THE 33RD IEEE INTERNATIONAL CONFERENCE ON MICRO ELECTRO MECHANICAL SYSTEMS

MEMS 2020

VANCOUVER CANADA

JANUARY 18-22, 2020

FINAL PROGRAM

CONFERENCE CHAIRS

Karen Cheung
University of British Columbia, CANADA

David Horsley
University of California, Davis, USA

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MEMS
IEEE MEMS TECHNICAL COMMUNITY

MEMS 2020

CONFERENCE AT A GLANCE

SATURDAY, JANUARY 18

12:00 – 19:00	Registration
13:00 – 17:00	MEMS Industry Workshop
17:00 – 19:00	Wine & Cheese Welcome Reception

SUNDAY, JANUARY 19

08:00 – 08:20	**Welcome Address** Conference Chairs: Karen Cheung & David Horsley
08:20 – 08:35	• IEEE Fellows Recognition in the Field of MEMS/NEMS • IEEE Electron Devices Society Robert Bosch Micro and Nano Electro Mechanical Systems Award
08:35 – 09:20	**Plenary Speaker I** Bill Peck, *Twist Bioscience, USA*
09:20 – 10:20	Session I – Biomedical MEMS
10:20 – 10:50	Break and Exhibit Inspection
10:50 – 11:50	Session II – Flexible Devices
11:50 – 13:30	Lunch on Own and Exhibit Inspection
13:30 – 15:30	Poster/Oral Session I
15:00 – 15:30	Break and Exhibit Inspection
15:30 – 16:45	Session III – Droplets
16:45 – 17:45	Session IV – Physical & Acoustic Sensors
17:45	Adjourn for the Day

MONDAY, JANUARY 20

08:00 – 08:45	**Plenary Speaker II** Takao Someya, *University of Tokyo, JAPAN*
08:45 – 09:45	Session V – Wearable Devices
09:45 – 10:15	Break and Exhibit Inspection
10:15 – 11:30	Session VI – Biosensors
11:30 – 11:45	MEMS 2021 Announcement
11:45 – 13:45	Lunch on Own and Exhibit Inspection
13:45 – 15:45	Poster/Oral Session II
15:15 – 15:45	Break and Exhibit Inspection
15:45 – 16:45	Session VII – Switches & Resonators
16:45 – 18:00	Session VIII – Microfluidics
18:00	Adjourn for the Day

MEMS 2020

CONFERENCE AT A GLANCE

TUESDAY, JANUARY 21

08:00 – 08:45	**Plenary Speaker III** Ellis Meng, *University of Southern California, USA*	
08:45 – 09:05	**Invited Speaker I** Sindy KY Tang, *Stanford University, USA*	
09:05 – 09:25	**Invited Speaker II** Shuhuai Yao, *Hong Kong University of Science and Technology, HONG KONG*	
09:25 – 10:05	**Panel Discussion**	
10:05 – 10:35	**Break and Exhibit Inspection**	
10:35 – 11:50	**Ballroom A** **Session IXa – Infrared Detectors** **INVITED SPEAKER** Tayfun Akin – *Mikrosens Elektronik San. ve Tic. A.Ş., TURKEY*	**Room 109/110** **Session IXb – Advanced Biomaterials** **INVITED SPEAKER** Francesca Santaro – *Italian Institute of Technology, ITALY*
11:50 – 13:10	**Lunch on Own and Exhibit Inspection**	
13:10 – 15:10	**Poster/Oral Session III**	
14:40 – 15:10	**Break and Exhibit Inspection**	
15:10 – 16:25	**Session Xa – Resonant Transducers** **INVITED SPEAKER** Sheng-Shian Li – *National Tsing Hua Univ., TAIWAN*	**Session Xb – Gas Sensors** **INVITED SPEAKER** Fei Wang – *Southern University of Science and Technology, CHINA*
16:25 – 17:55	**Session XIa – Resonant NEMS & MEMS** **INVITED SPEAKER** Philip X.-L. Feng – *University of Florida, USA*	**Session XIb – Flexible Bioelectronics & Biomaterials** **INVITED SPEAKER** Fabio Cicoira – *Polytechnique Montréal, CANADA*
17:55	**Adjourn for the Day**	
19:00 – 22:00	**Tuesday Evening Event at the Vancouver Aquarium**	

WEDNESDAY, JANUARY 22

08:00 – 08:45	**Plenary Speaker IV** Martin Wegener, *Karlsruhe Institute of Technology (KIT), GERMANY*
08:45 – 09:45	**Session XII – Inertial Sensors**
09:45 – 10:15	**Break**
10:15 – 11:00	**Session XIII – Power MEMS**
11:00 – 12:00	**Session XIV – Fabrication & Materials**
12:00 – 12:30	**Award Ceremony and Final Remarks**
12:30	**Conference Adjourns**

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Vancouver, BC

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Award Presentations	**Ballroom A**	1
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SUNDAY, JANUARY 19

Plenary Speaker I (08:35)

BALLROOM A

DNA FOR DIGITAL DATA STORAGE

Bill Peck

Twist Bioscience, USA

MONDAY, JANUARY 20

Plenary Speaker II (08:00)

BALLROOM A

ELECTRONIC SKINS FOR ROBOTICS AND WEARABLES

Takao Someya

University of Tokyo, JAPAN

TUESDAY, JANUARY 21

Plenary Speaker III (08:00)

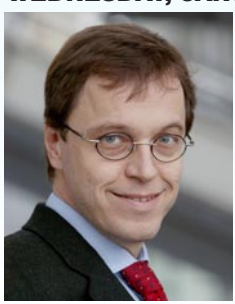
BALLROOM A

MEMS FOR UNLOCKING THE SECRETS OF THE NERVOUS SYSTEM

Ellis Meng

University of Southern California, USA

WEDNESDAY, JANUARY 22



Plenary Speaker IV (08:00)

BALLROOM A

3D LASER NANOPRINTING

Martin Wegener

Karlsruhe Institute of Technology (KIT), GERMANY

TUESDAY, JANUARY 21

Invited Speaker I (08:45)

BALLROOM A

MICROFLUIDIC TOOLS FOR SINGLE-CELL WOUND REPAIR STUDIES

Sindy KY Tang

Stanford University, USA

Invited Speaker II (09:05)

BALLROOM A

ONE-STEP RT-PCR FOR DETECTION OF MICRORNAS IN EXOSOMES USING DROPLET MICROFLUIDICS

Shuhuai Yao

Hong Kong University of Science and Technology, HONG KONG

Session IXa – Infrared Detectors (10:35)

BALLROOM A

LOW-COST LWIR-BAND CMOS INFRARED (CIR) MICROBOLOMETERS FOR HIGH VOLUME APPLICATIONS

Tayfun Akin

Mikrosens Elektronik San. ve Tic. A.Ş., TURKEY

Session IXb – Advanced Biomaterials (10:35)

ROOM 109/110

SMART MATERIALS FOR BIOELECTRONICS PLATFORMS

Francesca Santaro

Italian Institute of Technology, ITALY

Session Xa – Resonant Transducers (15:10)

BALLROOM A

CMOS-MEMS RESONANT TRANSDUCERS FOR FREQUENCY CONTROL AND SENSING

Sheng-Shian Li

National Tsing Hua University, TAIWAN

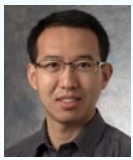
Session Xb – Gas Sensors (15:10)

ROOM 109/110

MEMS GAS SENSORS - FROM NANOMATERIALS TO MICROELECTRODES

Fei Wang

Southern University of Science and Technology, CHINA



Session XIa – Resonant NEMS & MEMS (16:25)

BALLROOM A

RESONANT NANOELECTROMECHANICAL SYSTEMS (NEMS): PROGRESS AND EMERGING FRONTIERS

Philip X.-L. Feng

University of Florida, USA

Session XIb – Flexible Bioelectronics & Biomaterials (16:25)

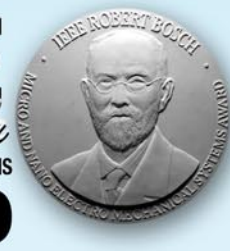
ROOM 109/110

ORGANIC CONDUCTING POLYMERS FOR BIOELECTRONICS

Fabio Cicoira

Polytechnique Montréal, CANADA

THE 2020 IEEE® Robert Bosch MICRO and NANO ELECTRO MECHANICAL SYSTEMS AWARD

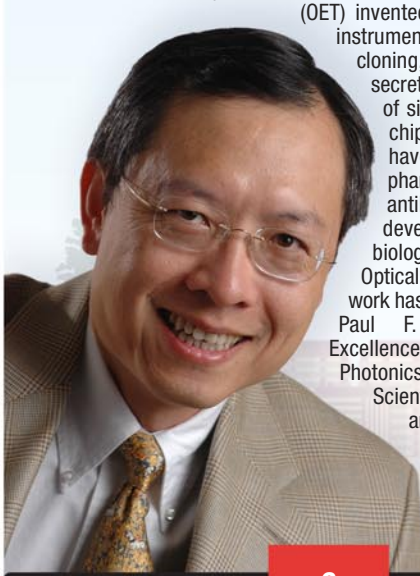


The Robert Bosch Micro and Nano Electro Mechanical Systems Award was established by the IEEE Electron Devices Society in 2014 to recognize and honor advances in the invention, design, and/or fabrication of micro- or nano- electromechanical systems and/or devices. The 2020 Bosch Award will be presented on Sunday, January 19th at 08:20.

Ming C. Wu

For pioneering contributions in MEMS optical switches and optoelectronic tweezers.

Ming C. Wu is Nortel Distinguished Professor of Electrical Engineering and Computer Sciences at University of California, Berkeley, and Co-Director of Berkeley Sensor and Actuator Center (BSAC). He received B.S. from National Taiwan University in 1983 and Ph.D. from UC Berkeley in 1988. Prior to joining the faculty at Berkeley, Dr. Wu has conducted research at AT&T Bell Laboratories at Murray Hill, New Jersey (1988-1992) and the University of California, Los Angeles (UCLA) (1992-2004). Dr. Wu has published over 600 journals and conferences papers and holds 30 US patents in Optical MEMS, optofluidics, silicon photonics and optoelectronics. In 1997, Prof. Wu co-founded OMM, Inc. to commercialize MEMS optical switches. OMM became the first company to supply Telcordia-qualified 8x8 and 16x16 switches. Recently, Prof. Wu has pushed the size of optical switches to 240x240 by combining MEMS with silicon photonics. In 2011, Prof. Wu co-founded Berkeley Lights, Inc. to commercialize optoelectronic tweezers (OET) invented by his group. The OET instrument is capable of sorting, cloning, culturing, analyzing secretions of tens of thousands of single cells on microfluidic chips. The OET instruments have been used by major pharmaceutical companies for antibody discovery, cell line development, and synthetic biology. Prof. Wu is IEEE and Optical Society (OSA) Fellow. His work has been recognized by 2007 Paul F. Forman Engineering Excellence Award (OSA), 2016 IEEE Photonics Society William Streifer Scientific Achievement Award, and 2017 C.E.K. Mees Medal (OSA).



IEEE Electron Devices Society with financial support from Robert Bosch LLC.

Oral Sessions

Oral sessions will be held in **Ballroom A** (1), with the Wednesday parallel concurrent sessions in Room **109/110** (2). See floor plan on page **3**.

Poster/Oral Sessions

The poster/oral format will consist of three (3) scheduled 10 minute, oral presentations which will be presented during each poster session on their assigned day in front of each poster starting at the designated times below. The remainder of the time should be used for questions & answers. The chimes will ring five minutes before the start of each presentation.

All poster papers are listed in this program by topic category with their assigned number starting on page **24**. See floor plan at the end of this program.

Session I	Session II
Sunday, January 19	Monday, January 20
13:30 – 15:30	13:45 – 15:45
Poster/Oral Presentation 1 – 14:00	Poster/Oral Presentation 1 – 14:15
Poster/Oral Presentation 2 – 14:30	Poster/Oral Presentation 2 – 14:45
Poster/Oral Presentation 3 – 15:00	Poster/Oral Presentation 3 – 15:15

Session III

Tuesday, January 21
13:10 – 15:10
Poster/Oral Presentation 1 – 13:40
Poster/Oral Presentation 2 – 14:10
Poster/Oral Presentation 3 – 14:40

Guide to Understanding Poster Numbering

Each poster is assigned a unique number which clearly indicates when and where the poster is presented.

Poster number: **S-130**
The first character (i.e. **M**) indicates the day of the Conference:

S = **Sunday** **M** = **Monday** **T** = **Tuesday**

The second character (i.e. **130**) is the poster board position on the floor plan.

Poster Track/Classification

- Bio & Medical MEMS
- EMS Actuators & PowerMEMS
- EMS Physical Sensors
- Materials, Fabrication and Packaging for Generic MEMS & NEMS
- Micro- & Nanofluidics
- Optical, RF and Electromagnetics for MEMS
- Technical Topics on MEMS Products
- Industry Open Posters

See poster floor plan at the end of this program.

Outstanding Student Paper Award Finalists

Award Nominees are indicated with an * above the paper title in the program and on the poster board number.

SATURDAY, JANUARY 18

12:00 – 19:00 **Registration**

MEMS Industry Workshop

Workshop Chair:
Jason Weigold, *MEMStaff, Inc., USA*

BALLROOM A

Session 1 - Fabrication/Microtechnology

13:00 **AN IDM PERSPECTIVE ON MEMS FOUNDRY**
Stefan Majoni
Robert Bosch GmbH, GERMANY

13:15 **CMOSSENSE® - COMBINING CMOS FOUNDRY SERVICES WITH MEMS APPLICATIONS**
Silvio Graf
SENSIRION AG, SWITZERLAND

13:30 **MICRODERMICS: UNLOCKING THE SKIN FOR BIOMEDICAL APPLICATIONS THROUGH MICRONEEDLES**
Boris Stoeber
Microdermics Inc., CANADA

13:45 **MEMS INDUSTRIALIZATION SURPRISES**
Sandy Vos
NXP, USA

14:00 **Networking Break**

Session 2 - Piezoelectrics/Ultrasonics

14:30 **THE PIEZOELECTRIC ACTUATORS LANDSCAPE**
Laura Castoldi
ST Microelectronics, ITALY

14:45 **BRINGING MEMS ULTRASONICS TO CONSUMER ELECTRONICS**
Michelle Kiang
Chirp Microsystems, USA

15:00 **IMPLEMENTATION OF SPUTTERED PZT IN HIGH RELIABILITY APPLICATIONS**
Niklas Svedin
Silex, SWEDEN

15:15 **SiP INTEGRATION OF MEMS TIMING SOLUTION FOR 5G AND IIOT**
Ernest Ting-Ta Yen
Texas Instruments, USA

15:30 **Networking Break**


Vancouver BC

Session 3 - Devices and Applications

16:00 **SEMICONDUCTOR SEQUENCING™ SENSOR TECHNOLOGY FOR CLINICAL DIAGNOSTIC APPLICATIONS**
James M. Bustillo
ThermoFisher Scientific, USA

16:15 **HIGH PERFORMANCE, SMALL FOOTPRINT MEMS INERTIAL SENSORS WITH SUPERIOR ROBUSTNESS**
Houri Johari-Galle
TDK Invensense, USA

16:30 **A PRODUCT INCUBATION JOURNEY: LARGE BUSINESS R&D TO START-UP COMMERCIALIZATION**
Chris Keimel
Menlo Micro, USA

16:45 **CAMERA-FREE EYE TRACKING MICROSYSTEMS FOR AR, VR, AND HEALTHCARE**
Neil Sarkar
Adhawk Microsystems, CANADA

17:00 – 19:00 **Wine & Cheese Welcome Reception**

Lynn Creek in Vancouver, BC

SUNDAY, JANUARY 19

Welcome Address

BALLROOM A

08:00 **MEMS 2020 Conference Chairs**
Karen Cheung, *University of British Columbia, CANADA*
David Horsley, *University of California, Davis, USA*

• IEEE Fellows Recognition in the Field of MEMS/NEMS
• IEEE Electron Devices Society Robert Bosch Micro and Nano Electro Mechanical Systems Award

BALLROOM A

08:20 **IEEE Electron Devices Society Robert Bosch Micro and Nano Electro Mechanical Systems Award Recipient**
Ming C. Wu
University of California, Berkeley, USA

Plenary Speaker I

Session Chair:
David Horsley, *University of California, Davis, USA*

BALLROOM A

08:35 **DNA FOR DIGITAL DATA STORAGE**
Bill Peck
Twist Bioscience, USA

Session I – Biomedical MEMS

Session Chair:
Dong-Weon Lee, *Chonnam National University, KOREA*

BALLROOM A

09:20 **DEVELOPMENT OF MAGNETICALLY DRIVEN MICROROBOTS FOR TARGETED CELL DELIVERY, AND THEIR CHARACTERIZATION IN *IN VITRO, EX VIVO* AND *IN VIVO* ENVIRONMENTS**
Sungwoong Jeon[1], Sun Hwa Park[2], Sung Won Kim[2], Jin-young Kim[1], and Hongsoo Choi[1]
[1]*Daegu Gyeongbuk Institute of Science and Technology (DGIST), KOREA and* [2]*Catholic University of Korea, KOREA*

09:35 **CONDUCTIVE LIQUID BANDAGE BASED ON NITROCELLULOSE AND AG PARTICLES FOR WOUND ISOLATION AND EVALUATION**
Yufeng Chen[1], Tongren Yang[2], Junshi Li[1], Yuanyu Huang[2], and Zhihong Li[1]
[1]*Peking University, CHINA and* [2]*Beijing Institute of Technology, CHINA*

09:50 **AN ULTRA MINIATURIZED MEMS MICROBIOPSY TOOL FOR TRANS BLOOD VESSEL WALL BIOPSIES**
Mikael Sandell[1,2], Rikard Grankvist[2], Stefan Jonsson[1], Wouter M. van der Wijngaart[1], Göran Stemme[1], Staffan Holmin[2], and Niclas Roxhed[1]
[1]*KTH Royal Institute of Technology, SWEDEN and* [2]*Karolinska Institutet, SWEDEN*

10:05 **AWARD NOMINEE***
A DEGRADABLE ANTIBACTERIAL SKIN PATCH OF FLEXIBLE TERAHERTZ METAMATERIALS MADE FROM SILK PROTEINS
Long Sun[1,2], Chi Gu[1], Tiger H. Tao[1,2], and Zhitao Zhou[1]
[1]*Chinese Academy of Sciences (CAS), CHINA and* [2]*University of Chinese Academy of Sciences (UCAS), CHINA*

10:20 **Break and Exhibit Inspection**

Session II – Flexible Devices

Session Chairs:
Jongbaeg Kim, *Yonsei University, KOREA*
Hiroaki Onoe, *Keio University, JAPAN*

BALLROOM A

10:50 **SENSORY-GLOVE-BASED HUMAN MACHINE INTERFACE FOR AUGMENTED REALITY (AR) APPLICATIONS**
Minglu Zhu[1], Zhongda Sun[1], Zixuan Zhang[1], Qiongfeng Shi[1], Tao Chen[2], Huicong Liu[2], and Chengkuo Lee[1]
[1]*National University of Singapore, SINGAPORE and*
[2]*Soochow University, CHINA*

11:05 **ULTRA-SENSITIVE STRAIN SENSOR USING HIGH DENSITY SELF-ALIGNED NANO-CRACKS**
Myung-Kun Chung, Jae-Young Yoo, Jae-Shin Lee, Min-Seung Jo, Kwang-Wook Choi, Su-Bon Kim, and Jun-Bo Yoon
Korea Advanced Institute of Science and Technology (KAIST), KOREA

11:20 **MASSIVELY PARALLEL LIQUID METAL WIRING FOR SOFT ELECTRONICS AND ROBOTICS**
Kaushal J. Sumaria and Tingyi "Leo" Liu
University of Massachusetts, Amherst, USA

11:35 **A WEARABLE BRAILLE RECOGNITION SYSTEM BASED ON HIGH DENSITY TACTILE SENSORS**
Chunpeng Jiang, Kunpeng Gao, Nan Zhao, Gencai Shen, Zhongke Mei, Zhenyu Song, Bin Yang, and Jingquan Liu
Shanghai Jiao Tong University, CHINA

11:50 **Lunch on Own and Exhibit Inspection**

Poster/Oral Session I

BALLROOM B/C

13:30 **Poster/Oral Session I**
Poster presentations are listed by topic category with their assigned number starting on page **24**.

15:00 **Break and Exhibit Inspection**

Session III – Droplets

Session Chairs:
Tianzhun Wu, *Chinese Academy of Sciences, CHINA*
Zhihong Li, *University, CHINA*

BALLROOM A

15:30 **AWARD NOMINEE***
ONE-STEP FABRICATION OF MULTI-FUNCTIONAL CORE-SHELL JANUS MICROPARTICLES FOR THERANOSTICS APPLICATION
Mio Tsuchiya[1], Yuta Kurashina[2], Yun Jung Heo[3], and Hiroaki Onoe[1]
[1]*Keio University, JAPAN,* [2]*Tokyo Institute of Technology, JAPAN, and*
[3]*Kyung Hee University, KOREA*

15:45 **AWARD NOMINEE***
SELF-CLEANING DROP FREE GLASS OPERATED BY ACOUSTIC ATOMIZATION/OSCILLATION FOR AUTONOMOUS DRIVING AND IOT TECHNOLOGY
Seungmin Lee, Youngbin Hyun, Kang Young Lee, Jeongmin Lee, and Sang Kug Chung
Myongji University, KOREA

Session III – Droplets
Continued

BALLROOM A

16:00 **AWARD NOMINEE***
ACOUSTOFLUIDICS BASED ON ZnO/AL PLATE SURFACE ACOUSTIC WAVE DEVICES WITH ENHANCED PERFORMANCES
Yong Wang[1], Ran Tao[2], Qian Zhang[1], Dongyang Chen[1], Lei Yang[1], Wei Huang[1], Jin Xie[1], and Yongqing Fu[2]
[1]Zhejiang University, CHINA and [2]University of Northumbria, UK

16:15 **DRUG-LOADED MICROBEADS SANDWICHED BETWEEN NANOFIBER LAYERS FOR EXTENDED LINEAR RELEASE**
Sheng-Po Fang, Gloria J. Kim, Anuj Chohan, and Yong Kyu "YK" Yoon
University of Florida, USA

16:30 **DETECTION AND CONTROL OF BUBBLE ENTRAPMENT DURING THE RECOIL PHASE OF DROPLET IMPACT**
Thanh-Vinh Nguyen and Masaaki Ichiki
National Institute of Advanced Industrial Science and Technology (AIST), JAPAN

Session IV – Physical & Acoustic Sensors
Session Chairs:
Núria Barniol, *Universitat Autonoma de Barcelona, SPAIN*
Yong-Kyu "YK" Yoon, *University of Florida, USA*

BALLROOM A

16:45 **A HIGH DYNAMIC RANGE AFM PROBE WITH COLLOCATED PIEZOELECTRIC TRANSDUCER PAIRS**
Mohammad Mahdavi, M. Bulut Coskun, Hazhir Mahmoodi Nasrabadi, and S.O. Reza Moheimani
University of Texas, Dallas, USA

17:00 **AWARD NOMINEE***
MONOLITHIC INTEGRATION OF PRESSURE/HUMIDITY/TEMPERATURE SENSORS FOR CMOS-MEMS ENVIRONMENTAL SENSING HUB WITH STRUCTURE DESIGNS FOR PERFORMANCES ENHANCEMENT
Yung-Chian Lin, Ping-Hsiu Hong, Sheng-Kai Yeh, Cheng-Chun Chang, and Weileun Fang
National Tsing Hua University, TAIWAN

17:15 **MEMS FOCUSED ULTRASONIC TRANSDUCER WITH AIR-CAVITY LENS BASED ON POLYDIMETHYLSILOXANE (PDMS) MEMBRANE**
Yongkui Tang, Song Liu, and Eun Sok Kim
University of Southern California, USA

17:30 **SUBCELLULAR IMAGING DURING SINGLE CELL MECHANICAL CHARACTERIZATION**
Deniz Pekin[1], Grégoire Perret[2,3], Quentin Rezard[2,4], Jean Claude Gerbedoen[2,3], Samuel Meignan[2,4,5], Dominique Collard[2,3], Chann Lagadec[2,4], and Mehmet C. Tarhan[2,4]
[1]INSERM, FRANCE, [2]CNRS, FRANCE, [3]LIMMS/CNRS-IIS, FRANCE, [4]University of Lille, FRANCE, and [5]Centre Oscar Lambert, FRANCE

17:45 **Adjourn for the Day**

Plenary Speaker II

Session Chair:
Jun-Bo Yoon, *Korea Advanced Institute of Science and Technology (KAIST), KOREA*

BALLROOM A

08:00 **ELECTRONIC SKINS FOR ROBOTICS AND WEARABLES**
Takao Someya[1,2], Tomoyuki Yokota[1], Sunghoon Lee[1], and Kenjiro Fukuda[2]
[1]*University of Tokyo, JAPAN and* [2]*RIKEN, JAPAN*

Session V – Wearable Devices

Session Chairs:
Niels Quack, *École Polytechnique Fédérale de Lausanne (EPFL), SWITZERLAND*
Shoji Takeuchi, *University of Tokyo, JAPAN*

BALLROOM A

08:45 **A SKIN-MOUNTABLE BACTERIA-POWERED BATTERY SYSTEM FOR SELF-POWERED MEDICAL DEVICES**
Maedeh Mohammadifar, Mehdi Tahernia, Jihyun Yang, Ahyeon Koh, and Seokheun Choi
State University of New York, Binghamton, USA

09:00 **AWARD NOMINEE***
TRANSIENT EPIDERMAL ELECTRONICS FOR LEARNING THE PHYSIOLOGICAL SIGNATURES
Yujia Zhang[1] and Tiger H. Tao[1,2,3,4]
[1]*Chinese Academy of Sciences (CAS), CHINA,*
[2]*ShanghaiTech University, CHINA,*
[3]*Zhangjiang Laboratory, CHINA, and*
[4]*Shanghai Brain/AI Center, CHINA*

09:15 **SMART TRIBOELECTRIC SOCKS FOR ENABLING ARTIFICIAL INTELLIGENCE OF THINGS (AIOT) BASED SMART HOME AND HEALTHCARE**
Zixuan Zhang, Tianyiyi He, Minglu Zhu, Qiongfeng Shi, and Chengkuo Lee
National University of Singapore, SINGAPORE

09:30 **SIMULTANEOUS MEASUREMENT OF PULSE WAVE AND RESPIRATION USING A SINGLE TUBE-SHAPED MEMS-BASED PRESSURE SENSOR**
Thanh-Vinh Nguyen and Masaaki Ichiki
National Institute of Advanced Industrial Science and Technology (AIST), JAPAN

09:45 **Break and Exhibit Inspection**

Session VI – Biosensors

Session Chairs:
Honglong Chang, *Northwestern Polytechnical University, CHINA*
Matthias Meier, *Helmholtz Zentrum Munich, GERMANY*

BALLROOM A

10:15 **IN-PLANE MODE RESONANT CANTILEVER SENSOR TO DETECT KINETIC/THERMODYNAMIC PARAMETERS FOR APTAMER-LIGAND BINDING**
Xuefeng Wang[1], Yarong Cheng[2], Shengran Cai[3], Pengcheng Xu[1], Ying Chen[1], Haitao Yu[1], and Xinxin Li[1]
[1]*Chinese Academy of Sciences (CAS), CHINA,*
[2]*Shanghai Normal University, CHINA, and*
[3]*University of Chinese Academy of Sciences (UCAS), CHINA*

Session VI – Biosensors
Continued

BALLROOM A

10:30 **ODORANT SENSOR USING OLFACTORY RECEPTOR RECONSTITUTED IN A LIPID BILAYER MEMBRANE WITH GAS FLOW SYSTEM**
Tetsuya Yamada[1], Hirotaka Sugiura[1], Hisatoshi Mimura[1], Koki Kamiya[1], Toshihisa Osaki[1], and Shoji Takeuchi[1,2]
[1]*Kanagawa Institute of Industrial Science and Technology, JAPAN and* [2]*University of Tokyo, JAPAN*

10:45 **BIO-INSPIRED SUPERHYDROPHILIC MICROPATTERNS FOR DETECTION OF TRACE MOLECULES IN FOG**
Ruirui Li[1,2], Yudong Yang[2], Shuai Yang[1,2], Bo Gui[2], Haiyang Mao[2,3], Jijun Xiong[1], Kewen Long[4], and Dapeng Chen[2,3]
[1]*North University of China, CHINA,* [2]*Chinese Academy of Sciences (CAS), CHINA,* [3]*Wuxi Internet of Things Innovation Center Co. Ltd., and* [4]*Foshan Chuandong Magnetic Electronic Co., Ltd.*

11:00 **HIGH-PERFORMANCE PAPER-BASED FLUIDIC CASSETTE FOR MASS SPECTROMETRY ANALYZING CAFFEINE AND NICOTINE METABOLITES**
Yi-Chieh Li, Ming-Hsu Cheng and Che-Hsin Lin
National Sun Yat-sen University, TAIWAN

11:15 **BIOINTEGRATED SUBTRACTIVE MICROFABRICATION BY HYDRODYNAMIC FLOW CONFINEMENT**
Daniel Widerker[1,2], Federico Paratore[1,2], Govind Kaigala[2], and Moran Bercovici[1]
[1]*Technion, ISRAEL and* [2]*IBM Research-Zurich, SWITZERLAND*

MEMS 2021 Announcement

BALLROOM A

11:30 **MEMS 2021 Announcement**
Núria Barniol, *Universitat Autonoma de Barcelona, SPAIN*
Franz Lärmer, *Bosch, GmbH, GERMANY*

11:45 **Lunch on Own and Exhibit Inspection**

Poster/Oral Session II

BALLROOM B/C

13:45 **Poster/Oral Session II**
Poster presentations are listed by topic category with their assigned number starting on page **24**.

15:15 **Break and Exhibit Inspection**

Session VII – Switches & Resonators
Session Chairs:
Cristian Cassella, *Northeastern University, USA*
Shinichiro Tezuka, *Yokogawa Electric Corporation, JAPAN*

BALLROOM A

15:45 **A 125-KHZ CMOS-MEMS RESOSWITCH EMBEDDED ZERO QUIESCENT POWER OOK/FSK RECEIVER**
Chun-Pu Tsai, Yen-Yu Liao, and Wei-Chang Li
National Taiwan University, TAIWAN

16:00 **AWARD NOMINEE***
HOLD-BIAS FREE MEM POWER GATING FOR ZERO STANDBY ENERGY DISSIPATION IN CMOS ICS
Dhairya Singh Arya, Sushil Kumar, and Pushpapraj Singh
Indian Institute of Technology, Delhi, INDIA

Session VII – Switches & Resonators

Continued

BALLROOM A

16:15 **4 W DUAL-CONTACT MATERIAL MEMS RELAY WITH A CONTACT FORCE MAXIMIZING STRUCTURE**
Su-Bon Kim, Yong-Hoon Yoon, Yong-Bok Lee, Kwang-Wook Choi, Min-Seung Jo, Hyun-Woo Min, and Jun-Bo Yoon
Korea Advanced Institute of Science and Technology (KAIST), KOREA

16:30 **DESIGN AND IMPLEMENTATION OF A NOVEL SKULL VIBRATION SENSING MODULE FOR BONE CONDUCTION MICROPHONE**
Bo-Cheng You[1,2], Sung-Cheng Lo[1,3], Chun-Kai Chan[3], Hsien-Lung Ho[3], Shih-Chia Chiu[3], Guan-Hong Hsieh[2], and Weileun Fang[1]
[1]*National Tsing Hua University, TAIWAN,* [2]*1MORE ShenZhen Acoustic Technology Co., Ltd, CHINA, and* [3]*Gettop Acoustic Co., Ltd, CHINA*

Session VIII – Microfluidics

Session Chairs:
Mehmet Cagatay Tarhan, *IEMN, FRANCE*
Arum Han, *Texas A&M University, USA*

BALLROOM A

16:45 **ECM-BASED GRADIENT GENERATOR FOR TUNABLE SURFACE ENVIRONMENT BY INTERSTITIAL FLOW**
Azusa Shimizu[1], Wei H. Goh[2], Rahul Karyappa[2], Michinao Hashimoto[2], and Hiroaki Onoe[1]
[1]*Keio University, JAPAN and* [2]*Singapore University of Technology and Design, SINGAPORE*

17:00 **ON-DEMAND PHOTOTHERMAL BAR-CHART MICROFLUIDIC PLATFORM USING ON-CHIP NANOMATERIAL-MEDIATED PHOTOTHERMAL EFFECT AS THE MICROFLUIDIC DRIVING FORCE**
Wan Zhou, Guanglei Fu, and Xiujun Li
University of Texas, El Paso, USA

17:15 **FABRICATION OF HAND-DRIVEN COAXIAL LAMINAR FLOW DEVICES**
Haruka Oda and Shoji Takeuchi
University of Tokyo, JAPAN

17:30 **A 3D NANOPRINTED NORMALLY CLOSED MICROFLUIDIC TRANSISTOR**
Abdullah T. Alsharhan, Anthony J. Stair, Ryan R. Utz, Andrew C. Lamont, Michael A. Restaino, Ruben Acevedo, and Ryan D. Sochol
University of Maryland, USA

17:45 **AWARD NOMINEE***
HIGH-SPEED AND HIGH-RESOLUTION ON-CHIP PUMPING UTILIZING ASYMMETRIC FLOW RESISTORS
Makoto Saito, Yusuke Kasai, Hiroki Kumon, Shinya Sakuma, and Fumihito Arai
Nagoya University, JAPAN

18:00 **Adjourn for the Day**


Vancouver, BC

Plenary Speaker III

Session Chair:
Karen Cheung, *University of British Columbia, CANADA*

BALLROOM A

08:00 **MEMS FOR UNLOCKING THE SECRETS OF THE NERVOUS SYSTEM**
Ellis Meng
University of Southern California, USA

Invited Speaker I

Session Chair:
Regina Luttge, *Eindhoven University of Technology, NETHERLANDS*

BALLROOM A

08:45 **MICROFLUIDIC TOOLS FOR SINGLE-CELL WOUND REPAIR STUDIES**
Luke R. Blauch, Kevin Zhang, and Sindy KY Tang
Stanford University, USA

Invited Speaker II

Session Chair:
Regina Luttge, *Eindhoven University of Technology, NETHERLANDS*

BALLROOM A

09:05 **ONE-STEP RT-PCR FOR DETECTION OF MICRORNAS IN EXOSOMES USING DROPLET MICROFLUIDICS**
Binbin Cui, Chunchen Liu, and Shuhuai Yao
Hong Kong University of Science and Technology, HONG KONG

Panel Discussion

Panel Moderator:
Ellis Meng, *University of Southern California, USA*

BALLROOM A

09:25 **Panel Discussion with Catherine Klapperich, Sindy KY Tang, and Shuhuai Yao**

10:05 **Break and Exhibit Inspection**

Session IXa – Infrared Detectors

Session Chair:
Shuji Tanaka, *Tohoku University, JAPAN*

BALLROOM A

10:35 **INVITED SPEAKER**
LOW-COST LWIR-BAND CMOS INFRARED (CIR) MICROBOLOMETERS FOR HIGH VOLUME APPLICATIONS
Tayfun Akin
Mikrosens Elektronik San. ve Tic. A.Ş., TURKEY

11:05 **SLOW-LIGHT-ENHANCED WAVEGUIDE-INTEGRATED BLACK PHOSPHORUS MID-INFRARED PHOTODETECTOR**
Yiming Ma[1,2], Bowei Dong[1], Jingxuan Wei[1], Yuhua Chang[1], Weixin Liu[1], and Chengkuo Lee[1,2]
[1]*National University of Singapore, SINGAPORE and*
[2]*NUS Suzhou Research Institute (NUSRI), CHINA*

Session IXa – Infrared Detectors
Continued

BALLROOM A

11:20 **MONOLITHIC INTEGRATION OF PLASMONIC META-MATERIAL ABSORBER WITH CMOS-MEMS INFRARED SENSOR FOR RESPONSIVITY ENHANCEMENT AND HUMAN DETECTION APPLICATION**
Pen-Sheng Lin[1], Ting-Wei Shen[2], Kai-Chieh Chang[3], and Weileun Fang[1]
[1]*National Tsing Hua University, TAIWAN,* [2]*Taiwan Semiconductor Manufacturing Company (TSMC) Ltd., TAIWAN, and* [3]*Asia Pacific Microsystem, Inc., TAIWAN*

11:35 **UNCOOLED $Si_XGe_YO_{1-X-Y}$ MICROBOLOMETER STACK FOR LWIR DETECTION**
Amjed Abdullah[1], Tao Liu[2], Edward Kinzel[2], and Mahmoud Almasri[1]
[1]*University of Missouri, Columbia, USA,* [2]*University of Notre Dame, USA*

Session IXb – Advanced Biomaterials
Session Chair:
Boris Stoeber, *University of British Columbia, CANADA*

ROOM 109/110

10:35 **INVITED SPEAKER**
SMART MATERIALS FOR BIOELECTRONICS PLATFORMS
Francesca Santaro
Italian Institute of Technology, ITALY

11:05 **A STRETCHABLE PRESSURE AND STRAIN SENSOR USING CONDUCTIVE SILK HYDROGELS**
Shan Zhang[1,2], Zhitao Zhou[1], and Tiger H. Tao[1,2]
[1]*Chinese Academy of Sciences (CAS), CHINA and* [2]*University of Chinese Academy of Sciences (UCAS), CHINA*

11:20 **PAAM/PEDOT:PSS HYDROGEL BASED HYBRID SENSOR FOR SIMULTANEOUS DETECTION OF PRESSURE AND TEMPERATURE**
Seokgyu Ko, Hyosang Yoon, Ashok Chhetry, and Jaeyoung Park
Kwangwoon University, KOREA

11:35 **JELLYFISH-LIKE HYDROGELS FOR TRANSPARENT, SELF-HEALING AND ULTRA-STRECHABILE SENSORS AND ACTUATORS**
Yu Long, Peisheng He, Fanping Sui, and Liwei Lin
University of California, Berkeley, USA

11:50 **Lunch on Own and Exhibit Inspection**

Poster/Oral Session III

BALLROOM B/C

13:10 **Poster/Oral Session III**
Poster presentations are listed by topic category with their assigned number starting on page **24**.

14:40 **Break and Exhibit Inspection**

Session Xa – Resonant Transducers

Session Chair:
Dana Weinstein, *Purdue University, USA*

BALLROOM A

15:10 INVITED SPEAKER
CMOS-MEMS RESONANT TRANSDUCERS FOR FREQUENCY CONTROL AND SENSING
Sheng-Shian Li and Shyam Trivedi
National Tsing Hua University, TAIWAN

15:40 AWARD NOMINEE*
A MICRO RESONANT ELECTROMETER WITH SINGLE-ELECTRON CHARGE RESOLUTION AT ROOM TEMPERATURE
Dongyang Chen[1,2], Hemin Zhang[2], Jiangkun Sun[2,3], Milind Pandit[2], Guillermo Sobreviela[2], Yong Wang[1], Qian Zhang[1], Ashwin Seshia[2], and Jin Xie[1]
[1]*Zhejiang University, CHINA,* [2]*University of Cambridge, UK, and* [3]*National University of Defense Technology, CHINA*

15:55 **BETA GALLIUM OXIDE (β-Ga_2O_3) VIBRATING CHANNEL TRANSISTOR**
Xu-Qian Zheng, Jaesung Lee, and Philip X.-L. Feng
University of Florida, USA

16:10 **A MODE-LOCALIZED MAGNETOMETER WITH RESOLUTION OF 6.9NT/$\sqrt{}$Hz WITHIN THE RANGE OF 100 MT**
Wenmu Li, Fang Ye, Bing Ruan, Yongcun Hao, and Honglong Chang
Northwestern Polytechnical University, CHINA

Session Xb – Gas Sensors

Session Chair:
Hanseup Kim, *University of Utah, USA*

ROOM 109/110

15:10 INVITED SPEAKER
MEMS GAS SENSORS - FROM NANOMATERIALS TO MICROELECTRODES
Changhui Zhao, Huimin Gong, Gaoqiang Niu, and Fei Wang
Southern University of Science and Technology, CHINA

15:40 AWARD NOMINEE*
AN INTEGRATED CMOS MEMS GAS FLOW SENSOR WITH DETECTION LIMIT TOWARDS MICROMETER PER SECOND
Wei Xu[1], Xiaoyi Wang[2], Xiaojin Zhao[1], Zongqin Ke[1], and Yi-Kuen Lee[2]
[1]*Shenzhen University, CHINA and*
[2]*Hong Kong University of Science and Technology, CHINA*

15:55 **GAS DETECTION BY NEAR-INFRARED SPECTROSCOPY BASED ON A SURFACE PLASMON RESONANCE PHOTODETECTOR**
Yosuke Yamamoto[1], Masaaki Oshita[1], Masahiro Fukasawa[1], Shiro Saito[2], and Tetsuo Kan[1]
[1]*University of Electro-Communications, JAPAN and*
[2]*Aisin Cosmos R&D Co., Ltd., JAPAN*

16:10 **OPTIMIZATION OF NANO-COPPER AS H_2S GAS SENSING MATERIAL BY QUANTITATIVELY EVALUATING THERMODYNAMIC ENTHALPY WITH RESONANT MICROCANTILEVER**
Ming Li[1,2], Pengcheng Xu[1,2], Haitao Yu[1,2], Xueqing Wang[1,2], Ying Chen[1,2], and Xinxin Li[1,2]
[1]*Chinese Academy of Sciences (CAS), CHINA and*
[2]*University of Chinese Academy of Sciences (UCAS), CHINA*

Session XIa – Resonant NEMS & MEMS

Session Chair:
Raafat Mansour, *University of Waterloo, CANADA*

BALLROOM A

16:25 INVITED SPEAKER
RESONANT NANOELECTROMECHANICAL SYSTEMS (NEMS): PROGRESS AND EMERGING FRONTIERS
Philip X.-L. Feng
University of Florida, USA

16:55 **MONOLITHIC MEMS FILTER BANKS ON RFSOI FRONT-END MODULE**
Humberto Campanella[1,2], You Qian[1], Christian O. Romero[1], Joan Giner[1], and Rakesh Kumar[1]
[1] *Global Foundries, SINGAPORE and* [2] *Tyndall National Institute, IRELAND*

17:10 **SINGLE-DIGIT-NANOMETER CAPACITIVE-GAP TRANSDUCED MICROMECHANICAL DISK RESONATORS**
Alper Ozgurluk, Kieran Peleaux, and Clark T.-C. Nguyen
University of California, Berkeley, USA

17:25 **CAPACITIVE LAMÉ MODE RESONATORS IN 65 µM-THICK MONOCRYSTALLINE SILICON CARBIDE WITH Q-FACTORS EXCEEDING 20 MILLION**
Jeremy Yang, Benoit Hamelin, and Farrokh Ayazi
Georgia Institute of Technology, USA

17:40 **AN EPI-SEAL ENCAPSULATED FRANKLIN OSCILLATOR SUSTAINING MORE THAN 200,000,000 ELECTRIC SWITCHING CYCLES**
Danny A. Kassie[1], Ian B. Flader[2], Shai Shmulevich[1], Hyun-Keun Kwon[2], Thomas W. Kenny[2], and David Elata[1]
[1] *Technion - Israel Institute of Technology, ISRAEL and*
[2] *Stanford University, USA*

TUESDAY

Session XIb – Flexible Bioelectronics & Biomaterials

Session Chair:
Bonnie Gray, *Simon Fraser University, CANADA*

ROOM 109/110

16:25 INVITED SPEAKER
ORGANIC CONDUCTING POLYMERS FOR BIOELECTRONICS
Fabio Cicoira
Polytechnique Montréal, CANADA

16:55 **OUT-OF-PLANE FLEXIBLE ELECTRONIC WHISKER ARRAY**
Seiji Wakabayashi[1], Takafumi Yamaguchi[1], Takayuki Arie[1], Seiji Akita[1], and Kuniharu Takei[1,2]
[1] *Osaka Prefecture University, JAPAN and*
[2] *Japan Science and Technology Agency (JST), JAPAN*

17:10 AWARD NOMINEE*
SELF-HEALING, HIGHLY-STRETCHABLE, TRANSPARENT, AND ION-CONDUCTING HYDROGEL ELECTROLYTE-BASED MICROSUPERCAPACITOR FOR FLEXIBLE ELECTRONICS
Peisheng He, Yu Long, Renxiao Xu, Guangchen Lan, and Liwei Lin
University of California, Berkeley, USA

17:25 **LOCALLY BENDABLE STIMULI-RESPONSIVE HYDROGEL ACTUATOR WITH AXIALLY PATTERNED FUNCTIONAL MATERIALS**
Nobuki Takeuchi[1], Shunsuke Nakajima[1], Ryuji Kawano[2], Yutaka Hori[1], and Hiroaki Onoe[1]
[1] *Keio University, JAPAN and* [2] *Tokyo University of Agriculture and Technology, JAPAN*

Session XIb – Flexible Bioelectronics & Biomaterials
Continued

ROOM 109/110

17:40 **SOFT AND FLEXIBLE 3D-STRUCTURED DEVICE WITH CRACK-FREE METAL PATTERNS**
Hyunmin Moon and Sohee Kim
Daegu Gyeongbuk Institute of Science and Technology (DGIST), KOREA

17:55 **Adjourn for the Day**

19:00 – 22:00 **Tuesday Evening Event at the Vancouver Aquarium**

Totem Poles at Capilano Suspension Bridge Park in North Vancouver

Plenary Speaker IV

Session Chair:
Ryan Sochol, *University of Maryland, College Park, USA*

BALLROOM A

08:00 **3D LASER NANOPRINTING**
Martin Wegener
Karlsruhe Institute of Technology (KIT), GERMANY

Session XII – Inertial Sensors

Session Chairs:
Nicole Kerness, *QST Solutions, USA*
Valentina Zega, *Politecnico di Milano, ITALY*

BALLROOM A

08:45 **INVESTIGATING LONG-TERM STABILITY OF WIDE BANDWIDTH SURFACE ACOUSTIC WAVES GYROSCOPES USING A MONOLITHICALLY INTEGRATED MICRO-OVEN**
Ashraf Mahmoud, Tamal Mukherjee, and Gianluca Piazza
Carnegie Mellon University, USA

09:00 **A CORIOLIS FORCE COMPENSATED MICRO THERMAL CONVECTIVE ACCELEROMETER WITH LOW CROSSING EFFECT**
Xiaoyi Wang[1], Xu Zhao[1], Huahuang Luo[1], Wei Xu[2], and Yi-Kuen Lee[1]
[1]*Hong Kong University of Science and Technology, HONG KONG and* [2]*Shenzhen University, CHINA*

09:15 **MODELING AND FIRST CHARACTERIZATION OF BROAD-SPECTRUM VIBRATION REJECTION OF FREQUENCY MODULATED GYROSCOPES**
Marco Bestetti, Valentina Zega, and Giacomo Langfelder
Politecnico di Milano, ITALY

09:30 **A <100 PPB/K FREQUENCY-MATCHING TEMPERATURE STABILITY MEMS RATE INTEGRATING GYROSCOPE ENABLED BY DONUT-MASS STRUCTURE**
Shiori Kaji[1], Ryunosuke Gando[1], Kei Masunishi[1], Etsuji Ogawa[1], Fumito Miyazaki[1], Hiroki Hiraga[1], Yasushi Tomizawa[1,2], and Hideki Shibata[1,2]
[1]*Toshiba Corporation, JAPAN and* [2]*Device & System Platform Development Center Co., Ltd., JAPAN*

09:45 **Break**

Session XIII – Power MEMS

Session Chairs:
Hanna Cho, *Ohio State University, USA*
David Elata, *Technion - Israel Institute of Technology, ISRAEL*

BALLROOM A

10:15 **SELF-POWERED WIRELESS IOT SENSOR BASED ON TRIBOELECTRIC TEXTILE**
Tianyiyi He[1], Feng Wen[1], Hao Wang[1], Qiongfeng Shi[1], Zhongda Sun[1], Zixuan Zhang[1], Ting Zhang[2], and Chengkuo Lee[1]
[1]*National University of Singapore, SINGAPORE and* [2]*Chinese Academy of Sciences (CAS), CHINA*

10:30 **A PLANAR ARCHITECTURE WITH DUAL-NONLINEARITY FOR BANDWIDTH EXTENSION OF A MULTI-MODAL ENERGY HARVESTER**
Kai Wang, Xiufeng Shao, Xuhan Dai, Zhuoqing Yang, Guifu Ding, and Xiaolin Zhao
Shanghai Jiao Tong University, CHINA

Session XIII – Power MEMS
Continued

BALLROOM A

10:45 **SILICON-CHIP BASED ELECTROMAGNETIC VIBRATION ENERGY HARVESTERS RAPIDLY FABRICATED BY WAFER-LEVEL MOLTEN METAL MICRO-CASTING TECHNIQUE**
Ruofeng Han[1], Nianying Wang[1], Dacheng Xu[2], Jiebin Gu[1], and Xinxin Li[1]
[1]*Chinese Academy of Sciences (CAS), CHINA and*
[2]*Soochow University, CHINA*

Session XIV – Fabrication & Materials
Session Chairs:
Anu Kärkkäinen, *VTT, FINLAND*
Frank Niklaus, *KTH Royal Institute of Technology, SWEDEN*

BALLROOM A

11:00 **FABRICATION OF SINGLE-CRYSTAL SILICON NANOSLITS WITH FEATURE SIZES DOWN TO 4 NM AND HIGH LENGTH-WIDTH RATIOS**
Li Ye, Hao Hong, and Zewen Liu
Tsinghua University, CHINA

11:15 **BROADBAND ANTIREFLECTIVE QUARTZ GLASSES WITH DOUBLE-SIDE NANOCONE FORESTS**
Yudong Yang[1], Haiyang Mao[1,3], Jin Li[2], Meng Shi[1], Kewen Long[4], and Dapeng Chen[1,3]
[1]*Chinese Academy of Sciences (CAS), CHINA,*
[2]*Suzhou Research Materials Microtech Co., Ltd, CHINA,*
[3]*Wuxi Internet of Things Innovation Center Co. Ltd., CHINA, and*
[4]*Foshan Chuandong Magnetic Electronics, CHINA*

11:30 **HIGHLY TRANSPARENT POROUS POLYDIMETHYLSILOXANE WITH MICRO-SIZE PORES USING WATER AND ISOPROPANOL MIXTURE**
Yeunjun Kwak, Eunhwan Jo, Yunsung Kang, and Jongbaeg Kim
Yonsei University, KOREA

11:45 **MEMS STICTION SUPPRESSION USING LOW-STRESS CAMPHOR SUBLIMATION**
Rugved Likhite, Aishwaryadev Banerjee, Chayanjit Ghosh, Apratim Majumder, Mohit Karkhanis, Hanseup Kim, and Carlos H. Mastrangelo
University of Utah, USA

Award Ceremony

BALLROOM A

12:00 **Award Ceremony and Final Remarks**

12:30 **Conference Adjourns**


Canada Place, Vancouver

BALLROOM B/C

SUNDAY	MONDAY	TUESDAY
13:30 – 15:30	13:45 – 15:45	13:10 – 15:10

TRACK/CLASSIFICATION

- Bio & Medical MEMS
- EMS Actuators & PowerMEMS
- EMS Physical Sensors
- Materials, Fabrication and Packaging for Generic MEMS & NEMS
- Micro- & Nanofluidics
- Optical, RF and Electromagnetics for MEMS
- Technical Topics on MEMS Products
- Industry Open Posters

See poster floor plan at the end of this program.

Bio and Medical MEMS

Biosensors and Bioreactors

S-001 **A SELECTIVE ELECTROCHEMICAL DOPAMINE SENSOR BASED ON SILOXENE NANOSHEET**
Rajendran Ramachandran, Minzhang Li, Chengjie Ge, Zong Xiang Xu, and Fei Wang
Southern University of Science and Technology, CHINA

M-002 **CMOS ION SENSITIVE FIELD EFFECT TRANSISTORS FOR DETECTION OF DNA HYBRIDIZATION UNDER DEBYE SCREENING EFFECT**
Chieh Lee and Michael S.-C. Lu
National Tsing Hua University, TAIWAN

T-003 **CHARACTERIZING ELECTROGENIC CAPABILITIES OF HUMAN GUT MICROBES**
Mehdi Tahernia, Yang Gao, Maedeh Mohammadifar, Melissa R. Oefelein, Laura C. Cook, and Seokheun Choi
State University of New York, Binghamton, USA

S-004 **IMPEDIMETRIC PLANT BIOSENSOR BASED ON MINIMALLY INVASIVE AND FLEXIBLE MICRONEEDLE ELECTRODES**
Abdullah Bukhamsin, Khalil Moussi, Niketan Patel, Alex Przybysz, Yajun Wang, Simon Krattinger, and Jürgen Kosel
King Abdullah University of Science and Technology (KAUST), SAUDI ARABIA

M-005 **NANOPIN - A MEMS BASED SENSOR FOR THE ANALYSIS OF SINGLE CELL MECHANICAL PROPERTIES**
Momoko Kumemura[1], Lili C. Kudo[2], Zhongcai Ma[2], and Stanislav L. Karsten[2]
[1]*Kyushu Institute of Technology, JAPAN and* [2]*NeuroInDx. Inc., USA*

T-006 **SIMULTANEOUS QUANTIFICATION AND IDENTIFICATION OF PROTEIN BY METAMATERIAL PERFECT ABSORBER**
Dongxiao Li[1], Hong Zhou[1], Xindan Hui[1], Donglin Hu[1], Cheng Yang[2], Xin Chen[1], Ming Chen[2], and Xiaojing Mu[1]
[1]*Chongqing University, CHINA and* [2]*Third Military Medical University, CHINA*

S-007 **SURFACE-ENHANCED INFRARED ABSORPTION-BASED BIOSENSOR AND ITS APPLICATION TO DNA IDENTIFICATION**
Xindan Hui[1], Hong Zhou[1], Dongxiao Li[1], Donglin Hu[1], Cheng Yang[2], Hongzhi Pan[1], Ming Chen[2], and Xiaojing Mu[1]
[1]*Chongqing University, CHINA and* [2]*Third Military Medical University, CHINA*

Bio and Medical MEMS

Manufacturing for Bio- & Medical MEMS & Microfluidics

M-008 **AWARD NOMINEE***
3D HYDROGEL MANUFACTURING EMPLOYING SELF-FOCUSING DURING PHOTO-CURING PROCESS
Gayeong Lee[1], Hidetoshi Takahashi[2], Tetsuo Kan[3], Jieun Kim[1], Nilsu Donmez[1], Jihoon Park[1], Dongwook Kim[1], Sanghoon Ka[1], Misong Nam[1], Donggi Lim[1], and Yun Jung Heo[1]
[1]*Kyung Hee University, KOREA,* [2]*Keio University, JAPAN, and* [3]*University of Electro-Communications, JAPAN*

T-009 **LOCALLY-PATTERNED PARYLENE MEMBRANE ENABLES ELECTRICAL RESISTANCE MEASUREMENT FOR A CELLULAR BARRIER CONSISTING OF < 100 CELLS**
Takumi Yamada, Minghao Nie, Ai Shima, Yuya Morimoto, and Shoji Takeuchi
University of Tokyo, JAPAN

S-010 **PRECISE MANUFACTURING AND ASSEMBLY OF 3D METAL-ORGANIC FRAMEWORKS USING NATURAL PROTEIN TEMPLATES**
Jianjuan Jiang[1] and Tiger H. Tao[1,2]
[1]*Chinese Academy of Sciences (CAS), CHINA and*
[2]*University of Chinese Academy of Sciences (UCAS), CHINA*

M-011 **PROGRAMMABLE DEGRADATION OF TRANSIENT SOLUBLE SILK BASED OPTICAL DEVICES VIA THERMAL NANOIMPRINTING**
Jianjuan Jiang[1], Zhitao Zhou[1,2], Yanghong Zhang[1,2], and Tiger H. Tao[1,2]
[1]*Chinese Academy of Sciences (CAS), CHINA and*
[2]*University of Chinese Academy of Sciences (UCAS), CHINA*

T-012 **STRETCHABLE AND PERFUSABLE MICROFLUIDIC DEVICE FOR CELL BARRIER MODEL**
Ryosuke Suzuki, Yuya Morimoto, Ai Shima, and Shoji Takeuchi
University of Tokyo, JAPAN

S-013 **WEARABLE MULTI VITAL MONITOR FOR NEWBORNS**
Go Inamori[1], Yutaka Isoda[1], Umihiro Kamoto[1], Azusa Uozumi[2], Shuichi Ito[2], and Hiroki Ota[1]
[1]*Yokohama National University, JAPAN and*
[2]*Yokohama City University, JAPAN*

Bio and Medical MEMS

Materials for Bio- and Medical MEMS

M-014 **3D POCKET-SHAPE DERMIS-EQUIVALENT AS A SKIN MATERIAL FOR A ROBOTIC FINGER**
Michio Kawai, Minghao Nie, Haruka Oda, Yuya Morimoto, and Shoji Takeuchi
University of Tokyo, JAPAN

T-015 **DANDELION FLOWER LIKE, APTES FUNCTIONALIZED GALLIUM NITRIDE MICROSPHERE FOR FLUORESCENCE DETECTION OF BOVINE SERUM ALBUMIN PROTEIN**
Manimuthu Veerappan and Fei Wang
Southern University of Science and Technology, CHINA

S-016 **FACILE METHODS TO MAKE PDMS HYDROPHILIC: A TIME EVOLUTION STUDY FOR MICROFLUIDIC DEVICES**
Daniel J. O'Brien, Andrew J. Sedlack, and Makarand Paranjape
Georgetown University, USA

Bio and Medical MEMS

Medical Microsystems (Probes, Implantables, Minimally Invasive, Etc.)

M-017 **A FLEXIBLE AND STRETCHABLE KIRIGAMI-INSPIRED IMPLANTABLE NEURAL PROBE WITH FLOATING MICROSITES FOR ELECTROPHYSIOLOGY RECORDINGS**
Zhejun Guo[1], Bowen Ji[1], Longchun Wang[1], Bin Yang[1], Wei Wang[2], and Jingquan Liu[1]
[1]*Shanghai Jiao Tong University, CHINA and* [2]*Peking University, CHINA*

T-018 **ACCESSING ANALYTES WITHIN ON-SKIN FLUIDS WITH WIRELESS EPIDERMAL OPTOELECTRONICS FOR BIOMEDICAL MONITORING**
Yujia Zhang[1,2] and Tiger H. Tao[1,2,3,4,5]
[1]*Chinese Academy of Sciences (CAS), CHINA,* [2]*University of Chinese Academy of Sciences (UCAS), CHINA,* [3]*ShanghaiTech University, CHINA,* [4]*Zhangjiang Laboratory, CHINA, and* [5]*Shanghai Brain/AI Center, CHINA*

S-019 **AN RF-POWERED WIRELESS MICRO-HEATER INTEGRATED WITH ACRYLATE-COMPOSITE-BASED TEMPERATURE REGULATOR FOR HYPERTHERMIA TREATMENT**
Chao-Chi Yeh and Yao-Joe Yang
National Taiwan University, TAIWAN

M-020 **CONCENTRIC, MEMS-BASED OPTOELECTROMECHANICAL PACER FOR MULTIMODAL CARDIAC EXCITATION**
Tobias Weber, Callum M. Zgierski-Johnston, Eric Klein, Suleman Ayub, Peter Kohl, Oliver Paul, and Patrick Ruther
University of Freiburg, GERMANY

T-021 **DERMAL ISF COLLECTION USING A Si MICRONEEDLE ARRAY**
Caleb A. Berry, Zachary R. Smith, Scott D. Collins, and Rosemary L. Smith
University of Maine, USA

S-022 **HETEROGENEOUS AND MULTIFUNCTIONAL SILK MICRONEEDLES FOR *IN SITU* TREATMENT OF BRAIN GLIOMA**
Zijing Wang[1,2], Ruofeng Han[2], Zhifeng Shi[3], Ying Mao[3], Tiger H. Tao[2], and Nan Qin[2]
[1]*Shanghai Normal University, CHINA,* [2]*Chinese Academy of Sciences (CAS), CHINA, and* [3]*Huashan Hospital of Fudan University, CHINA*

M-023 **HIGH-DENSITY MICRONEEDLE ARRAY (HIDMA): AN *IN VIVO* ELECTROPORATION METHOD FOR LOW-VOLTAGE GENE DELIVERY**
Junshi Li[1], Tongren Yang[2], Dong Huang[1], Yufeng Chen[1], Yuanyu Huang[2], and Zhihong Li[1]
[1]*Peking University, CHINA and* [2]*Beijing Institute of Technology, CHINA*

T-024 **HIGH-SPEED AND STEPPING MEMS ROTARY ACTUATOR FOR MULTIMODAL, 360° SIDE-VIEWING ENDOSCOPIC PROBES**
Sayed Mohammad Hashem Jayhooni[1], Babak Assadsangabi[1], Geoffrey Hohert[2], Pierre Lane[2], Haishan Zeng[2], and Kenichi Takahata[1]
[1]*University of British Columbia, CANADA and*
[2]*British Columbia Cancer Research Centre, CANADA*

S-025 **HIGHLY STRETCHABLE MICROELECTRODE ARRAY FOR FREE-FORM 3D NEURONAL TISSUE**
Chaeyun Shim[1], Yehhyun Jo[1], Hyo Kyeong Cha[2], Mi Kyung Kim[1], Hyojung Kim[1], Geon Kook[1], Kiup Kim[1], Gi Hoon Son[2], and Hyunjoo J. Lee[1]
[1]*Korea Advanced Institute of Science and Technology (KAIST), KOREA and* [2]*Korea University, KOREA*

Medical Microsystems (Probes, Implantables, Minimally Invasive, Etc.)

M-026 **IMPLANTED WIRELESS INTRAMEDULLARY FLUID MODULATOR FOR BONE DENSITY AUGMENTATION**
Ziyu Chen[1], Sunggi Noh[2], Rhonda D. Prisby[2], and Jeong-Bong Lee[1]
[1] *University of Texas, Dallas, USA and* [2] *University of Texas, Arlington, USA*

T-027 **LEAKY OPTO-ELECTRICAL NEURAL PROBE FOR OPTICAL STIMULATION AND ELECTROCHEMICAL DETECTION OF DOPAMINE EXOCYTOSIS**
Shashank Vasudevan, Janko Kajtez, Arto Heiskanen, Jenny Emnéus, and Stephan S. Keller
Technical University of Denmark, DENMARK

S-028 **MICROFLUIDIC CHIP FOR SIMULTANEOUS LOADING AND INJECTION OF A SINGLE CELL BY USING RACK AND PINION MECHANISMS**
Kevin T. Uning, Keita Ichikawa, Akiho Hirao, Taiga Michimoto, Tasuku Sato, Hiroaki Kume, Takumi Nishida, Shota Iwakawa, and Yoko Yamanishi
Kyushu University, JAPAN

M-029 **MICROMACHINED SHAPE MEMORY ALLOY ACTIVE STENT WITH WIRELESS MONITORING AND RE-EXPANSION FEATURES**
Yong Xian Ang, Farah Afiqa Mohd Ghazali, and Mohamed Sultan Mohamed Ali
Universiti Teknologi Malaysia, MALAYSIA

T-030 **PULSED WAVE DOPPLER ULTRASOUND USING 3.7 MHZ PMUTS TOWARD WEARABLE BLOOD FLOW MEASUREMENTS**
Hong Ding[1], Dengfei Yang[1], Jinghui Xu[2], Xuying Chen[1], Xianhao Le[1], Yong Wang[1], Liwei Lin[3], and Jin Xie[1]
[1] *Zhejiang University, CHINA,* [2] *University of California, Berkeley, USA,* [3] *Jilin University, CHINA, and* [4] *Guangzhou Chen Fang Info Tech Ltd., CHINA*

S-031 **SKIN-ATTACHABLE AND IMPLANTABLE POLYMER MICRONEEDLE BIOSENSOR FOR CONTINUOUS GLUCOSE MONITORING**
Hyunsik Kim[1], Hyosang Yoon[1], Md. Sharifuzzaman[1], Jongcheol Park[2], Daeheum Kim[1], and Jaeyeong Park[1]
[1] *Kwangwoon University, KOREA and* [2] *National Nanofab Center, KOREA*

M-032 **TRANSDERMAL DRUG DELIVERY BASED ON LIQUID NEEDLES GENERATED BY HYPERSONIC SYSTEMS**
Ji Liu, Xinyi Guo, Mengjie Sun, Huihui Xu, Wei Pang, and Xuexin Duan
Tianjin University, CHINA

T-033 **TWO-LAYER SCAFFOLD PLATFORMS FOR DRUG SCREENING OF NASOPHARYNGEAL EPITHELIAL CELLS**
Bowie P. Lam, Ka Chi Sarah Cheung, Yun Wah Lam, and Stella W. Pang
City University of Hong Kong, HONG KONG

S-034 **ULTRA-FLEXIBLE NEURAL PROBES WITH ELECTROCHEMICAL MODIFIED ELECTRODES FOR RELIABLE, CHRONICAL RECORDING**
Yu Zhou[1,2], Zhitao Zhou[1], Ming Li[1], Tiger H. Tao[1,2], and Xiaoling Wei[1]
[1] *Chinese Academy of Sciences (CAS), CHINA and*
[2] *University of Chinese Academy of Sciences (UCAS), CHINA*

M-035 **ULTRA-THIN, ULTRA-CONFORMAL NEURAL INTERFACES**
Ting Xiao[1,2], Zhitao Zhou[2,3], Faming Zheng[2,3], Yu Zhou[2,3], Feihong Xu[2,3], Shan Zhang[2,3], Zhifeng Shi[2], Ying Mao[4], and Tiger H. Tao[2,3]
[1] *Shanghai Normal University, CHINA,* [2] *Chinese Academy of Sciences (CAS), CHINA,* [3] *University of Chinese Academy of Sciences (UCAS), CHINA, and* [4] *Fudan University, CHINA*

T-036 **WAFER-SCALE GRAPHENE-BASED SOFT ELECTRODE ARRAY WITH OPTOGENETIC COMPATIBILITY**
Andrada I. Velea[1], Sten Vollebregt[1], Gandhika K. Wardhana[1], and Vasiliki Giagka[1,2]
[1] *TU Delft, NETHERLANDS and* [2] *Fraunhofer IZM, GERMANY*

Bio and Medical MEMS

Nanobiotechnology

S-037 **BIOGENIC PALLADIUM NANOPARTICLES FOR IMPROVING BIOELECTRICITY GENERATION IN MICROBIAL FUEL CELLS**
Mehdi Tahernia, Maedeh Mohammadifar, Shuai Feng, and Seokheun Choi
State University of New York, Binghamton, USA

M-038 **MOTILITY OF MICROTUBULES DRIVEN BY KINESIN IN A VISCOELASTIC MEDIA ON AU NANO-PILLAR SUBSTRATE**
Masayuki Furukawa, Taikopaul Kaneko, and Ryuji Yokokawa
Kyoto University, JAPAN

T-039 **NANO CAPSULE BASED CHEMICAL RELEASING SYSTEM FOR INSECT-COMPUTER HYBRID ROBOT**
Long D. Le[1], Keitaro Sou[1,2], and Hirotaka Sato[1]
[1]*Nanyang Technological University, SINGAPORE and*
[2]*Waseda University, JAPAN*

Bio and Medical MEMS

Tissue Engineering

S-040 **3D SILK-BASED BIOELECTRONIC SCAFFOLDS FOR OSTEOCHONDRAL REGENERATION**
Zhiheng Gao[1,2], Shengkun Li[3], Fang Chen[2], Yinghui Hua[3], Tiger H. Tao[1,2], and Keyin Liu[2]
[1]*ShanghaiTech University, CHINA,* [2]*Chinese Academy of Sciences (CAS), CHINA, and* [3]*Huashan Hospital of Fudan University, CHINA*

T-041 **AIRWAY-ON-A-CHIP: DEVELOPMENT AND *IN VITRO* VALIDATION OF A MICROFLUIDIC CELL CULTURE MODEL FOR CHRONIC OBSTRUCTIVE PULMONARY DISEASE**
Tanya J. Bennet[1], Brenda Shen[2], Jeremy Siwik[3], Stephanie Pan[1], Cheng Wei Tony Yang[1], Tillie Hackett[1], Don D. Sin[1], Tillie L. Hackett[1], and Karen C. Cheung[1]
[1]*University of British Columbia, CANADA,* [2]*McGill University, CANADA, and* [3]*University of Arizona, USA*

S-042 **AN ON-CHIP VASCULAR NETWORK TO INVESTIGATE PERICYTE MIGRATION AND INTERCELLULAR SIGNALING**
Scott Erickson[1], Hiroki Ihara[1], Sanshiro Hanada[2], Koichi Nishiyama[2], Takashi Miura[3], and Ryuji Yokokawa[1]
[1]*Kyoto University, JAPAN,* [2]*Kumamoto University, JAPAN, and* [3]*Kyushu University, JAPAN*

M-043 **ASSEMBLY OF MODULAR TISSUE STRUCTURE OF MICRO-FIBERS USING MAGNETIC FORCE AND CAPILLARY FORCE**
Zhaoyu Wang, Taisuke Masuda, Katsuki Miki, Hisataka Maruyama, and Fumihito Arai
Nagoya University, JAPAN

T-044 **CONTROLLED STRAIN OF CARDIAC MICROTISSUE VIA MAGNETIC ACTUATION**
Joshua Javor, Subramanian Sundaram, Christopher Chen, and David J. Bishop
Boston University, USA

S-045 **FORMATION OF MICRO-SIZE PERFUSABLE CHANNELS IN MM-THICK MUSCLE TISSUE**
Yasuaki Ishii, Yuya Morimoto, Ai Shima, and Shoji Takeuchi
University of Tokyo, JAPAN

Tissue Engineering

M-046 **MICRO TISSUE ASSEMBLY FOR CO-CULTURING 3D SKELETAL MUSCLE AND ADIPOSE TISSUES**
Byeongwook Jo, Minghao Nie, Ai Shima, Yuya Morimoto, and Shoji Takeuchi
University of Tokyo, JAPAN

T-047 **QUALITY PREDICTION OF EMBRYONIC BODIES ON INTEGRATED SPHEROID CULTURE CHIP BY USING 3D CONVOLUTIONAL NEURAL NETWORK**
Shuya Suda[1], Chihiro Aoyama[1], and Masashi Ikeuchi[1,2]
[1]*University of Tokyo, JAPAN and* [2]*Cymss-bio Inc., JAPAN*

Bio and Medical MEMS

Other

S-048 **A HIGH SENSITIVE AND LOW PARASITIC CAPACITANCE FOLDING MICRO COIL WITH MULTILAYERED ZIGZAG DIAMETER WIRING**
Tomohiko Izumizaki, Masataka Hori, and Tetsuji Dohi
Chuo University, JAPAN

M-049 **A MICROCHAMBER DEVICE FOR EVALUATION OF THE BARRIER FUNCTIONS OF EPITHELIAL CELLS**
Masayoshi Nakano, Mamiko Tsugane, Daichi Sakuma, Fumiko Sunaga, and Hiroaki Suzuki
Chuo University, JAPAN

T-050 ***IN-SITU* ELECTROPORATION ON A MICROPORE-ARRAYED FILTER FOR CELL LABELLING**
Tingting Hun[1], Yaoping Liu[1], Yechang Guo[1], Dong Huang[1], Mingxin Xu[2], Qi Wang[2], Zhihong Li[1,3], and Wei Wang[1,3]
[1]*Peking University, CHINA,* [2]*Dalian Medical University, CHINA, and* [3]*National Key Laboratory of Science and Technology on Micro/Nano Fabrication, CHINA*

S-051 **MICRO-FABRICATED SKIN-LIKE ALN/POLYIMIDE/PDMS SENSOR FOR OBSTRUCTIVE SLEEP APNEA MONITORING**
Tao Sun[1] and Wei Mong Tsang[2]
[1]*Massachusetts Institute of Technology, USA and*
[2]*Chongqing United Microelectronics Center Co., Ltd., CHINA*

M-052 **ON CHIP MONITORING OF TIGHT JUNCTIONS FORMED ON AN EPITHELIAL MONOLAYER AND THE EFFECT OF EXTRACELLULAR CALCIUM ION REMOVAL FROM APICAL AND BASAL SIDES**
Yuji Takata[1], Ryohei Ueno[1], Ramin Banan Sadeghian[2], Yang Liu[1], Kaori Naganuma[2], Kiyotaka Tsuji[2], and Ryuji Yokokawa[1]
[1]*Kyoto University, JAPAN and* [2]*Panasonic Corporation, JAPAN*

EMS Actuators & PowerMEMS

Actuator Components & Systems

T-053 **15 MILLINEWTON FORCE, 1 MILLIMETER DISPLACEMENT, LOW-POWER MEMS GRIPPER**
Craig B. Schindler, Hani C. Gomez, Dillon Acker-James, Daniel Teal, Wei Li, and Kristofer S.J. Pister
University of California, Berkeley, USA

S-054 **A CATERPILLAR-INSPIRED SOFT ROBOT BASED ON THERMAL EXPANSION**
Zihao Song, Ryosuke Matsuda, Ken Matsubara, Fumika Nakamura, and Hiroki Ota
Yokohama National University, JAPAN

Actuator Components & Systems

M-055 **A PLANAR SINGLE-ACTUATOR BI-STABLE MECHANICAL LATCH AS AN ELECTRICAL SWITCH**
Yang Bu[1], Yue Jiang[2], Saeko Kawano[3], Brian S.T. Tam[1], Sheng Ni[1], Liying Lin[1], Osamu Tabata[3], Toshiyuki Tsuchiya[3], Xiaohong Wang[2], and Man Wong[1]
[1] *Hong Kong University of Science and Technology, CHINA,*
[2] *Tsinghua University, CHINA, and* [3] *Kyoto University, JAPAN*

T-056 **DEVELOPMENT OF MICRO PUMP USING MAGNETIC ARTIFICIAL CILIA WITH METACHRONAL WAVE**
Hayato Shinoda and Fujio Tsumori
Kyushu University, JAPAN

S-057 **ELECTRICALLY CONTROLLED GEL ACTUATOR USING LIQUID METAL ELECTRODE**
Ken Matsubara, Yoshimi Tanaka, Ohmi Fuchiwaki, and Hiroki Ota
Yokohama National University, JAPAN

M-058 **MANIPULATION OF MICROSCALE OBJECTS UTILIZING THE SMECTIC-ISOTROPIC PHASE INTERFACE FORCE BY A LIQUID CRYSTALLINE MICROACTUATOR DEVICE**
Jose Eduardo Mejia, Tomohiro Tsuji, and Shigeomi Chono
Kochi University of Technology, JAPAN

T-059 **MICRO ELECTROMAGNETIC FLAT MOTOR USING AN 80-POLES AND 0.3-MM-THICK RING MAGNET FOR HIGH TORQUE**
Dong Han, Keita Nagai, and Tadahiko Shinshi
Tokyo Institute of Technology, JAPAN

S-060 **PIEZOELECTRIC MICROSPEAKER USING NOVEL DRIVING APPROACH AND ELECTRODE DESIGN FOR FREQUENCY RANGE IMPROVEMENT**
Hsu-Hsiang Cheng[1], Sung-Cheng Lo[1], Yi-Jia Wang[1], Yu-Chen Chen[1], Wei-Cheng Lai[1], Meng-Lin Hsieh[1], Mingching Wu[2], and Weileun Fang[1]
[1] *National Tsing Hua University, TAIWAN and*
[2] *CoretronicMEMS Co., Ltd., TAIWAN*

M-061 **RESONANT PZT MEMS MIRROR WITH SEGMENTED ELECTRODES**
Adrien Piot[1], Jaka Pribošek[1], Jordan Maufay[1], Johannes Schicker[1], Andreas Tortschanoff[1], Ramin Matloub[2], Paul Muralt[2], and Mohssen Moridi[1]
[1] *Silicon Austria Labs GmbH, AUSTRIA and*
[2] *École Polytechnique Fédérale de Lausanne (EPFL), SWITZERLAND*

T-062 **SELF-CLEANING DEVICE USING SAW ACTUATION**
Hyeonseok Song, Jeongmin Lee, Kang Yong Lee, and Sang Kug Chung
Myongji University, KOREA

S-063 **TOWARDS AERODYNAMIC CONTROL OF MINIATURE ROCKETS WITH MEMS CONTROL SURFACES**
Ahad M. Rauf, Brian G. Kilberg, Craig B. Schindler, Sang A. Park, and Kristofer S.J. Pister
University of California, Berkeley, USA

M-064 **WIDE ANGLE AND HIGH FREQUENCY (>120 DEGREES@ 10 KHZ/90 DEGREES@ 30 KHZ) RESONANT SI-MEMS MIRROR USING A NOVEL TUNING-FORK DRIVING**
Takami Ishida, Kazuki Komaki, Takakiyo Harigai, Ryoichi Takayama, and Takuma Katayama
Panasonic Corporation, JAPAN

EMS Actuators & PowerMEMS

Manufacturing for Actuators & PowerMEMS

T-065 **A MEMS PIEZOELECTRIC VIBRATION ENERGY HARVESTER BASED ON TRAPEZOIDAL CANTILEVER BEAM ARRAY**
Xianming He, Quan Wen, Zhiyu Wen, and Xiaojing Mu
Chongqing University, CHINA

S-066 **ELECTROMAGNETIC ENERGY HARVESTER WITH INERTIAL ROTARY STRUCTURE FOR HUMAN MOTION APPLICATION AT ULTRA-LOW FREQUENCY**
Anxin Luo[1,2], Yulong Zhang[1], Weihang Xu[1], Yan Lu[2], and Fei Wang[1]
[1] *Southern University of Science and Technology, CHINA and*
[2] *University of Macau, CHINA*

M-067 **PNIPAM/SWCNT-BASED HYDROGEL MICRO-GRIPPER DRIVEN BY INFRARED LIGHT FOR INTRAVASCULAR SURGERY**
Takaya Kuroda and Hiroaki Onoe
Keio University, JAPAN

T-068 **SELF-POWERED WIND SENSOR BASED ON TRIBOELECTRIC GENERATOR WITH CURVED FLAP ARRAY FOR MULTI-DIRECTIONAL WIND SPEED DETECTION**
Dae-Sung Kwon, Soonjae Pyo, and Jongbaeg Kim
Yonsei University, KOREA

S-069 **SOUND PRESSURE AND LOW FREQUENCY ENHANCEMENT USING NOVEL PZT MEMS MICROSPEAKER DESIGN**
Shih-Hsiung Tseng[1,2], Sung-Cheng Lo[1], Yi-Jia Wang[1], Shih-Wei Lin[1], Mingching Wu[2], and Weileun Fang[1]
[1] *National Tsing Hua University, TAIWAN and*
[2] *Coretronic MEMS Corp., TAIWAN*

M-070 **THIN-FILM PROCESSING TECHNOLOGIES OF PIEZOELECTRIC MATERIALS FOR IOT/IOE APPLICATIONS**
Hiroki Kobayashi, Kouhei Matsuoka, Tatsurou Tsuyuki, Akiyoshi Suzuki, Isao Kimura, Takehito Jinbo, and Koukou Suu
ULVAC, Inc., JAPAN

EMS Actuators & PowerMEMS

Materials for Actuators & PowerMEMS

T-071 **A HIGH-PERFORMANCE PHOTO-BIOSUPERCAPACITOR BASED ON MANGANESE OXIDE/CARBON NANOTUBE/PEDOT:PSS NANOCOMPOSITES**
Lin Liu and Seokheun Choi
State University of New York, Binghamton, USA

S-072 **100-µm-THICK HIGH-ENERGY-DENSITY ELECTROPLATED CoPt PERMANENT MAGNETS**
Yuzheng Wang, Beatriz Y. Jimenez, and David P. Arnold
University of Florida, USA

M-073 **CARBON BLACK NANOPARTICLES INCLUSION IN BISMUTH TELLURIDE FILM FOR MICRO THERMOELECTRIC GENERATOR APPLICATION**
Khairul Fadzli Samat[1,2], Yijie Li[1], Nguyen Van Toan[1], and Takahito Ono[1]
[1] *Tohoku University, JAPAN and*
[2] *Universiti Teknikal Malaysia Melaka, MALAYSIA*

T-074 **GRAPHENE QUANTUM DOTS INDUCED $NiCo_2S_4$ AS AN EFFICIENT ELECTROCATALYST FOR HYDROGEN HARVEST**
Liangjie Ren[1], Yuanyuan Huang[1,2], Renxiao Xu[1], and Liwei Lin[1]
[1] *University of California, Berkeley, USA and*
[2] *Huazhong University of Science and Technology, CHINA*

Materials for Actuators & PowerMEMS

S-075 **HIGH PERFORMANCE MICRO-THERMOELECTRIC GENERATOR BASED ON METAL DOPED ELECTROCHEMICAL DEPOSITION**
Nguyen Van Toan, Truong Thi Kim Tuoi, Khairul Fadzli Samat, Hongtao Sui, Naoki Inomata, Masaya Toda, and Takahito Ono
Tohoku University, JAPAN

M-076 **MICROELECTROMECHANICAL SWITCH WITH CARBON NANOTUBE ARRAYS FOR HIGH-TEMPERATURE OPERATION**
Eunhwan Jo[1], Yunsung Kang[1], Sangjun Sim[1], Jungwook Choi[2], and Jongbaeg Kim[1]
[1] *Yonsei University, KOREA and* [2] *Yeungnam University, KOREA*

T-077 **STRONG MAGNETOELECTRIC EFFECTS OF 2-2 COMPOSITES MADE OF AlN FILMS GROWN BY PLASMA-ENHANCED ATOMIC LAYER DEPOSITION ON MAGNETOSTRICTIVE FOILS FOR ENERGY HARVESTING APPLICATIONS**
Tai Nguyen[1,2], Noureddine Adjeroud[1], Sebastjan Glinsek[1], Yves Fleming[1], Jérôme Guillot[1], and Jérôme Polesel-Maris[1]
[1] *Luxembourg Institute of Science and Technology, LUXEMBOURG and*
[2] *University of Luxembourg, LUXEMBOURG*

S-078 **SUPERHYDROPHOBIC TRIBOELECTRIC TEXTILE FOR SENSING AND ENERGY HARVESTING APPLICATIONS**
Feng Wen[1], Tianyiyi He[1], Qiangfeng Shi[1], Ting Zhang[2], and Chengkuo Lee[1]
[1] *National University of Singapore, SINGAPORE and*
[2] *Chinese Academy of Sciences (CAS), CHINA*

EMS Actuators & PowerMEMS

PowerMEMS Components & Systems

M-079 **3D PRINTED PYROELECTRIC LITHIUM-NIOBATE HIGH VOLTAGE SOURCE WITH PULL-IN REGULATED OUTPUT**
Di Ni, Benyamin Davaji, Robert Shepherd, and Amit Lal
Cornell University, USA

T-080 **A HIGH-PERFORMANCE ELECTRODYNAMIC MICRO-RECEIVER FOR LOW-FREQUENCY WIRELESS POWER TRANSFER**
Miah A. Halim, Spencer E. Smith, Joseph M. Samman, and David P. Arnold
University of Florida, USA

S-081 **A PARADOXICAL APPROACH TO ENHANCE THE OUTPUT POWER OF VIBRATIONAL ENERGY HARVESTER BEYOND THE IMPEDANCE MATCHING CONDITIONS**
Hiroaki Honma, Yukiya Tohyama, and Hiroshi Toshiyoshi
University of Tokyo, JAPAN

M-082 **FULLY ADDITIVELY MANUFACTURED, NANOSTRUCTURED, MINIATURE IONIC LIQUID ELECTROSPRAY SOURCES**
Dulce Viridiana Melo-Máximo[1,2] and Luis Fernando Velásquez-García[1]
[1] *Massachusetts Institute of Technology, USA and*
[2] *Tecnológico de Monterrey, MEXICO*

T-083 **AN SOI-BASED BACK-JUNCTION BACK-CONTACT THIN-FILM TRITIUM BETAVOLTAIC CELL WITH INTERDIGITATED ELECTRODES**
Meng Wu and Jinwen Zhang
Peking University, CHINA

S-084 **AN ULTRAFAST MICRO SUPERCAPACITOR WITH REDUCED INTERFACIAL RESISTANCE**
Fan Xia[1,2], Sixing Xu[1,2], and Xiaohong Wang[1]
[1] *Tsinghua University, CHINA and* [2] *Beijing National Research Center for Information Science and Technology, CHINA*

PowerMEMS Components & Systems

M-085 **HIGH-VOLTAGE MEMS PLASMA SWITCH FOR BOOSTING THE ENERGY TRANSFER EFFICIENCY IN TRIBOELECTRIC NANOGENERATORS**
Hemin Zhang[1,2], Frédéric Marty[1], Dimitri Galayko[3], Naida Hodzic[1], and Philippe Basset[1]
[1] *Universite Paris-Est, FRANCE,* [2] *University of Cambridge, UK, and* [3] *Sorbonne Universites, FRANCE*

T-086 **TOWARD STANDARDIZED HIGH-POWER ON-CHIP DEVICES: MICRO SUPERCAPACITORS BASED ON MNO2 DECORATED MESOPOROUS GOLD ELECTRODES**
Fan Xia[1], Sixing Xu[1,2], Qifan Gao[1,2], and Xiaohong Wang[1,2]
[1] *Tsinghua University, CHINA and* [2] *Beijing National Research Center for Information Science and Technology, CHINA*

EMS Actuators & PowerMEMS

Other

S-087 **A NOVEL BISTABLE DEVICE DRIVEN BY SINGLE ACTUATOR VIA MOMENT INPUT**
Shin-Wei Huang, Fan-Chi Lin, and Yao-Joe Yang
National Taiwan University, TAIWAN

M-088 **DEMONSTRATION OF 155.1 µW WAKE-UP GAS SENSOR NODE TOWARD 8 MONTH LIFETIME**
Sang Kameron Minh Truong, Kyeong Heon Kim, Shakir-ul Haque Khan, Justin Salvant, Aishwaryadev Banerjee, Ryan Looper, Carlos H. Mastrangelo, and Hanseup Kim
University of Utah, USA

EMS Physical Sensors

Fluidic Sensors (Flow, Pressure, Density, Viscosity, Etc.)

T-089 **DESIGN AND CHARACTERIZATION OF A CMOS MEMS CAPACITIVE SQUEEZE-FILM PRESSURE SENSOR WITH HIGH SENSITIVITY**
Kuan-Yu Hsieh, Jonathan Lee, and Michael S.-C. Lu
National Tsing Hua University, TAIWAN

S-090 **DEVELOPMENT OF STENT FLOW SENSOR DEVICE EVALUATING BREATHING PROPERTY AT AIRWAY IN EXPERIMENTAL ANIMAL UNDER FREE MOVE CONDITION**
Hayato Noma[1], Yoshihiro Hasegawa[1], Kazuhiro Taniguchi[1], Miyoko Matsushima[2], Tsutomu Kawabe[2], and Mitsuhiro Shikida[1]
[1] *Hiroshima City University, JAPAN and* [2] *Nagoya University, JAPAN*

M-091 **FLEXIBLE AND WEARABLE FLOW SENSOR USING SPINNABLE CARBON NANOTUBE NANOFILM FOR RESPIRATION MONITORING**
Toan Dinh[1,2], Thanh Nguyen[1], Van Thanh Dau[1], Foisal Abu Riduan[1], Canh-Dung Tran[2], Hoang-Phuong Phan[1], Tuan-Khoa Nguyen[1], Pablo Guzman[1], Nam-Trung Nguyen[1], and Dzung Viet Dao[1]
[1] *Griffith University, AUSTRALIA and*
[2] *University of Southern Queensland, AUSTRALIA*

T-092 **FLEXIBLE ZNO THIN FILM SURFACE ACOUSTIC WAVE DEVICE FOR FLOW RATE MEASUREMENT**
Qian Zhang[1], Yong Wang[1], Ran Tao[2], Dongsheng Li[1], Yongqing Fu[2], and Jin Xie[1]
[1] *Zhejiang University, CHINA and* [2] *Northumbria University, UK*

Fluidic Sensors (Flow, Pressure, Density, Viscosity, Etc.)

S-093 **MULTIFUNCTIONAL RHINOMANOMETER WITH INTEGRATED HIGHLY SENSITIVE FLEXIBLE PIEZOELECTRIC-BEAM-ARRAY FLOW AND FAST DYNAMIC RESPONSE HUMIDITY SENSORS**
Guo-Hua Feng and Pin-Cheng Su
National Chung Cheng University, TAIWAN

M-094 **AWARD NOMINEE***
PIPETTE BASED VISCOMETER WITH PRESSURE SENSOR ELEMENT
Sinwoo Cho[1], Thanh-Vinh Nguyen[2], Miki Norihisa[1], and Hidetoshi Takahashi[1]
[1]*Keio University, JAPAN and* [2]*National Institute of Advanced Industrial Science and Technology (AIST), JAPAN*

T-095 **ROBUST AND SENSITIVE SENSING OF UNSTEADY FLOWS USING A HAIR-LIKE MACROSCOPIC GRAPHENE FIBER**
Binpeng Zhan, Bo Fang, Srikrishna C. Bodepudi, Zhen Xu, Jiahuan Cui, Yang Xu, Chao Gao, and Huan Hu
Zhejiang University, CHINA

S-096 **SANDWICH STRUCTURED FLEXIBLE THERMAL SHEAR STRESS SENSOR WITH IMPROVED PERFORMANCE**
Baoyun Sun, Wei Gao, Pengbin Wang, Runbo Chen, Jian Luo, Jinjun Deng, Weizheng Yuan, and Binghe Ma
Northwestern Polytechnical University, CHINA

M-097 **SENSITIVITY IMPROVEMENT OF P+SI/AU THERMOPILE-BASED GAS FLOW SENSOR BY OPTIMIZING HEAT-SINK AND THERMAL-INSULATION CONFIGURATION**
Shanshan Wang, Jiachou Wang, and Xinxin Li
Chinese Academy of Sciences (CAS), CHINA

EMS Physical Sensors

Force & Displacement Sensors (Tactile, Force, Torque, Stress & Strain Sensor)

T-098 **A 53.36PF/MPA CMOS-MEMS PRESSURE SENSOR WITH COMPACT SIZE AND INTEGRATED DIGITAL READOUT**
Jyun-Jie Yang, Gordon Tsai, and Tsung-Heng Tsai
National Chung Cheng University, TAIWAN

S-099 **A HIGHLY SENSITIVE SELF-POWERED FLEX SENSOR FOR PROSTHETIC ARM AND INTERPRETING GESTICULATION**
Pukar Maharjan, Trilochan Bhatta, Hyunok Cho, and Jae Y. Park
Kwangwoon University, KOREA

M-100 **A MAGNETIC-POLYMER-BASED PASSIVE PRESSURE SENSOR REALIZED WITH A FOLDABLE PARYLENE SUBSTRATE**
Yung-Chih Lin and Yao-Joe Yang
National Taiwan University, TAIWAN

T-101 **CROSSTALK-FREE MESH-EMBEDDED TACTILE SENSOR ARRAY WITH ELECTRICALLY ISOLATED SENSING CELLS**
Kyubin Bae, Soonjae Pyo, and Jongbaeg Kim
Yonsei University, KOREA

S-102 **DIRECT BINARY ENCODING OF DISPLACEMENTS ON THE NANO-SCALE**
Philip Schmitt and Martin Hoffmann
Ruhr University Bochum, GERMANY

M-103 **OPTOELECTRONIC ENHANCEMENT FOR PIEZORESISTIVE PRESSURE SENSOR**
Thanh Nguyen, Toan Dinh, Hoang-Phuong Phan, Tuan-Khoa Nguyen, Abu Riduan Md Foisal, Nam-Trung Nguyen, and Dzung Viet Dao
Griffith University, AUSTRALIA

Force & Displacement Sensors (Tactile, Force, Torque, Stress & Strain Sensor)

T-104 **SELF-RECOVERING 3-DIMENSIONAL MICRO PORE STRUCTURE PRESSURE SENSOR USING SHAPE MEMORY POLYMER**
Byung-geon Park[1], Young Jung[1], Myung-gyu Shin[2], Jongsoo Ko[2], and Hanchul Cho[1]
[1]*Korea Institute of Industrial Technology, KOREA and*
[2]*Pusan National University, KOREA*

S-105 **STRUCTURAL COLOR BASED TACTILE SENSOR FOR FLEXIBLE ENDOSCOPIC SURGERY TO DETECT GRAB STATE AND ORGANS HARDNESS**
Yusaku Maeda[1,2], Kyohei Terao[1], Fusao Shimokawa[1], and Hidekuni Takao[1]
[1]*Kagawa University, JAPAN and* [2]*Kagawa College, JAPAN*

M-106 **VERTICALLY INTEGRATED DOUBLE-BRIDGE DESIGN FOR CMOS-MEMS TRI-AXIAL PIEZO-RESISTIVE FORCE SENSOR**
Jia-Horng Lee, Sheng-Kai Yeh, and Weileun Fang
National Tsing Hua University, TAIWAN

EMS Physical Sensors

Gas & Chemical Sensors

T-107 **A BIOCHEMICAL SENSOR WITH ARTIFICIAL 3D ENZYME NETWORK**
Hussam Ibrahim, Satyanarayana Moru, and Liang Dong
Iowa State University, USA

S-108 **A FLEXIBLE PHOTOELECTROCHEMICAL SENSOR FOR HEXAVALENT CHROMIUM DETECTION**
Qingyuan Liu[1,2], Jungyoon Kim[2], and Tianhong Cui[2]
[1]*Tsinghua University, TAIWAN and* [2]*University of Minnesota, USA*

M-109 **FABRICATION OF WO_3 NANOCONE ARRAYS FOR HIGHLY SENSITIVE C_2H_6 GAS SENSOR INTEGRATED WITH LOW POWERED INPLANE MICROHEATER**
Md Ridwan Adib and Keekeun Lee
Ajou University, KOREA

T-110 ***IN-SITU* MONITORING OF GAS MOLECULES IN CHROMATOGRAPHY BY UTILIZING A PRESSURE SENSOR**
Ashrafuzzaman Bulbul and Hanseup Kim
University of Utah, USA

S-111 **INTEGRATED PHOSPHATE AND PH SENSING SYSTEM FOR WATER QUALITY MONITORING**
Renuka Bowrothu[1], Todd Schumann[1], Haein Kim[1], Kyoung Tae Kim[2], Sunghyun Hwang[1], Yoonseok Lee[1], and Yong Kyu Yoon[1]
[1]*University of Florida, USA and* [2]*University of Washington, USA*

M-112 **METAMATERIAL GAS SENSING PLATFORM BASED ON SURFACE-ENHANCED INFRARED ABSORPTION**
Hong Zhou, Dongxiao Li, Xindan Hui, Donglin Hu, Xin Chen, Xianming He, and Xiaojing Mu
Chongqing University, CHINA

T-113 **MICROMACHINED MASS-SENSITIVE AND CAPACITIVE CHEMICA MULTISENSOR USING SINGLE POLYMERIC SENSING FILM**
Steven A. Schwartz[1], Oliver Brand[1], and Luke A. Beardslee[2]
[1]*Georgia Institute of Technology, USA and*
[2]*Naval Submarine Medical Research Laboratory, USA*

S-114 **MULTI-BAND MID-IR MOLECULES IDENTIFICATION USING PLASMONIC METAMATERIALS INDUCED BY BRIGHT-DARK COUPLING**
Zhihao Ren, Zhangqi Dang, and Chengkuo Lee
National University of Singapore, SINGAPORE

Gas & Chemical Sensors

M-115 **SUSPENDED ALUMINA MEMBRANE FOR GA_2O_3 GAS SENSOR WITH ENHANCED LIFETIME AT HIGH-TEMPERATURE**
Han-Il Jeong, Gyujun Choi, and Jongbaeg Kim
Yonsei University, KOREA

T-116 **THRESHOLD POINT MODULATION OF A WAKE-UP NANO-GAP GAS SENSOR**
Shakir-ul Haque Khan, Aishwaryadev Banerjee, Kyeong Heon Kim, Justin Salvant, Ryan Looper, Carlos H. Mastrangelo, and Hanseup Kim
University of Utah, USA

EMS Physical Sensors

Inertial Sensors (Gyros, Accelerometers, Resonators, Etc.)

S-117 **0.0062 °/√hr ANGLE RANDOM WALK AND 0.027 °/hr BIAS INSTABILITY FROM A MICRO-SHELL RESONATOR GYROSCOPE WITH SURFACE ELECTRODES**
Sajal Singh, Jong-Kwan Woo, Guohong He, Jae Yoong Cho, and Khalil Najafi
University of Michigan, USA

M-118 **A HERMETICALLY-SEALED 2.9MHZ N=3 DISK BAW GYROSCOPE WITH SUB-DEGREE-PER-HOUR BIAS INSTABILITY**
Haoran Wen, Anosh Daruwalla, Chang-Shun Liu, and Farrokh Ayazi
Georgia Institute of Technology, USA

T-119 **A RELIABLE LIQUID-BASED HIGH SENSITIVE MICRO THERMORESISTIVE CONVECTIVE ACCELEROMETER BY USING 0.35μM CMOS MEMS TECHNOLOGY**
Xiaoyi Wang[1], Wei Xu[2], Gyuha Lim[1], and Yi-Kuen Lee[1]
[1]*Hong Kong University of Science and Technology, HONG KONG and*
[2]*Shenzhen University, CHINA*

S-120 **A WHEELED HORIZONTAL DUAL-AXIS MEMS GYROSCOPE BASED ON SINGLE PROOF MASS WITH MECHANICAL COUPLING SUPPRESSION SILICON GRATINGS**
Haibing Yang, Jian Cui, and Qiancheng Zhao
Peking University, CHINA

M-121 **ADAPTIVE ON-LINE SELF-CALIBRATION OF ERRORS IN MULTI-STAGE-NOISE-SHAPING (MASH) SIGMA-DELTA MODULATOR GYROSCOPE**
Fang Chen[1], Zuxiang Wen[2], Wei Zhou[1], Zao Ni[1], and Xinxin Li[1]
[1]*Chinese Academy of Sciences (CAS), CHINA and*
[2]*Soochow University, CHINA*

T-122 **LINEAR PARAMETRIC AMPLIFICATION/ATTENUATION WITHOUT SPRING HARDENING/SOFTENING EFFECT IN MEMS GYROSCOPES**
Haibin Wu, Xudong Zheng, Yiyu Lin, Zhipeng Ma, and Zhonghe Jin
Zhejiang University, CHINA

S-123 **MASS TUNING IN WEAKLY COUPLED LOW-Q PIEZOELECTRIC MEMS RESONATOR ARRAYS FOR PARTICULATE SENSING**
Malar Chellasivalingam, Brian Graves, Adam Boies, and Ashwin A. Seshia
University of Cambridge, UK

M-124 **MOLECULAR ELECTRONIC TRANSDUCER BASED TILTING SENSORS**
Mengbing Liang[1], Stella Nickerson[1], Lenore Dai[1], and Hongyu Yu[2]
[1]*Arizona State University, USA and*
[2]*Hong Kong University of Science and Technology, HONG KONG*

Inertial Sensors (Gyros, Accelerometers, Resonators, Etc.)

T-125 **NONLINEAR MODAL INTERACTIONS AND INTERNAL RESONANCE IN A MICROMACHINED DISK RESONATOR**
Jiangkun Sun[1,2], Hemin Zhang[1], Dongyang Chen[1], Milind Pandit[1], Guillermo Sobreviela[1], Dingbang Xiao[2], Ming Zhuo[2], Dustin D. Gerrard[3], Ryan Kwon[3], Gabrielle Vukasin[3], Thomas W. Kenny[3], and Ashwin Seshia[1]
[1] *University of Cambridge, UK,* [2] *National University of Defense Technology, CHINA, and* [3] *Stanford University, USA*

S-126 **PHASE-CONTROLLED OSCILLATION IN A CAPACITIVE NONLINEAR RING RESONATOR WITH ON-CHIP FEEDTHROUGH DE-EMBEDDING**
Dongyang Chen[1,2], Hemin Zhang[2], Jiangkun Sun[2,3], Milind Pandit[2], Guillermo Sobreviela[2], Yong Wang[1], Qian Zhang[1], Ashwin Seshia[2], and Jin Xie[1]
[1] *Zhejiang University, CHINA,* [2] *University of Cambridge, UK, and* [3] *National University of Defense Technology, CHINA*

M-127 **SELF-PACKAGED THREE AXIS CAPACITIVE MEMS ACCELEROMETER**
Akin Aydemir[1] and Tayfun Akin[1,2]
[1] *METU MEMS Center, TURKEY and*
[2] *Middle East Technical University, TURKEY*

T-128 **SINGLE-CRYSTAL LITHIUM NIOBATE PIEZOELECTRIC DISK GYROSCOPE**
Kazutaka Obitani[1], Toshiyuki Tsuchiya[1], Kazutaka Araya[2], and Masanori Yachi[3]
[1] *Kyoto University, JAPAN,* [2] *Tamagawa Seiki Co., Ltd., JAPAN, and* [3] *Tamagawa Mobile Equipment Co., Ltd.*

S-129 **SUB-μW OPERATION AND NOISE REDUCTION OF MONOLITHIC 3-AXIS ACCELEROMETERS USING A SIGE-MEMS-ON-CMOS TECHNIQUE**
Yoshihiko Kurui[1], Hideyuki Tomizawa[1], Tomohiro Saito[1], Akira Fujimoto[1], Ippei Akita[2], Masaya Miyahara[3], Kazusuke Maenaka[4], Akihiro Kojima[1], and Hideki Shibata[1]
[1] *Toshiba Corporation, JAPAN,* [2] *National Institute of Advanced Industrial Science and Technology (AIST), JAPAN,* [3] *High Energy Accelerator Research Organization (KEK), JAPAN, and* [4] *University of Hyogo, JAPAN*

M-130 **TEMPERATURE ROBUST SILICON RESONANT ACCELEROMETER WITH STRESS ISOLATION FRAME MOUNTED ON AXIS-SYMMETRICAL ANCHORS**
Jian Cui, Mengxia Liu, Haibing Yang, Dong Li, and Qiancheng Zhao
Peking University, CHINA

T-131 **ULTRA-SENSITIVE FORCE TRANSDUCTION IN WEAKLY COUPLED RESONATORS**
Hemin Zhang[1], Milind Pandit[1], Jiangkun Sun[1,2], Dongyang Chen[1,3], Guillermo Sobreviela[1], Chun Zhao[4], and Ashwin Seshia[1]
[1] *University of Cambridge, UK,* [2] *National University of Defense Technology, CHINA,* [3] *Zhejiang University, CHINA, and* [4] *Huazhong University of Science and Technology, CHINA*

EMS Physical Sensors

Manufacturing Techniques for Physical Sensors

S-132 **H_2S SENSOR BASED ON MEMS HOTPLATE AND ON-CHIP GROWTH OF CUO-SNO_2 NANOSHEETS FOR HIGH RESPONSE, FAST RECOVERY AND LOW POWER CONSUMPTION**
Gaoqiang Niu, Huimin Gong, Changhui Zhao, and Fei Wang
Southern University of Science and Technology, CHINA

T-133 **STRETCHABLE ARRAY OF RESISTIVE PRESSURE SENSORS IGNORING THE EFFECT OF STRAIN-INDUCED DEFORMATION**
Ryosuke Matsuda, Satoru Mizuguchi, Fumika Nakamura, Takuma Endo, Go Inamori, Yutaka Isoda, and Hiroki Ota
Yokohama National University, JAPAN

EMS Physical Sensors

Materials for Physical Sensors

S-134 **HIGH AVAILABLE CARBON NANOTUBE FILM MICRO-DEVICE WITH CONTROLLABLE TEMPERATURE COEFFICIENT OF RESISTANCE**
Wei Gao, Baoyun Sun, Yu Zhang, Binghe Ma, Jian Luo, Jinjun Deng, and Weizheng Yuan
Northwestern Polytechnical University, CHINA

M-135 **HIGHLY SENSITIVE AND STABLE PRESSURE SENSOR BASED ON POLYMER-MXENE COMPOSITE NANOFIBER MAT FOR WEARABLE HEALTH MONITORING**
Sudeep Sharma, Ashok Chhetry, Seokgyu Ko, and Jae Y. Park
Kwangwoon University, KOREA

T-136 **PIEZOELECTRIC PVDF FILMS ENHANCED BY Ag@SIO2 NANOPARTICLES FOR MEMS TRANSDUCER**
Lingxiao Gao, Xin Chen, Shan Lu, Weibo Xie, Liangke Wu, and Xiaojing Mu
Chongqing University, CHINA

S-137 **SURFACE HYDROXYLATED $CaCu_3Ti_4O_{12}$ WRAPPED POLYURETHANE SPONGE FOR HIGHLY SENSITIVE PRESSURE SENSING APPLICATION**
Ashok Chhetry, Sudeep Sharma, Seokgyu Ko, and Jae Y. Park
Kwangwoon University, KOREA

EMS Physical Sensors

Nanoscale Physical Sensors

M-138 **A NANOELECTROMECHANICAL RESONATOR-BASED FLASH STYLE ANALOG TO DIGITAL CONVERTER**
Xuecui Zou[1], Sally Ahmed[1], Syed Kazmi[2], Pedro Da Costa[1], Mohammad Younis[1], and Hossein Fariborzi[1]
[1]*King Abdullah University of Science and Technology, SAUDI ARABIA and* [2]*Netherlands Institute for Space Research, NETHERLANDS*

T-139 **BLACK PHOSPHORUS NEMS RESONANT INFRARED (IR) DETECTOR**
Arnob Islam[1], Jaesung Lee[1,2], and Philip X.-L. Feng[1,2]
[1]*Case Western Reserve University, USA and* [2]*University of Florida, USA*

S-140 **THE SHEAR MODULUS DETERMINATION VIA QUARTZ CRYSTAL RESONATOR FOR GRAPHENE FILM PREPARED BY DROP CASTING**
Jintao Pang, Xianhao Le, Qian Zhang, Changju Wu, and Jin Xie
Zhejiang University, CHINA

EMS Physical Sensors

Sonic & Ultrasonic MEMS Transducers (Microphones, PMUTs, Etc.)

M-141 **ACOUSTIC AMPLIFICATION USING CHARACTERISTIC GEOMETRY-BASED INTEGRATED PLATFORMS FOR MICROMECHANICAL RESONANT DETECTION**
Imran Latif, Masaya Toda, and Takahito Ono
Tohoku University, JAPAN

T-142 **FIRST MEMS MICROPHONE BASED ON CAPACITIVE TRANSDUCTION IN VACUUM**
Samer Dagher[1,2], Frederic Souchon[1], Audrey Berthelot[1], Stephane Durand[2], and Loïc Joet[1]
[1]*Université Grenoble Alpes, FRANCE and* [2]*LAUM UMR-CNRS, FRANCE*

S-143 **IMPLANTABLE BIO-HEATING SYSTEM BASED ON PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCERS**
Flavius Pop, Bernard Herrera, and Matteo Rinaldi
Northeastern University, USA

Sonic & Ultrasonic MEMS Transducers (Microphones, PMUTs, Etc.)

M-144 **IMPLEMENTATION OF PIEZOELECTRIC MEMS MICROPHONE FOR SENSITIVITY AND SENSING RANGE ENHANCEMENT**
Shih-Hsiung Tseng[1,2], Sung-Cheng Lo[1], Yu-Chen Chen[1], Ya-Chu Lee[1], Mingching Wu[2], and Weileun Fang[1]
[1]*National Tsing Hua University, TAIWAN and*
[2]*Coretronic MEMS Corporation, TAIWAN*

T-145 **LONG-RANGE ULTRASOUND WAKE-UP RECEIVER WITH A PIEZOELECTRIC NANOSCALE ULTRASOUND TRANSDUCER (PNUT)**
Pietro Simeoni, Matteo Castellani, and Gianluca Piazza
Carnegie Mellon University, USA

S-146 **LOW POWER CAPACITIVE ULTRASONIC TRANSCEIVER ARRAY FOR AIRBORNE OBJECT DETECTION**
Sebastian Anzinger[1], Fabian Lickert[2,3], Alessandra Fusco[3], Gabriele Bosetti[2], David Tumpold[3], Christian Bretthauer[3], and Alfons Dehe[1,4]
[1]*University of Freiburg, GERMANY,* [2]*Technical University Munich, GERMANY,* [3]*Infineon Technologies AG, GERMANY, and*
[4]*Hahn-Schickard Institute for Applied Sciences, GERMANY*

M-147 **AWARD NOMINEE***
MULTI-BAND MEMS RESONANT MICROPHONE ARRAY FOR CONTINUOUS LUNG-SOUND MONITORING AND CLASSIFICATION
Hai Liu, Song Liu, Anton A. Shkel, Yongkui Tang, and Eun Sok Kim
University of Southern California, USA

T-148 **NON-CONTACT SURFACE TEMPERATURE SENSING USING A SINGLE BIMORPH PMUTS ARRAY**
Zhichun Shao[1], Sedat Pala[1], Yue Liang[1], Tao Jiang[1,2], and Liwei Lin[1,2]
[1]*University of California, Berkeley, USA and*
[2]*Tsinghua-Berkeley Shenzhen Institute, CHINA*

S-149 **RADIUS OF CURVATURE MEASUREMENT USING PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCERS**
Sedat Pala, Yue Liang, Benjamin Eovino, Zhichun Shao, and Liwei Lin
University of California, Berkeley, USA

EMS Physical Sensors

Other

M-150 **ANALYTICAL COMPACT MODEL FOR OPTO-MECHANICAL SENSOR**
Houssein Elmi Dawale[1,2], Guillaume Jourdan[1,2], Loïc Sibeud[1,2], Sébastien Regord[1,2], Fabrice Lamberti[1,2], Sébastien Hentz[1,2], and Franck Badets[1,2]
[1]*Université Grenoble Alpes, FRANCE and* [2]*CEA-LETI, FRANCE*

T-151 **DESIGN OPTIMIZATION OF A LORENTZ FORCE, AMPLITUDE MODULATED, MEMS SPACE MAGNETOMETER**
Rosana A. Dias[1], Eurico E. Moreira[1,2], Filipe S. Alves[1], David Mesquita[3], João Gaspar[1], and Luis A. Rocha[2]
[1]*International Iberian Nanotechnology Laboratory (INL), PORTUGAL,*
[2]*University of Minho, PORTUGAL, and* [3]*Lusospace, Lda, PORTUGAL*

S-152 **ENVIRONMENTAL SENSING HUB ON SINGLE CHIP USING DOUBLE-SIDE POST-CMOS PROCESSES**
Cheng-Chun Chang, Ping-Hsiu Hong, Sheng-Kai Yeh, Yung-Chian Lin, Mei-Feng Lai, and Weileun Fang
National Tsing Hua University, TAIWAN

Other

M-153 **WEARABLE AND FLEXIBLE HEART PULSE SENSOR INTEGRATED WITH A SOFT PUMP AND ACTUATOR**
Takafumi Yamaguchi[1], Takayuki Arie[1], Seiji Akita[1], and Kuniharu Takei[1,2]
[1] *Osaka Prefecture University, JAPAN and*
[2] *Japan Science and Technology Agency (JST), JAPAN*

Materials, Fabrication and Packaging for Generic MEMS & NEMS

Digital Micromanufacturing (Laser Micromachining, Additive Manufacturing)

T-154 **BIOMIMETIC BARBED MICRONEEDLES FOR HIGHLY ROBUST TISSUE ANCHORING**
Sanwei Liu, Sangwook Chu, George E. Bani, Luke A. Beardslee, and Reza Ghodssi
University of Maryland, USA

S-155 **DIGITAL LIGHT PROCESSING (DLP) 3D PRINTING OF MILLIMETER-SCALE HIGH-ASPECT RATIO (HAR) STRUCTURES EXCEEDING 100:1**
Miguel Tirado, Avra Kundu, Laurene Tetard, and Swaminathan Rajaraman
University of Central Florida, USA

M-156 **RAPID PROTOTYPING OF MICROACTUATORS BY INTEGRATING 3D PRINTED POLYMERIC STRUCTURES WITH NiTi THIN FILM**
Camilo Velez[1], Sukjun Kim[1], Mahnoush Babaei[1], Dinesh K. Patel[1], Cory Knick[2], Gabriel Smith[2], and Sarah Bergbreiter[1]
[1] *Carnegie Mellon University, USA and*
[2] *Army Research Laboratory (ARL), USA*

Materials, Fabrication and Packaging for Generic MEMS & NEMS

Generic MEMS & NEMS Manufacturing Techniques

T-157 **3D NANOSCALE CHIRAL HELIXES FABRICATED BY FOCUSED HELIUM ION BEAM MANUFACTURING PROCESS**
Shengxiao Jin, Zhuojie Chen, Xiaoyu Chen, Rui Zhu, Jia Zhu, Yun Huang, Jun Xu, and Wengang Wu
Peking University, CHINA

S-158 **A NOVEL FABRICATION METHOD OF GRAPHENE WRINKLE-INDUCED SUPERHYDROPHOBIC SURFACE FOR FLEXIBLE MICRO/NANO SENSORS**
Kai-Ming Hu, Wei-Lang Zhou, Xue-Song Jiang, and Wen-Ming Zhang
Shanghai Jiao Tong University, CHINA

M-159 **AN EXPERIMENT BASED DAMAGE PROFILE FUNCTION FOR FOCUSED HELIUM ION BEAM PROCESS IN FABRICATION OF MICRO/NANO STRUCTURES**
Tianyang Shao, Qianhuang Chen, Yan Xing, Xiaohui Lin, Chen Fang, and Qing Chai
Southeast University, CHINA

T-160 **AN ORIGAMI-STRUCTURED FLEXIBLE ELECTRONIC SUBSTRATE WITH FACES PARALLEL TO TARGET-OF-ATTACHMENT SURFACES**
Hiroki Yasuga[1], Atsushi Eda[1], Kai Suto[2], Tomohiro Tachi[2], and Eiji Iwase[1]
[1] *Waseda University, JAPAN and* [2] *University of Tokyo, JAPAN*

S-161 **ATOMIC STRUCTURE METHOD FOR THE CALCULATION OF ANISOTROPIC WET ETCHING RATE OF SAPPHIRE CRYSTAL**
Guorong Wu, Yan Xing, Chen Fang, Jiabao Yao, and Xiaohui Lin
Southeast University, CHINA

Generic MEMS & NEMS Manufacturing Techniques

M-162 **DEMONSTRATING FULL INTEGRATION PROCESS FOR ELECTROACTIVE POLYMER MICROTRANSDUCERS TO REALIZE SOFT MICROCHIPS**
Laureline Seurre[1], Kätlin Rohtlaid[2], Giao T.M. Nguyen[2], Caroline Soyer[1], Sofiane Ghenna[1], Sébastien Grondel[1], Frédéric Vidal[2], Barthélemy Cagneau[3], Cédric Plesse[2], and Eric Cattan[1]
[1]*University Polytechnique Hauts-de-France, FRANCE,*
[2]*Université de of Cergy-Pontoise, FRANCE, and*
[3]*Université de Versailles, FRANCE*

T-163 **DIFFRACTION LITHOGRAPHY FOR 3-D MICRONEEDLE FABRICATION**
Jun Ying Tan, Myunhwan Ahn, Hassan Al-Thuwaini, Seong-O Choi, and Jungkwun "JK" Kim
Kansas State University, USA

S-164 **DIRECT FABRICATION OF PEGDA MICRO SUCTION CUP ARRAY USING INCLINED/ROTATING MIRROR EXPOSURE SYSTEM**
Takumi Sugimoto and Hidetoshi Takahashi
Keio University, JAPAN

M-165 **DIRECT TRANSFER OF NANOPATTERNED FUNCTIONAL MATERIALS ONTO TEXTILE SUBSTRATE FOR OPTICAL AND SENSING APPLICATIONS**
Jiwoo Ko[1,2], Jun-ho Jeong[2], and Inkyu Park[1]
[1]*Korea Advanced Institute of Science and Technology (KAIST), KOREA and* [2]*Korea Institute of Machinery & Materials (KIMM), KOREA*

T-166 **FABRICATION OF AL-BASED SUPERCONDUCTING HIGH-ASPECT RATIO TSVs FOR QUANTUM 3D INTEGRATION**
Juan A. Alfaro-Barrantes[1,3], Massimo Mastrangeli[1], David J. Thoen[1], Juan Bueno[1,2], Jochem Baselmans[1,2], and Pasqualina M. Sarro[1]
[1]*Delft University of Technology, NETHERLANDS,*
[2]*Netherlands Institute for Space Research, NETHERLANDS, and*
[3]*Instituto Tecnológico de Costa Rica, COSTA RICA*

S-167 **FABRICATION OF NANOPOROUS MEMBRANES FOR KNUDSEN PUMP USING GLANCING ANGLE DEPOSITION**
Chuang Qu, Bruce Alphenaar, Shamus McNamara, and Kevin Walsh
University of Louisville, USA

M-168 **FUNCTIONAL ELASTOMER FOR FLEXIBLE ELECTRONICS: LIGHT EMITTING DEVICE AND GAS SENSOR**
Atsushi Takei, Shiho Tsukamoto, Yusuke Komazaki, Yuichi Watanabe, Yasuyuki Kusaka, and Manabu Yoshida
Advanced Industrial Science and Technology (AIST), JAPAN

T-169 **AWARD NOMINEE***
LARGE-SCALE INTEGRATION OF 2D MATERIAL HETEROSTRUCTURES BY ADHESIVE BONDING
Arne Quellmalz[1], Xiaojing Wang[1], Stefan Wagner[2], Simon Sawallich[3,4], Max C. Lemme[2,4], Kristinn B. Gylfason[1], Niclas Roxhed[1], Göran Stemme[1], and Frank Niklaus[1]
[1]*KTH Royal Institute of Technology, SWEDEN,*
[2]*AMO GmbH, GERMANY,* [3]*Protemics GmbH, GERMANY, and*
[4]*RWTH Aachen University, GERMANY*

Materials, Fabrication and Packaging for Generic MEMS & NEMS

Materials for MEMS & NEMS

S-170 **AWARD NOMINEE***
"COAT & POP": ON-SUBSTRATE TWO-STEP COMPOSITION PATTERNING METHOD OF LIQUID METAL ALLOYS FOR FLEXIBLE DEVICES
Romain David and Norihisa Miki
Keio University, JAPAN

Materials for MEMS & NEMS

M-171 **A FIBER-Si_3N_4 COMPOSITE NANOFOREST WITH HIGH 7.6 TO 11.6μm ABSORPTION FOR MEMS INFRARED SENSORS**
Chenchen Zhang[1,2], Haiyang Mao[2,3], Meng Shi[2], Jijun Xiong[1], Kewen Long[4], and Dapeng Chen[2,3]
[1]*North University of China, CHINA,* [2]*Chinese Academy of Sciences (CAS), CHINA,* [3]*Wuxi Internet of Things Innovation Center Co. Ltd., CHINA, and* [4]*Foshan Chuandong Magnetic Electronic, CHINA*

T-172 **A HIGH-Q 30nm-THICK MFM RESONATOR USING FERROELECTRIC HAFNIUM ZIRCONIUM OXIDE**
Mayur Ghatge, Glen Walters, Toshikazu Nishida, and Roozbeh Tabrizian
University of Florida, USA

S-173 **AN EFFECT OF A NEEDLE ELECTRODE FOR THE OHMIC CONTACT BETWEEN AN ELECTRODE AND LIQUID METAL DROPLET IN ELECTRICAL SWITCHING**
Fuminari Mori, Akiya Hirata, Yugo Kakehi, and Satoshi Konishi
Ritsumeikan University, JAPAN

M-174 **BIDIRECTIONAL FREQUENCY TUNING OF VANADIUM DIOXIDE (VO_2) MICROSTRING RESONATOR BY OPTOTHERMAL EXCITATION**
Syed A. Bukhari[1], Ankur Goswami[2], Ryan McGee[3], Rosmi Abraham[1], Hyun Joong Chung[1], Dale Hume[4], and Thomas Thundat[5]
[1]*University of Alberta, CANADA,* [2]*Thermtest Instruments, CANADA,* [3]*Indian Institute of Technology Delhi, INDIA,* [4]*Texas Instruments, USA, and* [5]*State University, Buffalo, USA*

T-175 **HYBRID MEMRISTIVE SILK DEVICES FOR MULTILEVEL INFORMATION ENCRYPTION AND DECRYPTION**
Long Sun[1,2], Zhitao Zhou[1], and Tiger H. Tao[1,2]
[1]*Chinese Academy of Sciences (CAS), CHINA and*
[2]*University of Chinese Academy of Sciences (UCAS), CHINA*

S-176 **IMPACT OF X-RAY RADIATION ON GaN/AlN MEMS STRUCTURE AND GaN HEMT GAUGE FACTOR RESPONSE**
Ji-Tzuoh Lin[1], Peng Wang[2], Pranoy Shuvra[1], Shamus McNamara[1], Mike McCurdy[2], Jim Davidson[2], Kevin Walsh[1], Mike Alles[2], and Bruce Alphenaar[1]
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M-177 **AWARD NOMINEE***
ULTRAFAST AND INEXPENSIVE MICROFABRICATION OF FLEXIBLE ELECTRODES FOR NEURAL RECORDING/STIMULATION BASED ON DC ELECTROPHORESIS DEPOSITION AND NANO-TITANIUM DIOXIDE
Zhaoling Huang[1,2], Qi Zeng[1], Jinjiang Huang[3], Shuijie Qin[2], and Tianzhun Wu[1]
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[2]*Guizhou University, CHINA, and*
[3]*Shenzhen CAS Envision Medical Technology Co. Ltd., CHINA*

Materials, Fabrication and Packaging for Generic MEMS & NEMS

Packaging & Assembly

T-178 **A NOVEL VACUUM PACKAGING PROCESS USING SPUTTERED COPPER LAYER AS NON-EVAPORABLE GETTER ACTIVATED BY MICROWAVE**
Binbin Pei[1,2], Chaozhan Ye[1,2], Ke Sun[1], Peng Zhong[1,2], Tingting Yu[1,2], Heng Yang[1], and Xinxin Li[1]
[1]*Chinese Academy of Sciences (CAS), CHINA and*
[2]*University of Chinese Academy of Sciences (UCAS), CHINA*

S-179 **CMOS COMPATIBLE TSV PROCESS WITH POST-CMOS THERMOMIGRATION REFILLING OF AU-SI EUTECTIC ALLOY**
Peng Zhong[1,2], Binbin Pei[1,2], Tingting Yu[1,2], Chuanguo Dou[1], Heng Yang[1], and Xinxin Li[1]
[1]*Chinese Academy of Sciences (CAS), CHINA and*
[2]*University of Chinese Academy of Sciences (UCAS), CHINA*

Packaging & Assembly

M-180 **MEMS-BASED "TOUCH FEELING SCANNER" FOR QUANTITATIVE EVALUATION OF FINGERTIP SENSATION**
Yoshihiro Nishida[1], Kazuki Watatani[1,3], Kyohei Terao[1], Fusao Shimokawa[1], Kazutami Arimoto[2,3], and Hidekuni Takao[1,3]
[1]*Kagawa University, JAPAN,*
[2]*Okayama Prefectural University, JAPAN, and*
[3]*Japan Science and Technology Agency (JST), JAPAN*

T-181 **RESEARCH OF WAFER-LEVEL VACUUM PACKAGING BASED ON TGV TECHNOLOGY FOR MEMS DEVICES**
Yunbin Kuang, Zhanqiang Hou, Ming Zhuo, Qiang Xu, Qingsong Li, Bin Xiao, Heng Shan, Dingbang Xiao, and Xuezhong Wu
National University of Defense Technology, CHINA

S-182 **SELF-FOLDING ACUTE-ANGLE ORIGAMI DRIVEN BY SURFACE BENDING FORCE**
Takuya Uchida[1], Hiroki Yasuga[2], Tomohiro Tachi[3], Eiji Iwase[2], and Hiroaki Onoe[1]
[1]*Keio University, JAPAN,* [2]*Waseda University, JAPAN, and*
[3]*Tokyo University, JAPAN*

M-183 **SILICON MIGRATION SEAL FOR WAFER-LEVEL VACUUM ENCAPSULATION**
Yukio Suzuki[1], Victor Dupuit[1,2], Toshiya Kojima[1], Hirotaka Suzuki[1], and Shuji Tanaka[1]
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Micro- & Nanofluidics

Biological and Medical Microfluidics and Nanofluidics

T-184 **3D MICROFLUIDIC DEVICE FOR PERFUSION CULTURE OF SPHEROIDS**
Keigo Nishimura, Minghao Nie, and Shoji Takeuchi
University of Tokyo, JAPAN

S-185 **96-WELL FORMAT-BASED MICROFLUIDIC PLATFORM FOR AN *IN VITRO* MULTIPLE MICRO-ORGAN NETWORK**
Chaewon Jin, Jinyoung Kim, and Hongsoo Choi
Daegu Gyeongbuk Institute of Science and Technology (DGIST), KOREA

M-186 **A COMPACT MEMS CHIP FOR A RAPID AND HIGHLY ACCURATE PICOLITER CALORIMETRY**
Sheng Ni[1], Hanliang Zhu[2], Pavel Neuzil[2,3], and Levent Yobas[1]
[1]*Hong Kong University of Science and Technology, HONG KONG,*
[2]*Northwestern Polytechnical University, CHINA, and*
[3]*Brno University of Technology, CZECH REPUBLIC*

T-187 **A MICROFLUIDIC CHIP FOR CIRCULATING TUMOR CELLS RNA SEQUENCING AT SINGLE CELL LEVEL**
Fanghao Shi[1,2], Fei Jia[1,2], Weikai Zhang[3], and Zewen Wei[3]
[1]*National Center for Nanoscience and Technology, CHINA,*
[2]*University of Chinese Academy of Sciences (UCAS), CHINA, and*
[3]*Beijing Institute of Technology, CHINA*

S-188 **AN INTEGRATED MICROFLUIDIC SYSTEM FOR FAST ISOLATION OF BACTERIA IN HUMAN WHOLE BLOOD FOR DIAGNOSIS OF SEPSIS**
Yen-Ling Fang[1], Wen-Bin Lee[1], Chih-Hung Wang[1], Chun-Chih Chien[2], Huey-Ling You[2], Mel S. Lee[2], and Gwo-Bin Lee[1]
[1]*National Tsing Hua University, TAIWAN and*
[2]*Kaohsiung Chang Gung Memorial Hospital, TAIWAN*

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M-189 **BIDIRECTIONAL CELL SLIDING ON ACTIVE TRACKS FOR HIGH THROUGHPUT DIELECTROPHORETIC CELL SORTING IN CONTINUOUS-FLOW**
Xiaofeng Nie, Ziheng Liang, Youyu Lu, Yao Cai, Chaomin Zhang, Duli Yu, and Xiaoxing Xing
Beijing University of Chemical Technology, CHINA

T-190 **BUBBLE-ASSISTED *IN SITU* RE-FORMATION OF ARTIFICIAL BILAYER**
Izumi Hashimoto[1], Hirotaka Sugiura[2], Toshihisa Osaki[2], Tetsuya Yamada[2], Hisatoshi Mimura[2], Norihisa Miki[1], and Shoji Takeuchi[2,3]
[1]*Keio University, JAPAN,* [2]*Kanagawa Institute of Industrial Science and Technology, JAPAN, and* [3]*University of Tokyo, JAPAN*

S-191 **CO-CULTURE OF A BRAIN ORGANOID DERIVED FROM HUMAN IPSCS AND VASCULATURE ON A CHIP**
Yohei Isshiki[1], Taikopaul Kaneko[1], Atsushi Tamada[2], Keiko Muguruma[2], and Ryuji Yokokawa[1]
[1]*Kyoto University, JAPAN and* [2]*Kansai Medical University, JAPAN*

M-192 **DEVELOPMENT OF *IN VITRO* MICROFLUIDIC CIRCULATORY SYSTEM**
Ping-Liang Ko[1], Tse-Ang Lee[1], Heng-Hua Hsu[1,2], Wei-Hao Liao[1], and Yi-Chung Tung[1]
[1]*Academia Sinica, TAIWAN and* [2]*National Tsing Hua University, TAIWAN*

T-193 **ELECTROOSMOTIC MICROPUMP ARRAY FILM USING BIOFUEL CELL**
Toshiro Yamanaka and Fumihito Arai
Nagoya University, JAPAN

S-194 **FREEZE-DRIED CELL-FREE PROTEIN EXPRESSION SYSTEM IN MICROCHAMBERS TOWARD POINT-OF-CARE DIAGNOSTICS**
Taishi Tonooka
Kyoto Institute of Technology, JAPAN

M-195 **SINGLE-CELL ELECTROPORATION AND REAL-TIME ELECTRICAL MONITORING ON A MICROFLUIDIC CHIP**
Yifei Ye[1,2], Wenjie Zhao[1,2], Jian Chen[1], Jie Cheng[1,2], Xinyu Wei[1,2], Lingqian Zhang[1], Haiyang Mao[1], Mingxiao Li[1], Yang Zhao[1], and Chengjun Huang[1,2]
[1]*Chinese Academy of Sciences (CAS), CHINA and*
[2]*University of Chinese Academy of Sciences (UCAS), CHINA*

T-196 **HIGH VELOCITY DIELECTROPHORETIC CELL SEPARATION USING CONTINUOUSLY EXTENDED SIDEWALL ELECTRODE FEATURING UNDERCUT PROFILE**
Chaomin Zhang, Duli Yu, and Xiaoxing Xing
Beijing University of Chemical Technology, CHINA

S-197 **THE MICROFLUIDIC MICROWELL DEVICE INTEGRATING SURFACE ENHANCED RAMAN SCATTERING FOR BACTERIA ENRICHMENT AND *IN SITU* ANTIBIOTIC SUSCEPTIBILITY TEST**
Cheng-Chieh Liao, Hsiu-Kang Huang, Yi-Zih Chen, and Nien-Tsu Huang
National Taiwan University, TAIWAN

Micro- & Nanofluidics

Generic Microfluidics & Nanofluidics

M-198 **ACOUSTICALLY EXCITED MICRO MASS TRANSPORT FOR REMOTELY DOSE-CONTROLABLE DRUG RELEASING**
Fang-Wei Liu and Sung Kwon Cho
University of Pittsburgh, USA

Generic Microfluidics & Nanofluidics

T-199 **BIDIRECTIONAL MAGNETIC POLYMER MEMBRANE ACTUATORS INTEGRATED INTO THERMOPLASTIC MICROFLUIDICS**
Chelsey E. Currie and Bonnie L. Gray
Simon Fraser University, CANADA

S-200 **DEVELOPMENT OF OPEN MICROFLUIDIC DEVICES FOR WATER-IN-OIL TWO-PHASE FLOW**
Linjue Wang, Chenqi Niu, Chong Zhang, and Zheyao Wang
Tsinghua University, CHINA

M-201 **ELECTROLYTIC GENERATION OF TRAPPED NANOBUBBLES VIA NUCLEATION CORE WITH PICOLITER PRECISION**
Eugene Yoon and Ellis Meng
University of Southern California, USA

T-202 **NANOPARTICLE SYNTHESIS USING AN ELECTROHYDRODYNAMIC MICROMIXER**
Paresa Modarres and Maryam Tabrizian
McGill University, CANADA

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Integrated/Embedded Microfluidics and Nanofluidic Systems & Platforms

M-203 **A CYANOBACTERIAL ARTIFICIAL LEAF FOR SIMULTANEOUS CARBON DIOXIDE REDUCTION AND BIOELECTRICITY GENERATION**
Lin Liu and Seokheun Choi
State University of New York, Binghamton, USA

T-204 **A FLOW-TYPE NANOPARTICLE GENERATION SYSTEM USING A MICROCHANNEL DEVICE FOR GENERATING AND QUENCHING DROPLETS**
Nozomu Fujimoto[1], Takefumi Kanda[1], Kentaro Omori[1], Naohiro Tahara[1], Yusaku Sakata[1], Norihisa Seno[1], Shuichi Wakimoto[1], Yoshiaki Nakazaki[2], and Takafumi Otoyama[2]
[1] *Okayama University, JAPAN and* [2] *Nano Cube Japan Company Limited, JAPAN*

S-205 **A SEAL-FREE VALVELESS DIGITAL PCR CHIP SUPPORTED WITH A HIGH-PRESSURE WATER CIRCULATION SYSTEM**
Tiegang Xu[1], Lei Wu[1], Xuefeng Wang[1], Xiaoyue Zhu[2], Jianzhong Chen[1], Fanglan Yao[1], Hongbo Zhou[1], and Xinxin Li[1]
[1] *Chinese Academy of Sciences (CAS), CHINA and*
[2] *Fujian Agriculture and Forestry University, CHINA*

M-206 **AN AUTOMATED MICROFLUIDIC SYSTEM FOR OPTIMIZATION OF APTAMER SELECTION BY USING CANCER TISSUE SAMPLES**
Cheng-Sheng Lin, Yi-Cheng Tsai, and Gwo-Bin Lee
National Tsing Hua University, TAIWAN

T-207 **DROPLET SOLUTION EXCHANGE PLATFORM UTILIZING DIELECTROPHORETIC FORCE**
Can Huang, Song-I Han, and Arum Han
Texas A&M University, USA

S-208 **KINETICS STUDY AND ONLINE MONITORING OF *IN-SITU* GROWTH OF ZINC-OXIDE NANOWIRE ARRAYS WITHIN MICROFLUIDIC CHAMBERS**
Mazen Erfan[1], Lan Gao[1], Martine Gnambodoe-Capochich[1], Elyes Nefzaoui[1], Yasser M. Sabry[2], Diaa Khalil[2], Yamin Leprince-Wang[1], and Tarik Bourouina[1]
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Integrated/Embedded Microfluidics and Nanofluidic Systems & Platforms

M-209 **MASSIVE INTEGRATION OF LIGHT DRIVING GEL ACTUATOR FOR SINGLE CELL MANIPULATION**
Yuha Koike[1], Hiroki Wada[1], Yoshiyuki Yokoyama[2], and Takeshi Hayakawa[1]
[1] *Chuo University, JAPAN and* [2] *Toyama Industrial Technology Research and Development Center, JAPAN*

T-210 **RAPID AND CONTROLLABLE DIGITAL MICROFLUIDIC HEATING USING ALN/SI RAYLEIGH SURFACE ACOUSTIC WAVES**
Yong Wang[1], Qian Zhang[1], Dongyang Chen[1], Ran Tao[2], Yangyang Guan[1], Zhonggui Xu[3], Yongqing Fu[2], and Jin Xie[1]
[1] *Zhejiang University, CHINA,* [2] *University of Northumbria, UK, and* [3] *Hubei Minzu University, CHINA*

Micro- & Nanofluidics

Manufacturing for Micro- and Nanofluidics

S-211 **BIOINSPIRED ULTRAFAST TRAPPING OF MICROBEAD ARRAY FOR DIGITAL IMMUNOASSAY**
Zhiting Peng, Boshi Jiang, and Tianzhun Wu
Chinese Academy of Sciences (CAS), CHINA

M-212 **MASSIVE PARALLEL NEMS FLOW RESTRICTION FABRICATED USING SELF-ALIGNED 3D-CRYSTALLOGRAPHIC NANOLITHOGRAPHY**
Chris P. van Kampen[1], Erwin J. Berenschot[1], Gert-Jan Burger[2], Roald M. Tiggelaar[1], Remco G. Sanders[1], Han G. Gardeniers[1], and Niels R. Tas[1]
[1] *University of Twente, NETHERLANDS and* [2] *QMicro, NETHERLANDS*

T-213 **NORMALLY CLOSED MICROFLUIDIC VALVES WITH MICROSTRUCTURED VALVE SEATS: A STRATEGY FOR INDUSTRIAL MANUFACTURING OF THERMOPLASTIC MICROFLUIDICS WITH MICROVALVES**
Kebin Li, Keith Morton, Matthew Shiu, Karine Turcotte, Luke Lukic, Gaetan Veilleux, Lucas Poncelet, and Teodor Veres
National Research Council Canada, CANADA

S-214 **POLYMER MICRO ATOMIZER FOR CONE JET MODE ELECTROSPRAY OF WATER**
Ji-hun Jeong[1], Hyoungsu Choi[1], Jinyoung Choi[2], and Seung S. Lee[1]
[1] *Korea Advanced Institute of Science and Technology (KAIST), KOREA and* [2] *Dongshin University, KOREA*

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Materials for Micro & Microfluidics

M-215 **A DROPLET PLATFORM BASED ON PARAHYDROPHOBIC NANOFORESTS FOR ON-SITE ION DETECTIONS**
Bo Gui[1,2], Meng Shi[1], Haiyang Mao[1,3], Haiyang Mao[1], Kewen Long[4], and Dapeng Chen[1,3]
[1] *Chinese Academy of Sciences (CAS), CHINA,* [2] *University of Chinese Academy of Sciences (UCAS), CHINA,* [3] *Wuxi Internet of Things Innovation Center Co. Ltd., CHINA, and* [4] *Foshan Chuandong Magnetic Electronics, CHINA*

T-216 **PLASMA-TREATED PDMS AS INTRINSICALLY NON-WETTING SURFACE FOR GALLIUM-ALLOY LIQUID METAL MICROFLUIDICS**
Sachin Babu and Jeong-Bong Lee
University of Texas, Dallas, USA

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S-217 **ACOUSTOFLUIDICS ALONG INCLINED SURFACES BASED ON ALN/SI SURFACE ACOUSTIC WAVE DEVICES**
Yong Wang[1], Ran Tao[2], Qian Zhang[1], Dongyang Chen[1], Xuying Chen[1], Dongsheng Li[1], Yongqing Fu[2], and Jin Xie[1]
[1] *Zhejiang University, CHINA and* [2] *Northumbria University, UK*

M-218 **CENTRIFUGATION OF MICROPARTICLES INSIDE A SESSILE DROPLET ON A MICROMACHINED SILICON CHIP USING ACOUSTIC TWEEZERS**
Jingui Qian, Habiba Begum, and Joshua E-Y Lee
City University of Hong Kong, HONG KONG

T-219 **COMPREHENSIVE ANALYSIS AND CONTROL OF DIFFUSIOOSMOSIS-DRIVEN IONIC TRANSPORT THROUGH INTERCONNECTED NANOPOROUS MEMBRANES**
Jongwan Lee[1], Kyunghun Lee[1], Cong Wang[2], Dogyeong Ha[1], Jungyul Park[2], and Taesung Kim[1]
[1] *Ulsan National Institute of Science and Technology (UNIST), KOREA and* [2] *Sogang University, KOREA*

S-220 **MEMS MICROMIXER FOR ULTRA FAST MIXING OF FLUIDS**
Matthew A. Moyet, Muhammad R. Hossen, Austin Ward, Oliver Adams, Michael D. Mason, Scott D. Collins, and Rosemary L. Smith
University of Maine, USA

M-221 **THE PERFORMANCE OF MICRO-FABRICATED GAS CHROMATOGRAPHIC COLUMNS WITH DIFFERENT NUMBER OF SERPENTINE TURNS**
Qiyong Liu[1], Fei Feng[1,2], Xuelei Yang[1], Bin Zhao[1], Yangyang Zhao[1], Haimei Zhou[1], Guiyang Zhang[1], and Xinxin Li[1]
[1] *Chinese Academy of Sciences (CAS), CHINA and*
[2] *University of Chinese Academy of Sciences (UCAS), CHINA*

Optical, RF and Electromagnetics for MEMS

DC & Low Frequency Magnetic & Electrochemical Components & Systems

T-222 **MECHANICAL TUNING OF MAGNETIC ANISOTROPY**
Mustafa Mert Torunbalci and Sunil Ashok Bhave
Purdue University, USA

Optical, RF and Electromagnetics for MEMS

Free Space Optical Components & Systems (Displays, Lenses, Detectors)

S-223 **A ROBUST COMPACT LENS SCANNER WITH LARGE TUNABLE RANGE**
Liang Zhou[1], Xiaomin Yu[1,2], and Huikai Xie[1]
[1] *University of Florida, USA and* [2] *Chengdu University of Information Technology, CHINA*

M-224 **DESIGN AND FABRICATION OF MICRO-LED DISPLAY WITH SAPPHIRE MICRO-REFLECTOR ARRAY**
Chengshiun Liou[1], Mingyu Hsieh[1], FuChi Shih[1], Yuanyuan Huang[1], Zihsong Hu[1], Chingfu Tsou[1], and Weileun Fang[2]
[1] *Feng Chia University, TAIWAN and*
[2] *National Tsing Hua University, TAIWAN*

T-225 **ELECTROSTATIC MICRO MIRROR ARRAY WITH BATCH-FABRICATED TORSION BEAM OF SILICON NANOWIRE**
Tomoya Nakamura, Yoshikazu Hirai, Osamu Tabata, and Toshiyuki Tsuchiya
Kyoto University, JAPAN

Free Space Optical Components & Systems (Displays, Lenses, Detectors)

S-226 **MICROFLUIDIC REFLECTIVE DISPLAY WITH PRIMARY COLOR SUB-PIXELS**
Jumpei Muramatsu and Hiroaki Onoe
Keio University, JAPAN

M-227 **S/N IMPROVEMENT OF NANO-CUBOID PHOTODETECTOR USING COMBINATION OF SMALL DEVICE AREA AND CONVERGING LENS**
Kazuki Kobayashi and Tetsuo Kan
University of Electro-Communications, JAPAN

Optical, RF and Electromagnetics for MEMS

Manufacturing for Electromagnetic Transducers

T-228 **A NOVEL FABRICATION PROCESS OF NANO-CAVITY COUPLED PLASMONIC STRUCTURES FOR COLORMETRIC SENSING**
Jia Zhu[1], Yun Huang[1], Kenan Zhang[1,2], Guanzhou Lin[1], and Wengang Wu[1]
[1]*Peking University, CHINA and* [2]*Fuzhou University, CHINA*

S-229 **TORSIONAL MEMS MAGNETOMETER WITH VERTICALLY STAGGERED COMBS FOR IN-PLANE MAGNETIC FIELD SENSING**
Hengmao Liang[1,2], Song Liu[1,2], and Bin Xiong[1]
[1]*Chinese Academy of Sciences (CAS), CHINA and*
[2]*University of Chinese Academy of Sciences (UCAS), CHINA*

Optical, RF and Electromagnetics for MEMS

Materials for Electromagnetic Transducers

M-230 **MAGNETOPHORESIS ASSISTED CAPILLARY ASSEMBLY OF COBALT NANORODS: A NEW SOURCE OF PERMANENT MAGNETS FOR MEMS**
Pierre Moritz[1,2], Fabrice Mathieu[1], David Bourrier[1], Daisuke Saya[1], Antoine Gonon[2], Liviu Nicu[1], Lise-Marie Lacroix[2], Guillaume Viau[2], and Thierry Leichlé[1]
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T-231 **PRECISE FABRICATION OF GAP-TUNABLE NANOANTENNAS FOR PLASMON-ENHANCED SPECTROSCOPY AND BIOSENSING**
Yun Huang, Zhuojie Chen, Shengxiao Jin, Jia Zhu, Bocheng Yu, Wengang Wu, Rui Zhu, and Jun Xu
Peking University, CHINA

Optical, RF and Electromagnetics for MEMS

MEMS for Timing & Frequency Control

S-232 **AUTO-RESONANCE - A NEW PARADIGM FOR DRIVING LINEAR AND NONLINEAR ELECTROSTATIC RESONATORS**
Danny H. Kassie and David Elata
Technion - Israel Institute of Technology, ISRAEL

M-233 **AWARD NOMINEE***
EXPLORING THE PARAMETRIC ENERGY TRANSFER IN A MULTI-MODE PIEZOELECTRIC RESONATOR WITH NONLINEAR HARMONICS
Chun-You Liu, Gayathri Pillai, and Sheng-Shian Li
National Tsing Hua University, TAIWAN

T-234 **FREQUENCY STABILIZATION IN AN ENCAPSULATED HIGH-Q MICROMECHANICAL RESONATOR VIA INTERNAL RESONANCE**
Jun Yu[1], Hyun-Keun Kwon[2], Gabrielle D. Vukasin[2], Thomas W. Kenny[2], and Hanna Cho[1]
[1]*Ohio State University, USA and* [2]*Stanford University, USA*

MEMS for Timing & Frequency Control

S-235 **INJECTION LOCKING TYPE 1/2 FREQUENCY DIVIDER EMPLOYING PIEZOELECTRIC MEMS RESONATOR FOR SIMPLIFYING THE MICRO ATOMIC CLOCK SYSTEM**
Motoaki Hara[1], Yuichiro Yano[1], Masatoshi Kajita[1], Shinsuke Hara[1], Akifumi Kasamatsu[1], Hiroyuki Ito[2], and Tetsuya Ido[1]
[1] *National Institute of Information and Communications Technology, JAPAN and* [2] *Tokyo Institute of Technology, JAPAN*

M-236 **MICRO-OVEN-CONTROLLED MEMS OSCILLATOR INTEGRATED WITH MICRO-EVAPORATOR FOR FREQUENCY TRIMMING**
Binbin Pei[1,2], Ke Sun[1], Peng Zhong[1,2], Tingting Yu[1,2], Chaozhan Ye[1,2], Heng Yang[1], and Xinxin Li[1]
[1] *Chinese Academy of Sciences (CAS), CHINA and*
[2] *University of Chinese Academy of Sciences (UCAS), CHINA*

T-237 **TEMPERATURE HYSTERESIS IN PIEZORESISTIVE MICROCANTILEVERS**
James M.L. Miller, Ze Zhang, Nicholas E. Bousse, Dusan Coso, Seid Sadat, Hyun-Keun Kwon, Gabrielle Vukasin, Arun Majumdar, and Thomas W. Kenny
Stanford University, USA

S-238 **THERMAL STABILITY OF DETF MEMS RESONATORS: NUMERICAL MODELLING AND EXPERIMENTAL VALIDATION**
Valentina Zega[1], Andrea Opreni[1], Giorgio Mussi[1], Hyun-keun Kwon[2], Gabrielle Vukasin[2], Gabriele Gattere[3], Giacomo Langfelder[1], Attilio Frangi[1], and Thomas W. Kenny[2]
[1] *Politecnico di Milano, ITALY,* [2] *Stanford University, USA, and* [3] *STMicroelectronics, ITALY*

M-239 **THERMO-ACOUSTIC ENGINEERING OF GaN SAW RESONATORS FOR STABLE CLOCKS IN EXTREME ENVIRONMENTS**
Afzaal Qamar[1], Mayur Ghatge[2], Roozbeh Tabrizian[2], and Mina Rais-Zadeh[1,3]
[1] *University of Michigan, USA,* [2] *University of Florida, USA, and* [3] *California Institute of Technology, USA*

Optical, RF and Electromagnetics for MEMS

Photonic Components & Systems

T-240 **ACOUSTICALLY MEDIATED MICROWAVE-TO-OPTICAL CONVERSION ON THIN-FILM LITHIUM NIOBATE**
Linbo Shao[1], Mengjie Yu[1], Smarak Maity[1], Neil Sinclair[1,2], Lu Zheng[3], Cleaven Chia[1], Amirhassan Shams-Ansari[1], Cheng Wang[4], Mian Zhang[1], Keji Lai[3], and Marko Loncar[1]
[1] *Harvard University, USA,* [2] *California Institute of Technology, USA,* [3] *University of Texas, Austin, USA, and* [4] *City University of Hong Kong, HONG KONG*

S-241 **CELL TRAPPING AND MECHANICAL STIMULATION IN MICROFLUIDIC SENSOR COMBINED WITH OPTICAL FIBER COMPONENTS**
Motohide Yoshimi[1], Shinya Kumagai[2], Yasutake Ohishi[1], and Minoru Sasaki[1]
[1] *Toyota Technological Institute, JAPAN and* [2] *Meijo University, JAPAN*

M-242 **DIRECT LASER WRITING OF TITANIUM DIOXIDE-LADEN RETINAL CONE PHANTOMS**
Andrew C. Lamont[1,2], Michael A. Restaino[1], Abdullah T. Alsharhan[1], Zhoulin Liu[2], Daniel X. Hammer[2], Anant Agrawal[2], and Ryan D. Sochol[1]
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[2] *United States Food & Drug Administration, USA*

Photonic Components & Systems

T-243 **FREQUENCY STABILITY OF STRESS-ENGINEERED NANOMECHANICAL RESONATOR AND ITS CRAMER-RAO LOWER BOUND**
Mingkang Wang[1,2], Rui Zhang[3], Diego Perez-Morelo[1,2], Robert Ilic[1], Yuxiang Liu[3], and Vladimir Aksyuk[1]
[1]*National Institute of Standards and Technology (NIST), USA,* [2]*University of Maryland, USA, and* [3]*Worcester Polytechnic Institute, USA*

S-244 **HIGHLY DEFORMABLE OPTOELECTRONICS USING LIQUID METAL**
Takashi Kozaki, Satoshi Saito, Yota Otsuki, Ryosuke Matsuda, Yutaka Isoda, Takuma Endo, Fumika Nakamura, Takuto Araki, Taichi Furukawa, Shoji Maruo, Masayoshi Watanabe, Kazuhide Ueno, and Hiroki Ota
Yokohama National University, JAPAN

M-245 **INTEGRATION OF ALUMINUM NITRIDE MODULATOR AND TEXTILE TRIBOELECTRIC NANOGENERATOR TOWARD SELF-SUSTAINABLE TUNABLE WEARABLE PHOTONICS**
Bowei Dong, Qiongfeng Shi, Tianyiyi He, Zixuan Zhang, Yiming Ma, Guangya Zhou, and Chengkuo Lee
National University of Singapore, SINGAPORE

T-246 **RGB ALL LIQUID-BASED MICROFLUIDIC QUANTUM DOTS LIGHT-EMITTING DIODES USING DEEP-BLUE LIQUID ORGANIC SEMICONDUCTOR BACKLIGHT**
Masahiro Kawamura[1], Hiroyuki Kuwae[1], Takumi Kamibayashi[1], Juro Oshima[2], Takashi Kasahara[3], Shuichi Shoji[1], and Jun Mizuno[4]
[1]*Waseda University, JAPAN,* [2]*Nissan Chemical Corporation, JAPAN,* [3]*Hosei University, JAPAN, and* [4]*Tokyo University of Science, JAPAN*

Optical, RF and Electromagnetics for MEMS

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S-247 **8.5 GHZ AND 11.5 GHZ ACOUSTIC DELAY LINES USING HIGHER-ORDER LAMB MODES IN LITHIUM NIOBATE THIN FILM**
Ruochen Lu[1], Yansong Yang[1], Michael Breen[1], Ming-Huang Li[2], and Songbin Gong[1]
[1]*University of Illinois, Urbana-Champaign, USA and* [2]*National Tsing Hua University, TAIWAN*

M-248 **A NON-RECIPROCAL LAMB-WAVE DELAY LINE EXPLOITING ACOUSTOELECTRIC EFFECT IN SINGLE CRYSTAL GERMANIUM**
Faysal Hakim, Mehrdad Ramezani, Sushant Rassay, and Roozbeh Tabrizian
University of Florida, USA

T-249 **A NON-RECIPROCAL SURFACE ACOUSTIC WAVE FILTER BASED ON ASYMMETRICAL DELAY LINES AND PARAMETRIC INTERACTIONS**
José A. Bahamonde and Ioannis Kymissis
Columbia University, USA

S-250 **ACOUSTICALLY COUPLED WIDEBAND RF FILTERS WITH BANDWIDTH RECONFIGURABLITY USING FERROELECTRIC ALUMINUM SCANDIUM NITRIDE FILM**
Sushant Rassay, Faysal Hakim, Mehrdad Ramezani, and Roozbeh Tabrizian
University of Florida, USA

M-251 **ENHANCED PIEZOELECTRIC $AL_{1-X}SC_XN$ RF-MEMS RESONATORS FOR SUB-6GHZ RF-FILTER APPLICATIONS: DESIGN, FABRICATION AND CHARACTERIZATION**
Andreas Bogner[1,3], Ruediger Bauder[3], Hans-Joerg Timme[3], Thomas Forster[3], Christian Reccius[3], Robert Weigel[1], and Amelie M. Hagelauer[2]
[1]*University of Erlangen-Nuremberg, GERMANY,* [2]*University of Bayreuth, GERMANY, and* [3]*Infineon Technologies AG, GERMANY*

RF MEMS Components & Systems

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Vikrant J. Gokhale, Brian P. Downey, Matthew T. Hardy, Eric N. Jin, Jason A. Roussos, and David J. Meyer
US Naval Research Laboratory, USA

S-253 **LONG-RANGE TELEMETRIC SMART ORTHODONTIC BRACKET WITH CMOS-INTEGRATED 3D WIREBONDER-FABRICATED MICROCOILS**
Julian Hafner[1], Ali Moazenzadeh[2], Fabian Heinen[1], Miguel Rodriguez[1], Ulrike Wallrabe[1], and Oliver Paul[1]
[1]*University of Freiburg, GERMANY and* [2]*Voxalytic GmbH, GERMANY*

M-254 **MICRO-ACOUSTIC QUAD CIRCULATOR WITH SELF-INTERFERENCE CANCELLATION**
Yao Yu and Matteo Rinaldi
Northeastern University, USA

T-255 **RECONFIGURABLE N-PATH MEMS FILTER BASED ON THE PERIODIC COMMUTATION OF SINGLE FREQUENCY RESONATORS**
Giuseppe Michetti, Michele Pirro, Yao Yu, Guofeng Chen, Cristian Cassella, and Matteo Rinaldi
Northeastern University, USA

S-256 **RECORD-HIGH KT2 EXCEEDING 7.4% THROUGH LOW-IMPEDANCE LITHOGRAPHICALLY DEFINED RESONANT RODS IN ALUMINUM NITRIDE THIN PLATES**
Xuanyi Zhao, Bernard Herrera, and Cristian Cassella
Northeastern University, USA

T-257 **SUPER HIGH FREQUENCY SIMPLE PROCESS FLOW CROSS-SECTIONAL LAMÉ MODE RESONATORS IN 20% SCANDIUM-DOPED ALUMINUM NITRIDE**
Zachary A. Schaffer[1], Gianluca Piazza[1], Sergey Mishin[2], and Yury Oshmyansky[2]
[1]*Carnegie Mellon University, USA and*
[2]*Advanced Modular Systems, USA*

S-258 **THIN-FILM LITHIUM NIOBATE ACOUSTIC DELAY LINE OSCILLATORS**
Ming-Huang Li[1,2], Ruochen Lu[1], Tomas Manzaneque[3], and Songbin Gong[1]
[1]*University of Illinois, Urbana-Champaign, USA,*
[2]*National Tsing Hua University, TAIWAN, and*
[3]*Delft University of Technology, NETHERLANDS*

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Xu Han, Di Lan, and Jing Wang
University of South Florida, USA

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Takuya Kosuge[1], Tetsuo Kan[1], Kuniaki Konishi[2], Mizuho Matoba[2], Natsuki Kanda[2], and Makoto Kuwata-Gonokami[2]
[1]*University of Electro-Communications, JAPAN and*
[2]*University of Tokyo, JAPAN*

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Ryunosuke Gando[1], Daiki Ono[1,2], Shiori Kaji[1], Hiroshi Ota[2], Tetsuro Itakura[1], and Yasushi Tomizawa[1]
[1] *Toshiba Corporation, JAPAN and* [2] *Device & System Platform Development Center Co., Ltd., JAPAN*

M-262 **LONG-TERM STABILITY IMPROVEMENT OF MICRO-HOTPLATE METHANE SENSOR PRODUCT**
Ying Chen[1,2], Pengcheng Xu[1,2], Pingping Zhang[3], and Xinxin Li[1,2]
[1] *Chinese Academy of Sciences (CAS), CHINA,*
[2] *University of Chinese Academy of Sciences (UCAS), CHINA, and*
[3] *Suzhou Huiwen Nanotechnology Co., Ltd., CHINA*

T-263 **MONOTHIC INTEGRATION OF PRESSURE PLUS Z-AXIS ACCELERATION COMPOSITE TPMS SENSORS WITH 1.0MM×1.0MM CHIP-SIZE AND 0.09$/DIE FABRICATION-COST**
Dan Xue, Jiachou Wang, and Xinxin Li
Chinese Academy of Sciences (CAS), CHINA

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Fumiharu Matsuo[1], Haruka Oda[2], Fumina Miyake[1], Hideo Otsuki[1], Shoji Takeuchi[2], and Osamu Tsuji[1]
[1] *Samco Inc., JAPAN and* [2] *University of Tokyo, JAPAN*

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Hirofumi Chiba[1], Yukio Suzuki[2], Yoshiaki Yasuda[1], Mitsuyasu Kumagai[1], Takaaki Koyama[1], and Shuji Tanaka[2]
[1] *Stanley Electric Co., Ltd, JAPAN and* [2] *Tohoku University, JAPAN*

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Craig R. Copeland, Craig D. McGray, B. Robert Ilic, Jon Geist, and Samuel M. Stavis
National Institute of Standards and Technology (NIST), USA

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S-267 **THERMO-MECHANICAL SIMULATION OF DIE-LEVEL PACKAGED 3-AXIS MEMS GYROSCOPE PERFORMANCE**
Arnaud Parent[1], Chris Welham[1], and Brian Van Dyk[2]
[1] *Coventor, A Lam Research Company, FRANCE and*
[2] *Coventor, A Lam Research Company, USA*

S-268 **HOW TO MAKE MEMS DESIGN EASY?**
Jan E. Mehner[1], David Kriebel[2], and Philipp Jan Mehner[2]
[1] *i-ROM GmbH, GERMANY and*
[2] *Chemnitz University of Technology, GERMANY*

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Lyncée Tec, SWITZERLAND

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Jeroen Haneveld[1], Arenda Koelewijn[1], Jan-Joost Lankwarden[1], Mark Olde Riekerink[1], Marko Blom[1], Maurice Wijnperle[1], Remy Wiertz[1], Ronald Start[1], Maximilien J. Collon[2], Guiseppe Vacanti[2], Nicolas M. Barrière[2], Boris Landgraf[2], Ramses Günther[2], Ljubiša Babić[2], and David Girou[2]
[1]*Micronit Microtechnologies B.V., NETHERLANDS and*
[2]*cosine, NETHERLANDS*

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Georgiana I. Groza, Frederico O. Keller, Richard Haettel, Thibaut Devillers, and Nora M. Dempsey
CNRS - Institut NEEL/ Université Grenoble Alpes, FRANCE

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Hirokazu Terai and Atsushi Tsuchihashi
Samco, Inc., JAPAN

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Marcel Demmler, Thomas Tonert, Carsten Schulze, Thoralf Dunger, Matthias Nestler, and Michael Zeuner
scia Systems GmbH, GERMANY

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David Springer
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Kıvanç Esat and Romain Stomp
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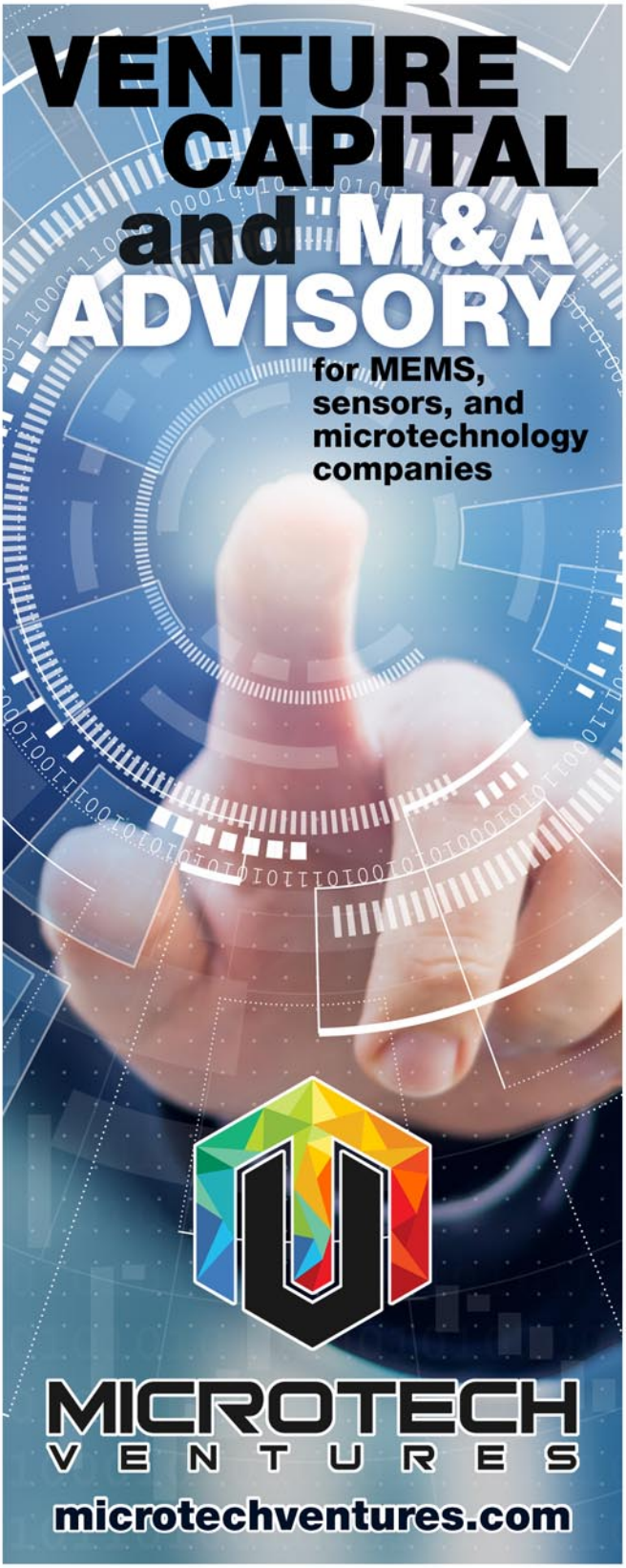
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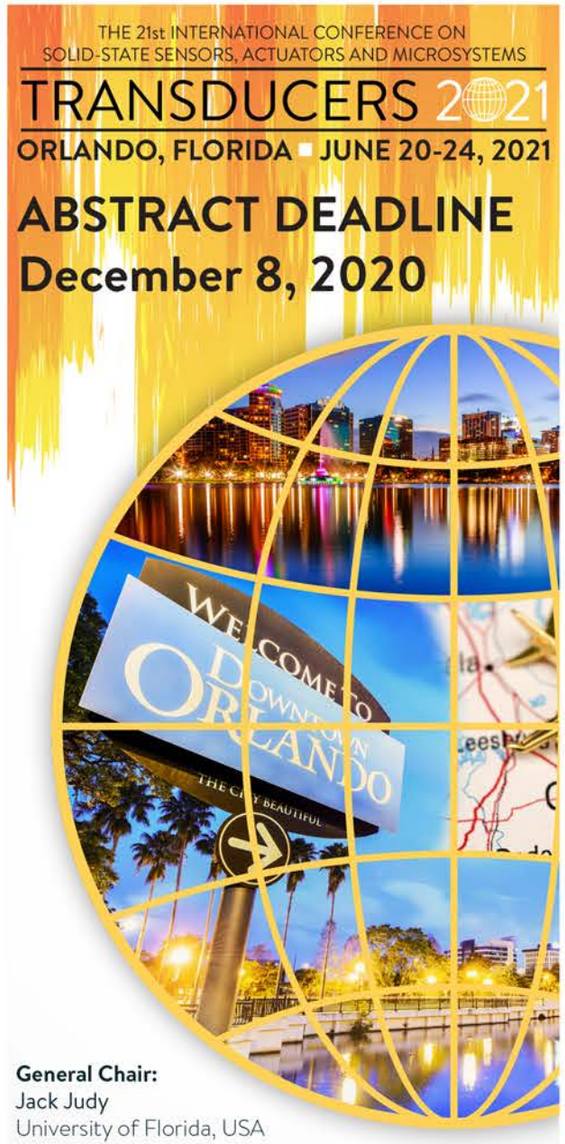

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