
Seoul National University, Korea

### ThM-S1.3

FREEFORM HIGH-SPEED LARGE-AMPLITUDE DEFORMABLE PIEZO MIRRORS ..... 157

Matthias C. Wapler, Jens Brunne and Ulrike Wallrabe  
University of Freiburg, Germany

### ThM-S1.4

FOCUSING MIRROR WITH TUNABLE ECCENTRICITY ..... 159

Moritz Stürmer, Matthias C. Wapler, Jens Brunne and Ulrike Wallrabe  
University of Freiburg – IMTEK, Germany

### ThM-S1.5

DISPLACEMENT-AMPLIFIED DYNAMIC VARIFOCAL MIRROR USING MECHANICAL  
RESONANCE ..... 161

Takashi Sasaki, Daiki Sato and Kazuhiro Hane  
Tohoku University, Japan

### ThM-S1.6

AN INFRARED DETECTOR BASED ON NONLINEAR OSCILLATION ..... 163

Daisuke Momonoi, Tatsuya Yamazaki, Shinya Kumagai and Minoru Sasaki  
Toyota Technological Institute, Japan

## Coffee Break



## 10:50 ThM THz Applications

Session Chair: Jui-Che Tsai (National Taiwan University, Taiwan)

### ThM-S2.1

#### INVITED TALK

#### ELECTROSTATIC MEMS TUNABLE SPLIT-RING RESONATORS FOR THZ FILTER APPLICATIONS ..... 165

Zhengli Han<sup>1</sup>, Kenta Kohno<sup>1</sup>, Tomi Haatainen<sup>2</sup>, Tapio Makela<sup>2</sup>, Hiroyuki Fujita<sup>1</sup>, Kazuhiko Hirakawa<sup>1</sup> and Hiroshi Toshiyoshi<sup>1</sup>

<sup>1</sup>Institute of Industrial Science, The University of Tokyo, Japan, <sup>2</sup>VTT Microsystems and Nanoelectronics, Finland

### ThM-S2.2

#### TUNABLE THz FILTER USING 3-D SPLIT-RING RESONATORS ..... 167

Yu-Sheng Lin<sup>1,2</sup>, Chong Pei Ho<sup>1,2</sup>, Prakash Pitchappa<sup>1,2</sup>, Fusheng Ma<sup>1</sup>, You Qian<sup>1</sup>, Piotr Kropelnicki<sup>2</sup> and Chengkuo Lee<sup>1</sup>

<sup>1</sup>National University of Singapore, Singapore, <sup>2</sup>Institute of Microelectronics (IME), Agency for Science, Technology and Research (A\*STAR), Singapore

### ThM-S2.3

#### A 3-D MOVABLE THz FILTER USING SURFACE MICROMACHINING PROCESS ..... 169

Yu-Sheng Lin, Fusheng Ma and Chengkuo Lee  
National University of Singapore, Singapore

### ThM-S2.4

#### BIPOLAR OPTICAL FORCES IN COUPLED PHOTONIC CRYSTAL CAVITIES ..... 171

Feng Tian, Guangya Zhou, Yu Du and Fook Siong Chau  
National University of Singapore, Singapore

### ThM-S2.5

#### APPLICATIONS OF NANOELECTROMECHANICAL ACTUATORS IN NANO OPTOMECHANICS ..... 173

Feng Tian, Guangya Zhou, Yu Du and Fook Siong Chau  
National University of Singapore, Singapore

**Optional Tour: Shirakawa-go**