THE 36TH IEEE INTERNATIONAL CONFERENCE ON MICRO ELECTRO MECHANICAL SYSTEMS

MEMS 2023

MUNICH, GERMANY
15 - 19 JANUARY

FINAL PROGRAM

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MEMS
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MEMS 2023 CONFERENCE AT A GLANCE

	SUNDAY 15 JANUARY	MONDAY 16 JANUARY	TUESDAY 17 JANUARY	WEDNESDAY 18 JANUARY	THURSDAY 19 JANUARY
08:00		**WELCOME ADDRESS** (08:00 - 08:30)			
08:30		**IEEE RECOGNITION** (08:30 - 08:50)	**PLENARY II** (08:30 - 09:15)	**PLENARY III** (08:30 - 09:15)	**PLENARY IV** (08:30 - 09:15)
09:00		**PLENARY I** (08:50 - 09:35)			
09:30		**SESSION I** Novel MEMS/NEMS Devices for Computing/Imaging (09:35 - 10:35)	**SESSION V** New Materials, Fabrication, & Packaging (09:15 - 10:15)	**SESSION IX** Optomechanics & Photonics Integration (09:15 - 10:00)	**SESSION XIII** Gas & Flow Sensors (09:15 - 10:15)
10:00					
10:30		**BREAK & EXHIBITS** (10:35 - 11:05)	**BREAK & EXHIBITS** (10:15 - 10:45)	**BREAK & EXHIBITS** (10:00 - 10:30)	**BREAK & EXHIBITS** (10:15 - 10:45)
11:00		**SESSION II** BioMEMS I (11:05 - 12:20)	**SESSION VI** Micro- and Nanofluidics & Medical Applications (10:45 - 12:00)	**SESSION X** RF MEMS Filters & Resonators (5G & 6G) (10:30 - 11:45)	**SESSION XIV** New Fabrication Techniques (10:45 - 11:45)
11:30					**AWARDS CEREMONY** (11:45 - 12:00)
12:00			**MEMS 2024 ANNCMNT** (12:00 - 12:15)	**LUNCH & EXHIBITS** (11:45 - 13:00)	**CONFERENCE ADJOURNS** (12:00)
12:30		**LUNCH & EXHIBITS** (12:20 - 13:45)	**LUNCH & EXHIBITS** (12:15 - 13:15)		
13:00	**INDUSTRY SESSION** (13:00 - 17:00)			**SESSION XIA** MEMS/NEMS Resonators & Non-Linear Dynamics (13:00 - 14:00) / **SESSION XIB** BioSensors I (13:00 - 14:00)	
13:30		**SESSION III** MEMS Inertial Sensors & Power MEMS (13:45 - 14:45)	**SESSION VII** MEMS Fluidic Sensors (13:15 - 14:30)		
14:00					
14:30		**POSTER SESSION I** (14:45 - 16:45)	**POSTER SESSION II** (14:15 - 16:15)	**POSTER SESSION III** (14:00 - 16:00)	
15:00					
15:30					
16:00		**BREAK & EXHIBITS** (16:15 - 16:45)	**BREAK & EXHIBITS** (15:45 - 16:15)	**BREAK & EXHIBITS** (15:30 - 16:00)	
16:30		**MEMS ANNOUNCEMENT** (16:45 - 16:50)			
17:00	**CONFERENCE REGISTRATION & CHECK-IN** (17:00 - 19:00)	**SESSION IV** BioMEMS II (16:50 - 18:05)	**SESSION VIII** Sonics & Ultrasonics MEMS (16:15 - 17:30)	**SESSION XIIA** Force & Displacement/Tactile Sensors & Human-Machine (16:00 - 17:15) / **SESSION XIIB** BioSensors II (16:00 - 17:15)	
17:30					
18:00	**WELCOME RECEPTION** (17:00 - 19:00)		**ADJOURN FOR DAY** (17:30)	**ADJOURN FOR DAY** (17:15)	
18:30		**ADJOURN FOR DAY** (18:05)			
19:00			**BANQUET AT THE LÖWENBRÄU KELLER** (19:00 - 22:00)		
19:30					
20:00					
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21:00					
21:30					
22:00					

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TECHNICAL PROGRAM

Victory Gate in Munich, Germany. *Image by wdreblow0 from Pixabay.*

WELCOME TO THE 36TH IEEE INTERNATIONAL CONFERENCE ON MICRO ELECTRO MECHANICAL SYSTEMS (MEMS 2023) IN MUNICH, GERMANY!

The IEEE MEMS Conference series originated in 1987, and has been known as the IEEE International Conference on Micro Electro Mechanical Systems since 1999. Over the last decade, the MEMS community has experienced immense progress in the science and technology of miniaturization, as well as increasing technical maturity and commercialization of ever smarter products encompassing embedded artificial intelligence and wireless connectivity to the Internet-of-Things. Since 2020, the conference is sponsored by the IEEE MEMS Technical Community, a new body within the IEEE dedicated to supporting and developing our MEMS community.

This Conference brings together annually the international MEMS community consisting of top players in academia and industry by providing them with the latest results on every aspect of MEMS. The organizers this year made a special effort to attract technical contributions from industry, also showcased in the Industry Workshop. We hope that you will enjoy the presentations by our accomplished invited plenary speakers and stringently selected contributed oral and poster presentations.

We would like to express our sincerest gratitude to all the authors who submitted their abstracts. Their high-quality work serves as the foundation for the success of this conference. A total of 314 papers out of 636 submitted abstracts were carefully selected by 47 experts comprising the Technical Program Committee (TPC) using a well-established double-blind review process that ensures scientific quality as the sole selection criterion. The TPC comprises academic and industrial members, with equal representation from three regional divisions: the Americas, Europe & Africa, and Asia & Oceania. To allow for more focused and careful deliberation, the actual abstract review process divided the overall TPC into eight sub-committees, each with six members to evaluate and rate each abstract. We are grateful to all TPC members who volunteered their valuable time, including participation in a two-day virtual meeting last October, for paper selection.

The conference arranges presentation of accepted papers in a mixed single/parallel session format with 4 invited plenary, 70 oral, 238 poster presentations, and 15 open poster presentations. In addition, the TPC collectively nominated, based on quality, abstract submissions as finalists for the Outstanding Student Paper Awards and images for the Art in Microtechnology prize. These awards aim to recognize excellence amongst work presented by students and will be announced in a special ceremony to conclude the conference late Thursday morning.

We gratefully acknowledge the industrial support groups, exhibitors, and benefactors for their contributions to this conference. The dedicated and relentless effort of Ms. Sara Stearns and her team at PMMI in managing this conference is highly appreciated.

In closing, we hope you enjoy the networking, technical presentations, exhibition booths, and events of the 2023 IEEE International MEMS Conference this week in Munich!

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Universidad Autonoma Barcelona, SPAIN

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GENERAL INFORMATION

WIRELESS INTERNET

Wireless Internet will be available in the conference meeting rooms.

- Select "**MEMS2023**" from the list of available networks.
- Once prompted, the Conference code is: **mems2023** (case sensitive).

We ask that you limit your usage to be considerate of other attendees and please logout once you are finished. There is a bandwidth limit of 2 Mbps per device.

CONFERENCE APP

Please refer to the conference email you received for instructions on downloading the conference app.

REGISTRATION & INFORMATION DESK

The Registration and Information Desk will be open during the times listed below. All meeting rooms will close shortly after registration closes each day.

Sunday, 15 January	17:00 – 19:00
Monday, 16 January	07:00 – 18:05
Tuesday, 17 January	08:00 – 17:30
Wednesday, 18 January	08:00 – 17:15
Thursday, 19 January	08:00 – 12:00

BREAKS

All scheduled breaks will be held on all three floors of the **SCCM**. Coffee will be served during scheduled mid-morning and afternoon breaks only.

CLOAK ROOM

There will be a cloak room open during Conference hours. The cloak room is located on the second floor in **Orion 1**. Please note that this room is unsecured. Leave personal property at own risk.

CHIMES

The chimes will ring five minutes before the end of each scheduled break. The sessions will begin on time, so please return to the sessions when you hear the chimes.

NAME BADGES

All attendees must wear their badge at all times to gain admission to all sessions, exhibits, and social functions.

JOB BOARD

The Job Board will be located on the **ground floor**. See floor plan at the end of this program.

CELLULAR PHONES AND ALARMS

As a courtesy to our speakers and other attendees, please silence any cellular phones and alarms during sessions.

VIDEO RECORDING

Video recordings are strictly prohibited in the sessions, poster presentations and the exhibit area.

SOCIAL EVENTS

WINE AND CHEESE WELCOME RECEPTION

Sunday, 15 January
17:00 – 19:00

An informal Welcome Reception with be held in conjunction with registrationthroughout the **SCCM**. This will allow you the opportunity to enjoy Munich with your colleagues for the remainder of the evening.

CONFERENCE BANQUET AT THE LÖWENBRÄU KELLER

Tuesday, 17 January
19:00 – 22:00

MEMS 2023 welcomes you to the Löwenbräu Keller. Munich's tavern culture has been thriving at Löwenbräukeller (Löwenbräu Beer Cellar) on Stiglmaierplatz square for over 130 years. Marked by the distinctive lion sitting above its main entrance and the large tower with its green copper spire, Löwenbräukeller is just a few minutes away from Munich Hauptbahnhof (central station) by foot. This traditional tavern houses a rustic restaurant and a historic beer hall (Schwemme). This event is included in your registration. As of the printing of this program, there are a few guest tickets remaining. Please visit the Onsite Conference Registration Desk for availability.

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IEEE Micro Electro Mechanical Systems (MEMS) Technical Community will keep you abreast of the latest in MEMS ideas, designs, and manufacturing methodologies, many of which could very well spark new thinking and enable new capabilities in a myriad of IEEE fields. MEMS is an enabling technology harnessing the benefits of miniaturization in physical domains beyond the electrical and found in billions of devices today. The field of MEMS encompasses tiny (generally chip-scale) devices or systems capable of realizing functions not easily achievable via macroscopic ones. Many IEEE organizational units already benefit from MEMS, as the utility of its fundamental concepts and technology touches nearly all IEEE field of interest areas.

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Sunday, 15 January	17:00 – 19:00	Wednesday, 18 January	08:00 – 17:15
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In the OxideMEMS Lab at Purdue University, PI Sunil Bhave and his research group explore inter-domain coupling in Opto-mechanical, Spin-Acoustic and Atom-MEMS devices. We strive to leverage our understanding of these coupled systems to design and fabricate tunable filters, inertial sensors, microwave to optical converters, tunable lasers and nonreciprocal photonic and microwave systems.

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PLENARY SPEAKERS & ROBERT BOSCH AWARD

MONDAY, 16 JANUARY

PLENARY SPEAKER I

08:50 - 09:35

FROM ETCH TO EDGE AI: OPENING NEW HORIZONS WITH SMART SENSOR TECHNOLOGIES

Stefan Finkbeiner

Robert Bosch, GmbH

TUESDAY, 17 JANUARY

PLENARY SPEAKER II

08:50 - 09:35

ACOUSTOFLUIDICS: MERGING ACOUSTICS AND FLUID MECHANICS FOR BIOMEDICAL APPLICATIONS

Tony Jun Huang

Duke University, USA

WEDNESDAY, 18 JANUARY

PLENARY SPEAKER III

08:30 - 09:15

LEVERAGE SEMICONDUCTOR ECO-SYSTEMS FOR MEMS

Weileun Fang

National Tsing Hua University, TAIWAN

THURSDAY, 19 JANUARY

PLENARY SPEAKER IV

08:30 - 09:15

MATERIALS ENGINEERING FOR CHEMICAL SENSING ENHANCEMENT

Elisabetta Comini

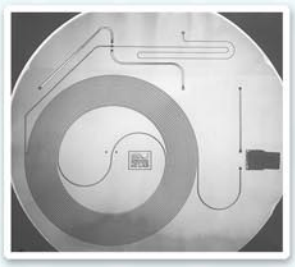
University of Brescia, ITALY

THE 2023 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 2023 Bosch Award will be presented on Monday, 16 January at 08:30.

GAS CHROMATOGRAPH ON A CHIP PROJECT

For pioneering contributions to MEMS by developing and commercializing the microfabricated gas chromatograph



Stephen C. Terry, **John H. (Hal) Jerman**, both now retired, and the late **Prof. James B. Angell**, were all involved with the development of the "***gas chromatograph on a chip***" project at Stanford University in the 1970's, and **Steve** and **Hal** later at Microsensor Technology until its sale in 1985. The concept was initially suggested by NASA as an instrument to fly to Mars on the early Viking missions, but the technology was not ready for launch. There were three separate iterations of the GC system through the years to increase performance, yield, and to reduce cost of the system. Ultimately, portable GC systems and a fixed, high-accuracy system for natural gas analysis, containing multiple GC modules, were developed and sold commercially. The concept of a miniature system to combine chemical or biological sample preparation, analysis, and detection was taken up by multiple researchers through the decades in what is now the field of micro-TAS.

Jim Angell was educated at MIT and was as a professor at Stanford until 2001, and he died in 2006. Many of his students were involved in what was then micromaching in the 1960's, 1970's, and 1980's. He was a Fellow of the IEEE. **Steve Terry** was an undergraduate at MIT and developed the first-generation GC system as his Ph. D. research in 1975. **Hal Jerman** joined the program from Caltech in 1975, and he fabricated the thin-film thermal conductivity detector as his Ph. D. research while the 2nd generation GC system was being developed. **Steve** and **Hal** continued work on a wide variety of MEMS and related devices in a number of Silicon Valley companies until their recent retirements. They are named as inventors on a combined 83 US patents.

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

Oral Sessions

Oral sessions will be held in **Audimax**, with the Wednesday parallel concurrent sessions in **Hörsaal**. See floor plans at the end of this program.

Poster Sessions

Three (3) poster sessions will be held on three floors of the SCCM on Monday, Tuesday, and Wednesday. All posters are listed with their assigned number and day that they are on display. Authors will be available for questions during their appointed time. Posters are color coded by day and poster category.

Guide to Understanding Poster Numbering

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

Poster number: **M01-a**
The first character (i.e. **M**) indicates the day of the Conference:

M = Monday **T** = Tuesday **W** = Wednesday

The second character (i.e. **01**) is the poster board position on the floor plan.

The last character (i.e. **a**) is the poster category that is reflected in the Poster Topic Category chart.

Poster Topic Categories

- a - Bio and Medical MEMS
- b - Emerging Technologies and New Opportunities for MEMS/NEMS
- c - Industry MEMS and Advancing MEMS for Products and Sustainability
- d - Materials, Fabrication and Packaging for Generic MEMS and NEMS
- e - MEMS Actuators and PowerMEMS
- f - MEMS Physical and Chemical Sensors
- g - Micro- and Nanofluidics
- h - Optical, RF and Electromagnetics for MEMS/NEMS
- i - Open Posters

Posters will be on display and available for viewing on their assigned day only. See poster floor plans at the end of this program.

Outstanding Student Paper Award Finalists

Award Nominees are indicated next to the paper title.

Olympic Tower in Munich, Germany. *Image by Renato Canepa from Pixabay*

SUNDAY

SUNDAY, 15 JANUARY

INDUSTRY SESSION I: From Laboratory to Mass Market

Session Chairs:
Núria Barniol, *Universidad Autonoma Barcelona, SPAIN and* Franz Lärmer, *Robert Bosch GmbH, GERMANY*

Hörsaal

13:00 **THE MEMS JOURNEY - THE BEST IS YET TO COME**
Anton Hofmeister
STMicroelectronics, ITALY

13:30 **FROM IDEA TO PRODUCT - FROM ONE TO ONE BILLION**
Alfons Dehe
Hahn-Schickard Freiburg, GERMANY

14:00 **EUV HIGH-NA LITHOGRAPHY - PROCESS AND METROLOGY ASPECTS FOR MIRROR FABRICATION**
Wilhelm Kühn
Carl Zeiss SMT GmbH, GERMANY

14:30 **ENVIRONMENTAL SENSORS - THE QUEST FOR SURVIVAL**
Christoph Schelling
Robert Bosch GmbH, GERMANY

15:00-15:30 **Networking Break**

INDUSTRY SESSION II: From Ideas to Start-up's

Session Chairs:
Núria Barniol, *Universidad Autonoma Barcelona, SPAIN and* Franz Lärmer, *Robert Bosch GmbH, GERMANY*

Hörsaal

15:30 **MEMS MIRROR TECHNOLOGY - KEY ENABLER FOR AUGMENTED REALITY SMARTGLASSES**
Ulrich Hofmann
OQmented, GERMANY

16:00 **SILICON MICROGRAVITY: RESONANT MEMS TECHNOLOGY FOR GRAVIMETRY AND PRECISION INERTIAL SENSING**
Ashwin A. Seshia
Silicon Microgravity, Ltd. and University of Cambridge, UK

16:30 **THE LED OF ACOUSTICS**
Ferrucio Bottoni
USound, AUSTRIA

17:00 - 19:00 **Welcome Reception**

Munich, Germany. *Image by David Mark from Pixabay*

SUNDAY

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MONDAY

MONDAY, 16 JANUARY

Welcome Address

Audimax

08:00 **MEMS 2023 Conference Chairs**
Núria Barniol, *Universitat Autonoma de Barcelona, SPAIN*
Franz Lärmer, *Robert Bosch GmbH, GERMANY*

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

08:35 **IEEE Electron Devices Society Robert Bosch Micro and Nano Electro Mechanical Systems Award Recipient**
John H. (Hal) Jerman will accept on behalf of the Gas Chromatograph on a Chip Project.

Plenary Speaker I

Session Chair:
Franz Laermer, *Robert Bosch GmbH, GERMANY*

Audimax

08:50 **FROM ETCH TO EDGE AI: OPENING NEW HORIZONS WITH SMART SENSOR TECHNOLOGIES**
Stefan Finkbeiner
Bosch Sensortec GmbH, GERMANY

Session I – Novel MEMS/NEMS Devices for Computing/Imaging

Session Chair:
Jose-Luis Sanchez-Rojas, *Universidad de Castilla-La Mancha, SPAIN*

Audimax

09:35 **SUB-300 MILLIVOLT OPERATION IN NONVOLATILE 300 NM X 100 NM PHASE CHANGE NANOELECTROMECHANICAL SWITCH** — **Award Nominee**
Mohammad Ayaz Masud and Gianluca Piazza
Carnegie Mellon University, USA

09:50 **A FAST AND ENERGY-EFFICIENT NANOELECTROMECHANICAL NON-VOLATILE MEMORY FOR IN-MEMORY COMPUTING** — **Award Nominee**
Yong-Bok Lee[1], Min-Ho Gang[2], Pan-Kyu Choi[1], Su-Hyun Kim[1], Tae-Soo Kim[1], So-Young Lee[1], and Jun-Bo Yoon[1]
[1]*Korea Advanced Institute of Science and Technology (KAIST), KOREA and* [2]*National NanoFab Center (NNFC), KOREA*

10:05 **TOWARDS ULTRA-HIGH SPATIAL RESOLUTION SENSING OF GHZ ULTRASOUND USING STRAIN MODULATION OF FIELD EFFECT TRANSISTORS** — **Award Nominee**
Rohan Sanghvi[1], Justin Kuo[2], Adarsh Ravi[1], and Amit Lal[1]
[1]*Cornell University, USA and* [2]*Geegah Inc., USA*

10:20 **A TACTILE SENSOR ARRAY WITH A MONOLITHICALLY INTEGRATED NEURAL NETWORK FOR EDGE COMPUTATION**
Tengteng Lei, Yushen Hu, and Man Wong
Hong Kong University of Science and Technology, HONG KONG

10:35 **Break and Exhibit Inspection**

Session II – BioMEMS I

Session Chair:
Anders Wolff, *Technical University of Denmark DTU, DENMARK*

Audimax

11:05 **EVALUATION OF LOCAL AND INTERNAL ELASTICITY OF HYDROGEL MATERIALS BY USING LIGHT-DRIVEN GEL ACTUATOR**
Hibiki Nakajima[1], Yuha Koike[1], Yoshiyuki Yokoyama[2], Masaya Hagiwara[3], and Takeshi Hayakawa[1]
[1]*Chuo University, JAPAN,* [2]*Toyama Industrial Technology Research and Development Center, JAPAN, and* [3]*RIKEN, JAPAN*

11:20 **3D PRINTED MINIATURIZED SOFT MICROSWIMMER FOR MULTIMODAL 3D AIR-LIQUID NAVIGATION AND MANIPULATION**
Dominique Decanini[1], Abdelmounaim Harouri[1], Ayako Mizushima[2], Beomjoon Kim[2], Yoshio Mita[2], and Gilgueng Hwang[1,2]
[1]*Paris-Saclay University, FRANCE and* [2]*University of Tokyo, JAPAN*

11:35 **SELF-DRIVEN CAPILLARIC VISCOMETER FOR DIRECT OR CASCADED BAR GRAPH READ-OUT OF RELATIVE SAMPLE VISCOSITY**
Daniel Mak[1], R. Claude Meffan[1,2], Julian Menges[1], Fabian Dolamore[1], Conan Fee[1], Renwick C.J. Dobson[1], and Volker Nock[1]
[1]*University of Canterbury, NEW ZEALAND and* [2]*Kyoto University, JAPAN*

11:50 **A FLEXIBLE BIOSENSING PLATFORM FOR HIGH-THROUGHPUT MEASUREMENT OF CARDIOMYOCYTE CONTRACTILITY** — **Award Nominee**
Wenkun Dou[1], Jason Maynes[2], and Yu Sun[1]
[1]*University of Toronto, CANADA and* [2]*Hospital for Sick Children, CANADA*

12:05 **FLEXIBLE BI-DIRECTIONAL BRAIN COMPUTER INTERFACE FOR CONTROLLING TURNING BEHAVIOR OF MICE** — **Award Nominee**
Yifei Ye[1], Ye Tian[1,2], Han Wang[1], Qian Cheng[1], Kuikui Zhang[1], Xueying Wang[1,2], Cunkai Zhou[1], Chengjian Xu[1], Xiaoling Wei[1,2], Zhitao Zhou[1,2], Tiger H. Tao[1,2,3,4,5,6], and Liuyang Sun[1,2]
[1]*Chinese Academy of Sciences, CHINA,* [2]*University of Chinese Academy of Sciences, CHINA,* [3]*ShanghaiTech University, CHINA,* [4]*Neuroxess Co., Ltd. (Jiangxi), CHINA,* [5]*Guangdong Institute of Intelligence Science and Technology, CHINA, and* [6]*Tianqiao and Chrissy Chen Institute for Translational Research, CHINA*

12:20 **Lunch and Exhibit Inspection**

Session III – MEMS Inertial Sensors and Power MEMS

Session Chair:
Frank Goldschmidtboeing, *University Freiburg, GERMANY*

Audimax

13:45 **HIGH SENSITIVITY MEMS Z-AXIS ACCELEROMETER WITH IN-PLANE DIFFERENTIAL READOUT**
Valentina Zega[1], Gabriele Gattere[2], Manuel Riani[2], Francesco Rizzini[2], and Attilio Frangi[1]
[1]*Politecnico di Milano, ITALY and* [2]*STMicroelectronics, ITALY*

14:00 **TWO-AXIS ELECTROMAGNETIC SCANNER INTEGRATED WITH AN ELECTROSTATIC XY-STAGE POSITIONER**
Yuki Okamoto, Hironao Okada, and Masaaki Ichiki
National Institute of Advanced Industrial Science and Technology (AIST), JAPAN

14:15 **MEMS SHOCK ABSORBERS INTEGRATED WITH AL2O3-REINFORCED, MECHANICALLY RESILIENT NANOTUBE ARRAYS** **Award Nominee**
Hojoon Lee[1], Eunhwan Jo[1], Jae-Ik Lee[2], and Jongbaeg Kim[1]
[1]*Yonsei University, KOREA and* [2]*Harvard Medical School, USA*

14:30 **HIGH-INDUCTANCE-DENSITY MEMS 3D-SOLENOID TRANSFORMERS WITH INSERTED THIN-FILM FERRITE MAGNETIC CORE FOR ON-CHIP INTEGRATED DC-DC POWER CONVERSIONS**
Changnan Chen[1,2], Pichao Pan[1,2], Jiebin Gu[1,2], and Xinxin Li[1,2]
[1]*Chinese Academy of Sciences, CHINA and* [2]*University of Chinese Academy of Sciences, CHINA*

Poster Session I

14:45 **Poster Session I**
Poster presentations are listed by topic category with their assigned number starting on page 29.

16:15 **Break and Exhibit Inspection**

MEMS Community Announcement

Audimax

16:45 Clark T.-C. Nguyen, *University of California, Berkeley, USA*

Session IV – BioMEMS II

Session Chair:
Niclas Roxhed, *KTH Royal Institute of Technology, SWEDEN*

Audimax

16:50 **MICRON-SIZED PARYLENE-IN-OIL WATER PROTECTION LAYER** **Award Nominee**
Kuang-Ming Shang[1], Haixu Shen[1], Ningxuan Dai[1], David Kong[1,2], Tzung Hsiai[3], and Yu-Chong Tai[1]
[1]*California Institute of Technology, USA,* [2]*Harvard University, USA, and* [3]*University of California, Los Angeles, USA*

17:05 **A PIPETTE TIP INTEGRATED WITH A CAPACITIVE MICROSENSOR FABRICATED BY COMBINED 3D PRINTING AND MEMS PROCESS FOR CELL DETECTION AND TRANSPORTATION**
Satoshi Amaya, Hirotaka Sugiura, Bilal Turan, Shingo Kaneko, and Fumihito Arai
University of Tokyo, JAPAN

17:20 **FOLDABLE POLYMER STENT INTEGRATED WITH WIRELESS PRESSURE SENSOR FOR BLOOD PRESSURE MONITORING**
Nomin-Erdene Oyunbaatar and Dong-Weon Lee
Chonnam National University, KOREA

17:35 **A DYNAMIC MICROARRAY DEVICE FOR SELECTIVE PAIRING AND ELECTROFUSION OF LIPOSOMES**
Sho Takamori[1], Hisatoshi Mimura[1], Toshihisa Osaki[1], and Shoji Takeuchi[1,2]
[1]*Kanagawa Institute of Industrial Science and Technology, JAPAN and* [2]*University of Tokyo, JAPAN*

17:50 **REAL-TIME FUNCTIONAL BRAIN MAPPING BASED ON HIGH-CHANNEL-COUNT, ULTRA-CONFORMAL NEURAL INTERFACE** **Award Nominee**
Xiner Wang[1,2], Zhaohan Chen[3], Jizhi Liang[1,2], Xiaoling Wei[1,2], Liuyang Sun[1,2], Meng Li[1,2], Zhitao Zhou[1,2], and Tiger H. Tao[1,2,4,5,6]
[1]*Chinese Academy of Sciences, CHINA,* [2]*University of Chinese Academy of Science, CHINA,* [3]*Shanghai Normal University, CHINA,* [4]*Neuroxess Co., Ltd. (Jiangxi), CHINA,* [5]*Guangdong Institute of Intelligence Science and Technology, CHINA, and* [6]*Tianqiao and Chrissy Chen Institute for Translational Research, CHINA*

18:05 **Adjourn for the day**

MONDAY

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TUESDAY, 17 JANUARY

Plenary Speaker II
Session Chair:
Núria Barniol, *Universitat Autonoma de Barcelona, SPAIN*

Audimax

08:30 **ACOUSTOFLUIDICS: MERGING ACOUSTICS AND FLUID MECHANICS FOR BIOMEDICAL APPLICATIONS**
Tony Jun Huang
Duke University, USA

Session V - New Materials, Fabrication, and Packaging
Session Chair:
Hiroshi Miyajima, *Sumitomo Precision Products Co.,Ltd., JAPAN*

Audimax

09:15 **SILICON CARBIDE REINFORCED VERTICALLY ALIGNED CARBON NANOTUBE COMPOSITE FOR HARSH ENVIRONMENT MEMS** **Award Nominee**
Jiarui Mo, Shreyas Shankar, Guoqi Zhang, and Sten Vollebregt
Delft University of Techonology, NETHERLANDS

09:30 **A RELIABLE RELEASE METHOD FOR A BACK-END-OF-LINE NEMS SWITCH OF A MONOLITHIC THREE-DIMENSIONAL INTEGRATED CMOS-NEMS CIRCUIT**
Tae-Soo Kim, Yong-Bok Lee, So-Young Lee, Seung-Jun Lee, and Jun-Bo Yoon
Korea Advanced Institute of Science and Technology (KAIST), KOREA

09:45 **INCREASE OF EXPANSION RATE AND DIRECTION CONTROL OF MICROGEL ACTUATORS FOR SINGLE CELL MANIPULATIONS**
Kyoka Nakano[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*

10:00 **GENERALIZED-ACCUMULATED-TEMPERATURE PARAMETER FOR CHARACTERISTIC PREDICTION OF METAL-BASED MEMS CANTILEVER** **Award Nominee**
Yulong Zhang[1], Jianwen Sun[1], Huiliang Liu[2], and Zewen Liu[1]
[1]*Tsinghua University, CHINA and* [2]*China Academy of Space Technology, CHINA*

10:15 **Break and Exhibit Inspection**

Session VI - Micro- and Nanofluidics and Medical Applications
Session Chair:
Andreu Llobera, *Silicon Austria Labs (SAL), AUSTRIA*

Audimax

10:45 **MEMS-BASED WATER COLLECTION CONDENSATION PARTICLE COUNTER (WCCPC) OPTIMIZED FOR MULTI-POINT MONITORING OF AIRBORNE NANOPARTICLES**
Seong-Jae Yoo and Yong-Jun Kim
Yonsei University, KOREA

11:00 **RECONSTITUTING FUNDAMENTALS OF BACTERIA MEDIATED CANCER THERAPY ON A CHIP**
Wonjun Lee[1], Jiin Park[2], Dongil Kang[3], and Seungbeum Suh[4]
[1]*Seoul National University, KOREA,* [2]*Ewha Womans University, KOREA,* [3]*Hanyang University, KOREA, and* [4]*Korea Institute of Science and Technology (KIST), KOREA*

11:15 **3D SPATIAL FOCAL CONTROL BY ARRAYED OPTOFLUIDIC PRISMS**
Cheng-Hsun Lee, Yeonwoo Lee, and Sung-Yong Park
San Diego State University, USA

11:30 **HIGH-SPEED AND PINPOINT LIQUID EXCHANGE ON MICROFLUIDIC CHIP USING 3D PRINTED DOUBLE-BARRELED MICROPROBE WITH DUAL PUMPS**
Xu Du[1], Shingo Kaneko[2], Hisataka Maruyama[1], Hirotaka Sugiura[2], and Fumihito Arai[1,2]
[1]*Nagoya University, JAPAN and* [2]*University of Tokyo, JAPAN*

11:45 **DESIGN OF A DNA SYNTHESIS CHIP FOR DATA STORAGE WITH ULTRA-HIGH THROUGHPUT AND DENSITY FEATURING LARGE-SCALE INTEGRATED CIRCUITS AND MICROFLUIDIC CONFINEMENT**
Ning Wang[1,2,3], Shijia Yang[1,3], Dayin Wang[1,2,3], Zhen Cao[4], Yuan Luo[1,3], and Jianlong Zhao[1,3]
[1]*Chinese Academy of Sciences, CHINA,* [2]*ShanghaiTech University, CHINA,* [3]*University of Chinese Academy of Sciences, CHINA, and* [4]*Zhejiang University, CHINA*

MEMS 2024 Announcement

Audimax

12:00 **MEMS 2024 Conference Chairs**
Wen Li, *Michigan State University, USA*
Dana Weinstein, *Purdue University, USA*

12:15 **Lunch and Exhibit Inspection**

Session VII - MEMS Fluidic Sensors

Session Chair:
Roland Zengerle, *Hahn-Schickard & University of Freiburg, GERMANY*

Audimax

13:15 **A REAL-TIME WIRELESS CALORIMETRIC FLOW SENSOR SYSTEM WITH A WIDE LINEAR RANGE FOR LOW-COST RESPIRATORY MONITORING** — Award Nominee
Lifeng Huang[1], Izhar[2,4], Xiaoyong Zhou[3], Mingdong Fang[3], Siwei Huang[1], Yi-Kuen Lee[2], Xiaofang Pan[1], and Wei Xu[1]
[1]*Shenzhen University, CHINA,* [2]*Hong Kong University of Science and Technology, CHINA,*
[3]*Mindray Medical International Limited, CHINA, and* [4]*University of Pennsylvania, USA*

13:30 **ADVANCED THERMOPHYSICAL PROPERTIES MEASUREMENTS USING HEATER-INTEGRATED FLUIDIC RESONATORS** — Award Nominee
Juhee Ko, Bong Jae Lee, and Jungchul Lee
Korea Advanced Institute of Science and Technology (KAIST), KOREA

13:45 **A MINIATURIZED TRANSIT-TIME ULTRASONIC FLOWMETER USING PMUTS FOR LOW-FLOW MEASUREMENT IN SMALL-DIAMETER CHANNELS** — Award Nominee
Yunfei Gao[1,2], Zhipeng Wu[2], Minkan Chen[2], and Liang Lou[1,2]
[1]*Shanghai University, CHINA and* [2]*Shanghai Industrial μ Technology Research Institute, CHINA*

14:00 **MEMS DIFFERENTIAL THERMOPILES FOR HIGHLY-SENSITIVE HYDROGEN GAS DETECTION** — Award Nominee
Haozhi Zhang[1,2], Hao Jia[1,2], Ming Li[1,2], Pengcheng Xu[1,2], and Xinxin Li[1,2]
[1]*Chinese Academy of Sciences, CHINA and* [2]*University of Chinese Academy of Sciences, CHINA*

Poster Session II

14:15 **Poster Session II**
Poster presentations are listed by topic category with their assigned number starting on page 29.

15:45 **Break and Exhibit Inspection**

Session VIII - Sonics & Ultrasonics MEMS

Session Chair:
Mina Rais-Zadeh, *NASA JPL, USA*

Audimax

16:15 **DOMAIN/BOUNDARY VARIATION IN CANTILEVER ARRAY FOR BANDWIDTH ENHANCEMENT OF PZT MEMS MICROSPEAKER** — Award Nominee
Shu-Wei Chang[1], Ting-Chou Wei[1], Sung-Cheng Lo[2], and Weileun Fang[1]
[1]*National Tsing Hua University, TAIWAN and* [2]*Transducer Star Technology Inc., TAIWAN*

16:30 **ON THE DESIGN OF PIEZOELECTRIC MEMS MICROSPEAKER WITH HIGH FIDELITY AND WIDE BANDWIDTH**
Ting-Chou Wei, Zih-Song Hu, Shu-Wei Chang, and Weileun Fang
National Tsing Hua University, TAIWAN

16:45 **HIGH-PERFORMANCE WAFER-SCALE TRANSFER-FREE GRAPHENE MICROPHONES**
Roberto Pezone, Gabriele Baglioni, Pasqualina M. Sarro, Peter G. Steeneken, and Sten Vollebregt
Delft University of Technology, NETHERLANDS

17:00 **HIGH-SPL AND LOW-DRIVING-VOLTAGE PMUTS BY SPUTTERED POTASSIUM SODIUM NIOBATE**
Fan Xia[1,2], Yande Peng[1,2], Sedat Pala[1,2], Ryuichi Arakawa[1,3], Wei Yue[1,2], Pei-Chi Tsao[2], Chun-Ming Chen[2], Hanxiao Liu[1,2], Megan Teng[2], Jong Ha Park[1,2], and Liwei Lin[1,2]
[1]*Berkeley Sensor and Actuator Center, USA,* [2]*University of California, Berkeley, USA, and* [3]*NGK Spark Plug Co., JAPAN*

17:15 **EPITAXIAL $P_B(Z_R,T_I)O_3$-BASED PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCER FABRICATED ON SILICON-ON-NOTHING (SON) STRUCTURE**
Takuma Sekiguch[1], Shinya Yoshida[2], Yoshiaki Kanamori[1], and Shuji Tanaka[1]
[1]*Tohoku University, JAPAN and* [2]*Shibaura Institute of Technology, JAPAN*

17:30 **Adjourn for the day**

Tuesday Banquet at the Löwenbräu Keller

19:00 – 22:00 **Banquet at the Löwenbräu Keller**
MEMS 2023 welcomes you to the historic Löwenbräu Keller. Join us for a memorable evening of networking with colleagues in a traditional German beer hall.

SPRINGER NATURE

TUESDAY

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NAGASE

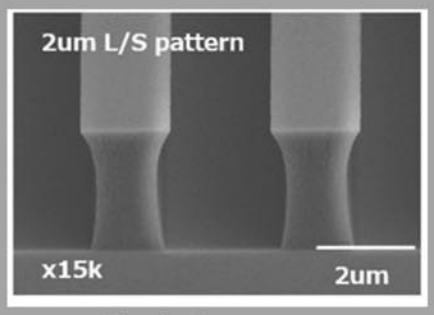
TUESDAY

Positive Tone Photoresists

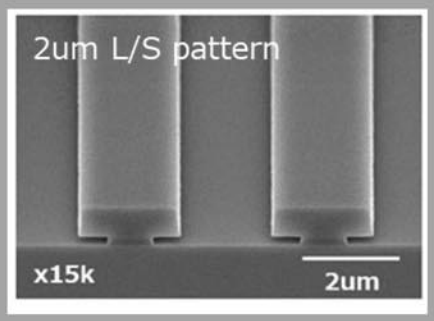
Liquid

- Lift-off
- Dry Etching
- Wet Process Chemicals (Etching agent / Etchant, Remover, etc.)

Photoresists for Lift-off Process



Single layer type
For rough metal patterning

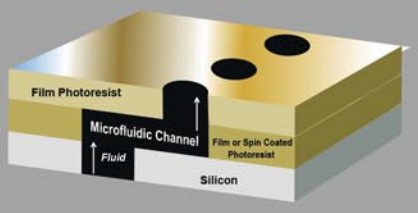


Bi layer type
For fine metal patterning

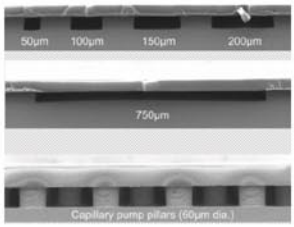
Negative Tone Photoresists

Liquid and Dry Films

- Microfluidics
- Via Sealing
- Metallization



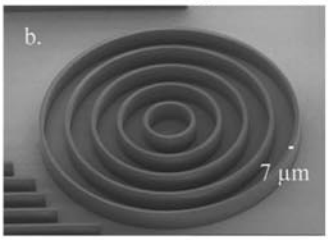
Tenting capability of 50 µm film (DF-1050)

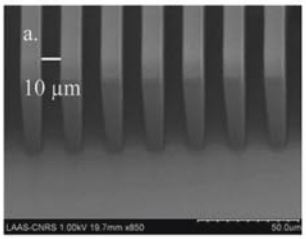


picture courtesy of IBM research, Zürich

(Temiz and Delamarche, J. Micromeng. 24, 2014)

Resolution capability of 20 µm film (DF-1020)





pictures courtesy of LAAS- Toulouse

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WEDNESDAY, 18 JANUARY

Plenary Speaker III

Session Chair:
Franz Laermer, *Robert Bosch GmbH, GERMANY*

Audimax

08:30 **LEVERAGING SEMICONDUCTOR ECOSYSTEMS TO MEMS**
Weileun Fang, Sheng-Shian Li, and Ming-Huang Li
National Tsing Hua University, TAIWAN

Session IX - Optomechanics & Photonics Integration

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

Audimax

09:15 **PROGRAMMABLE SILICON NITRIDE PHOTONIC INTEGRATED CIRCUITS** — **Award Nominee**
Hao Tian[1], Alaina G. Attanasio[1], Anat Siddharth[2], Andrey Voloshin[2], Viacheslav Snigirev[2], Grigory Lihachev[2], Andrea Bancora[2], Vladimir Shadymov[2], Rui N. Wang[2], Johann Riemensberger[2], Tobias J. Kippenberg[2], and Sunil A. Bhave[1]
[1]*Purdue University, USA and* [2]*Swiss Federal Institute of Technology Lausanne (EPFL), SWITZERLAND*

09:30 **MULTIFREQUENCY NANOMECHANICAL MASS SPECTROMETER PROTOTYPE FOR MEASURING VIRAL PARTICLES USING OPTOMECHANICAL DISK RESONATORS**
Oscar Malvar[1], Eduardo Gil-Santos[1], Jose J. Ruz[1], Elena Sentre-Arribas[1], Adrián Sanz-Jiménez[1], Priscila M. Kosaka[1], Sergio García-López[1], Álvaro San Paulo[1], Samantha Sbarra[2], Louis Waquie'[2], Ivan Favero[2], Maurits van der Heiden[3], Robert K. Altmann[3], Dimitris Papanastasiou[4], Diamantis Kounadis[4], Ilias Panagiotopoulos[4], Jesús Mingorance[5], María Rodríguez-Tejedor[5], Rafael Delgado[6], Montserrat Calleja[1], and Javier Tamayo[1]
[1]*Instituto de Micro y Nanotechnologis, IMN-CSIC, CSIC (CEI UAM+CSIC), SPAIN,* [2]*Université Paris Cité, FRANCE,* [3]*The Netherland Organization for Applied Scientific Research (TNO), NETHERLANDS,* [4]*Fasmatech Science and Technology, GREECE,* [5]*Hospital Universitario La Paz, SPAIN, and* [6]*Hospital Universitario 12 de Octubre, SPAIN*

09:45 **A MICROFABRICATED DIAMOND QUANTUM MAGNETOMETER WITH PICOTESLA SCALE SENSITIVITY**
Fei Xie[1,2], Qihui Liu[1,2], Yuqiang Hu[3,4], Lingyun Li[1,2], Zhichao Chen[1,2], Jin Zhang[1], Yonggui Zhang[1,2], Yuyao Zhang[3,4], Yang Wang[1,2], Jiangong Cheng[1,2], Hao Chen[1,2], and Zhenyu Wu[1,2,3,4]
[1]*Chinese Academy of Sciences, CHINA,* [2]*University of Chinese Academy of Sciences, CHINA,* [3]*Shanghai University, CHINA, and* [4]*Shanghai Industrial μTechnology Research Institute, CHINA*

Session X - RF MEMS Filters & Resonators (5G & 6G)

Session Chair:
Sheng Shian Li, *National Tsing Hua University, TAIWAN*

Audimax

10:30 **A NON-VOLATILE THRESHOLD SENSING SYSTEM USING A FERROELECTRIC $HF_{0.5}ZR_{0.5}O_2$ DEVICE AND A $L_lN_bO_3$ MICROACOUSTIC RESONATOR** — **Award Nominee**
Onurcan Kaya, Luca Colombo, Benyamin Davaji, and Cristian Cassella
Northeastern University, USA

10:45 **RESONANT CONFINERS FOR ACOUSTIC LOSS MITIGATION IN BULK ACOUSTIC WAVE RESONATORS**
Jeronimo Segovia-Fernandez and Ernest T.-T. Yen
Texas Instruments, Kilby Labs, USA

11:00 **HIGH-CRYSTALLINITY 30% SCALN ENABLING HIGH FIGURE OF MERIT X-BAND MICROACOUSTIC RESONATORS FOR MID-BAND 6G**
Gabriel Giribaldi, Pietro Simeoni, Luca Colombo, and Matteo Rinaldi
Northeastern University, USA

11:15 **FERRITE-ROD ANTENNA DRIVEN WIRELESS RESOSWITCH RECEIVER**
Kevin H. Zheng, Qiutong Jin, and Clark T.-C. Nguyen
University of California, Berkeley, USA

11:30 **ULTRA-WIDEBAND MEMS FILTERS USING LOCALIZED THINNED 128° Y-CUT THIN-FILM LITHIUM NIOBATE**
Jinbo Wu[1,2,3], Shibin Zhang[1], Pengcheng Zheng[1,2], Liping Zhang[1,2], Hulin Yao[1,2], Xiaoli Fang[1,2], Xuedi Tian[1,2], Xiaomeng Zhao[1], Tao Wu[3], and Xin Ou[1,2]
[1]*Shanghai Institute of Microsystem and Information Technology, CHINA,* [2]University of Chinese Academy of Sciences, CHINA, and [3]ShanghaiTech University, CHINA

11:45 **Lunch and Exhibit Inspection**

Women in Engineering-MEMS Group Networking Event

Courtyard Marriott Restaurant

11:45 Dana Weinstein[1], Hyunjoo "Jenny" Lee[2], and Irene Fernandez-Cuesta[3]
[1]*Purdue University, USA,* [2]*Korea Advanced Institute of Science and Technology (KAIST), KOREA, and* [3]*University of Hamburg, GERMANY*

Actively participate through a mobile application to answer questions and situations. We envision a very interactive and fun event! Open to all conference attendees.

Session XIa - MEMS/NEMS Resonators & Non-Linear Dynamics

Session Chair:
Guillermo Villanueva, *EPFL, SWITZERLAND*

Audimax

13:00 **ATTRACTOR EXCHANGER FOR OPEN-LOOP OPERATION OF MICROMECHANICAL NONLINEAR RESONATORS USING GAP-SPACING CONTINUATION**
Chun-Pu Tsai and Wei-Chang Li
National Taiwan University, TAIWAN

13:15 **A CMOS-MEMS ULTRASENSITIVE THERMOMETER USING INTERNAL RESONANCE INDUCED FREQUENCY COMBS**
Ting-Yi Chen, Chun-Pu Tsai, and Wei-Chang Li
National Taiwan University, TAIWAN

13:30 **ATOMICALLY THIN NEMS FREQUENCY COMB WITH BOTH FREQUENCY TUNABILITY AND RECONFIGURABLE VIA SIMULTANEOUS 1:2 AND 1:3 MODE COUPLING**
Bo Xu, Jiankai Zhu, Chenyin Jiao, Jianglong Chen, and Zenghui Wang
University of Electronic Science and Technology of China, CHINA

13:45 **INSTRUMENTAL ANALYSIS OF ADVANCED CATALYSTS BASED ON RESONANT MICROCANTILEVERS** **Award Nominee**
Xinyu Li[1,2], Pengcheng Xu[1,2], Ying Chen[1], Haitao Yu[1], and Xinxin Li[1,2]
[1]*Chinese Academy of Sciences, CHINA and* [2]*University of Chinese Academy of Sciences, CHINA*

Session XIb - BioSensors I

Session Chair:
Michael Kraft, *KU Leuven, BELGIUM*

Hörsaal

13:00 **A MULTIPLEXED BIOAFFINITY BIOSENSING PATCH FOR POINT-OF-CARE CHRONIC ULCER MONITORING**
Md Sharifuzzaman, Dongkyun Kim, Md Selim Reza, SeongHoon Jeong, Hye Su Song, Md Abu Zahed, and Jae Yeong Park
Kwangwoon University, KOREA

13:15 **3-DOF BIOHYBRID ACTUATOR WITH MULTIPLE SKELETAL MUSCLE TISSUES**
Xinzhu Ren, Yuya Morimoto, and Shoji Takeuchi
University of Tokyo, JAPAN

13:30 **A LOW NOISE MICROELECTRODE ARRAY FOR SPECIFIC CELL ACTIVITY MODULATION FROM CELL TO TISSUE**
Bohan Zhang[1,2], Huiran Yang[2], Xiner Wang[2,3], Ziyi Zhu[2,3], Zongxing He[1], Wanqi Jiang[2,3], Chen Tao[1,2], Dujuan Zou[2,3], Meng Li[2,3], Zhitao Zhou[2,3], Liuyang Sun[2,3], Tiger H. Tao[1,2,3,4,5,6], and Xiaoling Wei[2,3]
[1]*ShanghaiTech University, CHINA,* [2]*Chinese Academy of Sciences, CHINA,* [3]*University of Chinese Academy of Sciences, CHINA,* [4]*Neuroxess Co., Ltd. (Jiangxi), CHINA,* [5]*Guangdong Institute of Intelligence Science and Technology, CHINA, and* [6]*Tianqiao and Chrissy Chen Institute for Translational Research, CHINA*

13:45 **BIONIC MECHANICAL HAND INTEGRATED WITH ARTIFICIAL OLFACTORY SENSOR ARRAY FOR ENHANCED OBJECT RECOGNITION**
Jiachuang Wang[1,2], Xiaohui Li[1,2], MengWei Liu[1,2], Pingping Zhang[3], Tiger H. Tao[1,2,4], and Nan Qin[1,2]
[1]*Chinese Academy of Sciences, CHINA,* [2]*University of Chinese Academy of Sciences, CHINA,* [3]*Suzhou Huiwen Nanotechnology Co., Ltd., CHINA, and* [4]*Neuroxess Co., Ltd. (Jiangxi), CHINA*

WEDNESDAY

Poster Session III

14:00 **Poster Session III**
Poster presentations are listed by topic category with their assigned number starting on page 29.

15:30 **Break and Exhibit Inspection**

Session XIIa - Force & Displacement/Tactile Sensors & Human-Machine

Session Chair:
Nathan Jackson, *University of New Mexico, USA*

Audimax

16:00 **HIGH RESOLUTION TACTILE SENSOR FOR MEASUREMENT OF A COMPLICATED TACTILE FEELING OF "*SHITTORI*" WITH MOISTNESS**
Genki Yamada, Yuto Morita, Kyohei Terao, Fusao Shimokawa, and Hidekuni Takao
Kagawa University, JAPAN
Award Nominee

16:15 **PYRAMIDAL STRUCTURED MXENE/ECOFLEX COMPOSITE-BASED TOROIDAL TRIBOELECTRIC SELF-POWERED SENSOR FOR HUMAN-MACHINE INTERFACE**
Shipeng Zhang, Sm Sohel Rana, Gagan Bahadur Pradhan, Trilochan Bhatta, Seonghoon Jeong, and Jae Yeong Park
Kangwoon University, KOREA
Award Nominee

16:30 **LIG-BASED TRIAXIAL TACTILE SENSOR UTILIZING ROTATIONAL ERECTION SYSTEM**
Rihachiro Nakashima[1], Nagi Nakamura[2], Tomohiko G. Sano[1], Eiji Iwase[2], and Hidetoshi Takahashi[1]
[1]*Keio University, JAPAN and* [2]*Waseda University, JAPAN*

16:45 **A STRETCHABLE STRAIN-INSENSITIVE SMART GLOVE FOR SIMULTANEOUS DETECTION OF PRESSURE AND TEMPERATURE**
Sudeep Sharma, Gagan Bahadur Pradhan, Seonghoon Jeong, and Jae Yeong Park
Kwangwoon University, KOREA

17:00 **A GESTURE RECOGNITION GLOVE ASSEMBLED WITH NANOFOREST-INTEGRATED INFRARED THERMOPILES**
Mao Li[1,2], Meng Shi[1,2], Guidong Chen[1,2], Na Zhou[1,2], Haiyang Mao[1,2], and Chengjun Huang[1,2]
[1]*Chinese Academy of Sciences, CHINA and*
[2]*University of Chinese Academy of Sciences, CHINA*

Session XIIb - BioSensors II

Session Chair:
Nicole Hashemi, *Iowa State University, USA*

Hörsaal

16:00 **ONE PUSH MEMBRANE FORMATION FOR ITERATIVE MEASUREMENT OF ION CHANNEL ACTIVITY ON ARRAYED CHIP**
Hisatoshi Mimura[1], Toshihisa Osaki[1,2], Sho Takamori[1], Kenji Nakao[2], and Shoji Takeuchi[1,3]
[1]*Kanagawa Institute of Industrial Science and Technology (KISTEC), JAPAN,* [2]*Maqsys Inc., JAPAN, and* [3]*University of Tokyo, JAPAN*

16:15 **AN IMPLANTABLE DIFFERENTIAL SENSOR WITH PASSIVE WIRELESS INTERROGATION FOR IN-SITU EARLY DETECTION OF PERIPROSTHETIC JOINT INFECTION**
Jiaxin Jiang, Cole Napier, Chandrashekhar Choudhary, H. Claude Sagi, Chia-Ying Lin, Michael T. Archdeacon, and Tao Li
University of Cincinnati, USA

16:30 **MICROMACHINED PIEZOELECTRIC FILM-BASED FLEXIBLE ELECTRONICS WITH INTEGRATION OF FILM-SELF TEMPERATURE-DETECTING BREATH SENSOR AND ACETONE GAS SENSOR**
Hung-Yu Yeh and Guo-Hua Feng
National Tsing Hua University, TAIWAN

16:45 **FLEXIBLE TACTILE SENSING ARRAY WITH HIGH SPACIAL DENSITY BASED ON PARYLENE MEMS TECHNIQUE**
Meixuan Zhang[1], Zetian Wang[1], Han Xu[2], Lang Chen[1], Yufeng Jin[2,3], and Wei Wang[1,3,4]
[1]*Peking University, CHINA,* [2]*Peking University Shenzhen Graduate School, CHINA,* [3]*National Key Lab of Micro/Nano Fabrication Technology, CHINA, and* [4]*Beijing Advanced Innovation Center for Integrated Circuits, CHINA*

17:00 **SILK-ENABLED FOLDABLE AND CONFORMAL NEURAL INTERFACE WITH IN-PLANE SHIELDING FOR HIGH-QUALITY ELECTROPHYSIOLOGICAL RECORDINGS**
Jizhi Liang[1,2], Zhaohan Chen[1,3], Xiner Wang[1,2], Feihong Xu[1,2], Xiaoling Wei[1,2], Liuyang Sun[1,2], Meng Li[1,2], Tiger H. Tao[1,2,4,5,6,7], and Zhitao Zhou[1,2]
[1]*Chinese Academy of Sciences, CHINA,* [2]*University of Chinese Academy of Sciences, CHINA,* [3]*Shanghai Normal University, CHINA,* [4]*ShanghaiTech University, CHINA,* [5]*Neuroxess Co., Ltd. (Jiangxi), CHINA,* [6]*Guangdong Institute of Intelligence Science and Technology, CHINA and* [7]*Tianqiao and Chrissy Chen Institute for Translational Research, CHINA*

17:15 **Adjourn for the day**

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MEMSCAP

PolyMUMPs
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PiezoMUMPs
Process Technology

SILTERRA

pMUT
Technology Platform for piezoelectric micromachined ultrasonic transducers

coming soon

WEDNESDAY

WEDNESDAY

4 PHOTORESISTS

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WHAT IS HARE SQ NEGATIVE EPOXY?

HARE SQ is an acronym that stands for High Aspect Ratio Epoxy with Superior Quality. This breakthrough resist was developed by KemLab over the last decade and has evolved into a suite of products. The HARE SQ line of resists is designed to provide process solutions to avoid going down those lithographic rabbit holes.

HARE SQ

MEMS • MICROFLUIDICS

HARE SQ uses a superior quality resin manufacturing process that produces a cleaner, more consistent photoresist with fewer particles, more transparency, and less microbubbles.

QUICKDRY

RAPID PROTOTYPING

HARE SQ QuickDry utilizes a faster drying solvent system reducing processing times and increasing throughput in thick film applications up to 200 microns.

OPTICOAT

WAVEGUIDES • SENSORS

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THURSDAY, 19 JANUARY

Plenary Speaker IV
Session Chair:
Núria Barniol, *Universitat Autonoma de Barcelona, SPAIN*

Audimax

08:30 **MATERIALS ENGINEERING FOR CHEMICAL SENSING ENHANCEMENT**
Navpreet Kaur, Dario Zappa, and **Elisabetta Comini**
University of Brescia, ITALY

Session XIII - Gas & Flow Sensors
Session Chair:
Cristian Cassella, *Northeastern University, USA*

Audimax

09:15 **ON-DEMAND PREPARATION OF GAS-SENSING MATERIALS GUIDED BY RESONANT CANTILEVER-BASED THERMOGRAVIMETRIC ANALYSIS**
Yufan Zhou[1,2], Ming Li[1,2], Ying Chen[1,2], Xinyu Li[1,2], Pengcheng Xu[1,2], and Xinyu Li[1,2]
[1]*Chinese Academy of Sciences, CHINA and* [2]*University of Chinese Academy of Sciences, CHINA*

09:30 **AN INTELLIGENT GAS ANALYSIS SYSTEM CONSISTING OF SENSORS AND A NEURAL NETWORK IMPLEMENTED USING THIN-FILM TRANSISTORS**
Zong Liu[1,2], Yushen Hu[1,2], Gabriel E. Carranza[1], Fei Wang[2], and Man Wong[1]
[1]*Hong Kong University of Science and Technology, HONG KONG and* [2]*Southern University of Science and Technology, CHINA*

09:45 **SINGLE-LAYER-ELECTRODE TEMPERATURE-MODULATED SNO2 GAS SENSOR CELL WITH LOW POWER CONSUMPTION FOR DISCRIMINATION OF FOOD ODORS**
Chong Xing, Ruichen Liu, Yan Zhang, Dongcheng Xie, Yudong Wang, Yuan Huang, Muhammad Mustafa, Haochen Zhang, Zhongyu Shi, Lei Xu, and Feng Wu
University of Science and Technology of China, CHINA

10:00 **A PERFORMANCE ENHANCED THERMAL FLOW SENSOR WITH NOVEL DUAL-HEATER STRUCTURE USING CMOS COMPATIBLE FABRICATION PROCESS**
Zhongyi Liu[1], Ruoqin Wang[2], Gai Yang[1], Xinyuan Zhang[1], Rui Jiao[2], Xuejiao Li[1], Jiali Qi[3], Hongyu Yu[2], Huikai Xie[1,4], and Xiaoyi Wang[1,4]
[1]*Beijing Institute of Technology, CHINA,* [2]*Hong Kong University of Science and Technology, HONG KONG,* [3]*Hangzhou Dianzi University, CHINA, and* [4]*BIT Chongqing Institute of Microelectronics and Microsystems, CHINA*

Session XIV - New Fabrication Techniques
Session Chair:
Shuji Tanaka, *Tohoku University, JAPAN*

Audimax

10:45 **LOCAL METAL DEPOSITION ON HYDROGELS USING MICRO-PLASMA-BUBBLES**
Haruna Takahashi, Yu Yamashita, Naotomo Tottori, Shinya Sakuma, and Yoko Yamanishi
Kyushu University, JAPAN

11:00 **FOLDING METHOD OF KIRIGAMI STRUCTURE WITH FOLDING LINES**
Nagi Nakamura and Eiji Iwase
Waseda University, JAPAN

11:15 **BUBBLE-ASSISTED RE-FORMATION OF INDIVIDUAL LIPID BILAYERS IN ARRAYED DEVICE**
Izumi Hashimoto[1,2], Toshihisa Osaki[2], Hisatoshi Mimura[2], Sho Takamori[2], Norihisa Miki[1,2], and Shoji Takeuchi[2,3]
[1]*Keio University, JAPAN,* [2]*Kanagawa Institute of Industrial Science and Technology, JAPAN, and* [3]*University of Tokyo, JAPAN*

11:30 **LARGE-SCALE ARRAYS OF TUNABLE MONOLAYER MoS_2 NANOELECTROMECHANICAL RESONATORS**
Zuheng Liu[1], Luming Wang[3], Pengcheng Zhang[1], Maosong Xie[1], Yueyang Jia[1], Ying Chen[4], Hao Jia[4], Zenghui Wang[3], and Rui Yang[1,2]
[1]*University of Michigan – Shanghai Jiao Tong University Joint Institute, Shanghai Jiao Tong University, CHINA,* [2]*Shanghai Jiao Tong University, CHINA,* [3]*University of Electronic Science and Technology of China, CHINA, and* [4]*Chinese Academy of Sciences, CHINA*

Awards Ceremony

11:45 **Awards Ceremony**

11:55 **Final Remarks**

12:00 **Conference Adjourns**

GROUND, FIRST, AND SECOND FLOORS

MONDAY, 16 JANUARY	TUESDAY, 17 JANUARY	WEDNESDAY, 18 JANUARY
14:45 – 16:45	14:15 – 16:15	14:00 – 16:00

Poster Topic Categories
(last character of poster number)

- a - Bio and Medical MEMS
- b - Emerging Technologies and New Opportunities for MEMS/NEMS
- c - Industry MEMS and Advancing MEMS for Products and Sustainability
- d - Materials, Fabrication and Packaging for Generic MEMS and NEMS
- e - MEMS Actuators and PowerMEMS
- f - MEMS Physical and Chemical Sensors
- g - Micro- and Nanofluidics
- h - Optical, RF and Electromagnetics for MEMS/NEMS
- i - Open Posters

Posters will be on display and available for viewing on their assigned day only.
See poster floor plans at the end of this program.

a - Bio and Medical MEMS

Biosensors and Bioreactors

M01-a **ANTIFOULING FOR ELECTROCHEMICALLY BIOSENSING IN BODY FLUIDS**
Wenzheng He[1], Changdong Zhou[2], Yang Lin[2], Yuxin Tian[2], Liying Liu[2], Qifu Zhang[2], Xiongying Ye[1], and Tianhong Cui[3]
[1]*Tsinghua University, CHINA,* [2]*Jilin Cancer Hospital, CHINA, and* [3]*University of Minnesota, USA*

T01-a **ELECTRO-MAGNETIC SENSOR MEDIATED BY MAGNETIC BIOMOLECULES**
Qian Cheng[1,2], Yuqing Ge[1], Hongju Mao[1,2], Lin Zhou[1], and Jianlong Zhao[1,2]
[1]*Chinese Academy of Science, CHINA and* [2]*University of Chinese Academy of Sciences, CHINA*

W01-a **GAS-FLOW DEVICE FOR EFFECTIVE DISSOLUTION OF GAS-PHASE ODORANTS UTILIZED FOR BIOHYBRID SENSORS**
Takuma Nakane[1,2], Toshihisa Osaki[2], Hisatoshi Mimura[2], Sho Takamori[2], Norihisa Miki[1,2], and Shoji Takeuchi[2,3]
[1]*Keio University, JAPAN,* [2]*Kanagawa Institute of Industrial Science and Technology, JAPAN, and* [3]*University of Tokyo, JAPAN*

M02-a **MULTIPLE WELLS ON A CMOS-MEA FOR CELL-BASED BIOHYBRID ODORANT SENSORS**
Yujia Lian, Haruka Oda, Minghao Nie, and Shoji Takeuchi
University of Tokyo, JAPAN

T02-a **THE INTEGRATED RGO/PEDOT: PSS-MODIFIED ULTRAFLEXIBLE MICROELECTRODES TOWARDS LONG-TERM NEUROPHYSIOLOGICAL SIGNALING AND DOPAMINE SENSITIVE DETECTION**
Xueying Wang[1,2], Huiran Yang[1], Bohan Zhang[1,3], Meng Li[1,2], Liuyang Sun[1,2], Zhitao Zhou[1,2], Tiger H. Tao[1,2,3,4,5,6], and Xiaoling Wei[1,2]
[1]*Chinese Academy of Sciences, CHINA,* [2]*University of Chinese Academy of Sciences, CHINA,* [3]*Shanghai Tech University, CHINA,* [4]*Neuroxess Co., Ltd. (Jiangxi), CHINA,* [5]*Guangdong Institute of Intelligence Science and Technology, CHINA, and* [6]*Tianqiao and Chrissy Chen Institute for Translational Research, CHINA*

Devices & Systems for Cellular and Molecular Studies

W02-a **COMPARISON OF SELECTIVE FILTRATION OF ON-CHIP GLOMERULUS COMPRISED OF ORGANOID-DERIVED AND IMMORTALIZED PODOCYTES**
Ayumu Tabuchi[1], Kensuke Yabuuchi[2,3], Yoshiki Sahara[2], Minoru Takasato[2,4], Kazuya Fujimoto[1], and Ryuji Yokokawa[1]
[1]*Kyoto university, JAPAN,* [2]*RIKEN, JAPAN, and* [3]*Osaka University, JAPAN*

M03-a **CONTROLLING FIRING POINT OF MICROFIBER-SHAPED HIPSC-DERIVED CARDIAC TISSUE WITH LOCALIZED ELECTRICAL STIMULATION DEVICE**
Akari Masuda[1], Shun Itai[1], Yuta Kurashina[2], Shugo Tohyama[1], and Hiroaki Onoe[1]
[1]*Keio University, JAPAN and* [2]*Tokyo University of Agriculture and Technology, JAPAN*

T03-a **DEVELOPMENTAL PHASES OF ON-CHIP VASCULOGENESIS CLASSIFIED USING A DEEP LEARNING VISUAL MODEL**
Taiga Irisa, Hang Zhou, Kazuya Fujimoto, and Ryuji Yokokawa
Kyoto University, JAPAN

W03-a **HAND-DRIVEN DEVICE FOR PREPARATION OF LINEARLY ALIGNED HYDROGEL SHEETS**
Aoi Kato[1,2], Haruka Oda[3], Sho Takamori[2], Hisatoshi Mimura[2], Toshihisa Osaki[2], Norihisa Miki[1,2], and Shoji Takeuchi[2,3]
[1]*Keio University, JAPAN,* [2]*Kanagawa Institute of Industrial Science and Technology, JAPAN, and* [3]*University of Tokyo, JAPAN*

M04-a **MICROFABRICATION AND CHARACTERIZATION OF MICRO-STEREOLITHOGRAPHICALLY 3D PRINTED, AND DOUBLE METALLIZED BIOPLATES WITH 3D MICROELECTRODE ARRAYS FOR *IN-VITRO* ANALYSIS OF CARDIAC ORGANOIDS** Award Nominee
Jorge Manrique Castro, Isaac Johnson, and Swaminathan Rajaraman
University of Central Florida, USA

T04-a **OIL-SEALED RGD-MODIFIED HYDROGEL MICROWELL ARRAY WITH SIZE- SELECTIVE PERMEATION FOR ANALYSIS ON EXOSOMES FROM SINGLE CELLS**
Chisaki Yamagata[1], Shun Itai[1], Yuta Kurashina[2], Makoto Asai[1], Ayuko Hoshino[3], and Hiroaki Onoe[1]
[1]Keio University, JAPAN, [2]Tokyo University of Agriculture and Technology, JAPAN, and [3]Tokyo Institute of Technology, JAPAN
Award Nominee

W04-a **PICKING SINGEL CELLS FROM 10 ML SAMPLE BASED ON A MICROFILTRATION- LIFT COMBINATION PLATFORM**
Qingmei Xu[1], Yuntong Wang[2,3], Xiao Ma[4], Hang Li[5], Ying Xue[5], Yi Zhang[1], Songtao Dou[1], Huan Wang[2], Bei Li[2,5], and Wei Wang[1,6,7]
[1]Peking University, CHINA, [2]Chinese Academy of Sciences, CHINA, [3]University of Chinese Academy of Sciences, CHINA, [4]Hangzhou Branemagic Medical Technology Co. Ltd., CHINA, [5]Hooke Laboratory, CHINA, [6]National Key Lab of Micro/Nano Fabrication Technology, CHINA, and [7]Beijing Advanced Innovation Center for Integrated Circuits, Beijing, CHINA

Flexible and Wearable Devices and Systems

M05-a **A TRANSFER METHOD FOR EMBEDDING CONDUCTIVE FILLERS ON THE SURFACE OF MULTI-SCALE STRUCTURES FOR 3D FLEXIBLE CONDUCTORS**
Dongwoo Yoo, Sangmok Kim, Jeonghyeon Hwang, and Joonwon Kim
Pohang University of Science and Technology (POSTECH), KOREA

T05-a **FABRICATION OF HIGH FREQUENCY 2D FLEXIBLE PMUT ARRAY**
Sanjog V. Joshi, Sina Sadeghpour, and Michael Kraft
KU Leuven, BELGIUM

W05-a **FLEXIBLE SILK-BASED GRAPHENE BIOELECTRONICS FOR WEARABLE MULTIMODAL PHYSIOLOGICAL MONITORING**
Sajjad Mirbakht[1], Ata Golparvar[1,2], Muhammad Umar[1], and Murat Kaya Yapici[1,3]
[1]Sabanci University, TURKEY, [2]École Polytechnique Fédérale de Lausanne (EPFL), SWITZERLAND, and [3]University of Washington, USA

M06-a **HIGHLY ACCURATE MEASUREMENT OF CONTACT RESISTANCE BETWEEN GALINSTAN AND COPPER USING TRANSFER LENGTH METHOD**
Takashi Sato and Eiji Iwase
Waseda University, JAPAN

T06-a **MACHINE LEARNING ENABLED HIND FOOT DEFORMITY DETECTION USING INDIVIDUALLY ADDRESSABLE HYBRID PRESSURE SENSOR MATRIX**
Nadeem Tariq Beigh, Faizan Beigh, Sourav Naval, Dibyajyoti Mukherjee, and Dhiman Mallick
Indian Institute of Technology, Delhi, INDIA

W06-a **MULTI-MODE E-SKIN INTEGRATING CAPACITIVE-PIEZOELECTRIC SENSORS FOR STATIC-DYNAMIC MECHANORESPONSE WITH WIDE SENSING RANGE**
Mujeeb Yousuf[1], Sushil Kumar[1], Dhairya Singh Arya[2], Manu Garg[1], Khanjhan Joshi[1], and Pushpapraj Singh[1]
[1]Indian Institute of Technology, Delhi, INDIA and [2]CSIR-Central Scientific Instruments Organisation (CSIO), INDIA

M07-a **NON-INVASIVE INSTANT MEASUREMENT OF ARTERIAL STIFFNESS BASED ON HIGH-DENSITY FLEXIBLE SENSOR ARRAY**
Fang Wang[1,2], Heng Yang[1,2], Ke Sun[1], Yi Sun[1], and Xinxin Li[1,2]
[1]Chinese Academy of Sciences, CHINA and [2]University of Chinese Academy of Sciences, CHINA

T07-a **SUPPRESSION OF BIOELECTRICAL NOISE SIGNALS IN MOTION STATE BY LOW-COST MICROPILLAR HYDROGEL ELECTRODE**
Gencai Shen, Nan Zhao, Chunpeng Jiang, Zhuangzhuang Wang, and Jingquan Liu
Shanghai Jiao Tong University, CHINA

W07-a **ULTRA-THIN MEMS PACKAGING BASED ON AUXETIC STRETCHABLE STRUCTURES FOR APPLICATIONS IN WEARABLE ELECTRONICS**
Daniel Zymelka, Toshihiro Takeshita, Yusuke Takei, and Takeshi Kobayashi
National Institute of Advanced Industrial Science and Technology, JAPAN

M08-a **ULTRALOW POWER FLEXIBLE OCULAR MICROSYSTEM FOR VERGENCE AND DISTANCE SENSING BASED ON PASSIVE DIFFERENTIAL MAGNETOMETRY**
Adwait Deshpande, Mohit U. Karkhanis, Chayanjit Ghosh, Hanseup Kim, and Carlos H. Mastrangelo
University of Utah, USA

Manufacturing for Bio- & Medical MEMS

T08-a **ELECTROHYDRODYNAMIC NEBULISER (eNEB) FOR DIRECT PULMONARY DRUG DELIVERY APPLICATION**
Trung-Hieu Vu[1], Luan Ngoc Mai[2,3], Tuan-Hung Nguyen[1], Dang Tran[1], Tuan-Khoa Nguyen[1], Thanh Nguyen[4], Jarred Fastier-Woollel[1,5], Canh-Dung Tran[4], Toan Dinh[4], Hong-Quan Nguyen[1], Dzung Viet Dao[1], and Van Thanh Dau[1]
[1]Griffith University, AUSTRALIA, [2]Ho Chi Minh City University of Technology (HCMUT), VIETNAM, [3]Vietnam National University, VIETNAM, [4]University of Southern Queensland, AUSTRALIA, and [5]University of Tokyo, JAPAN

W08-a **FLEXIBLE POLYMER OPTICAL WAVEGUIDES FOR INTEGRATED OPTOGENETIC BRAIN IMPLANTS**
Julian A. Singer[1], Till Stramm[2], Jens Fasel[2], Oliver Schween[2], Anton Gelaeschus[1], Andreas Bahr[1,3], and Matthias Kuhl[4]
[1]Hamburg University of Technology, GERMANY, [2]TU Dortmund University, GERMANY, [3]University of Kiel, GERMANY, and [4]University of Freiburg, GERMANY

M09-a **HIGHLY REPRODUCIBLE TISSUE POSITIONING WITH TAPERED PILLAR DESIGN IN ENGINEERED HEART TISSUE PLATFORMS**
Milica Dostanic[1,2], Laura M. Windt[2], Maury Wiendels[2], Berend J. van Meer[2], Christine L. Mummery[2,3], Pasqualina M. Sarro[1], and Massimo Mastrangeli[1]
[1]Delft University of Technology, NETHERLANDS, [2]Leiden University Medical Center, NETHERLANDS, and [3]University of Twente, NETHERLANDS

T09-a **IN VITRO ASSEMBLY OF MUSCLE RINGS AND BIOPRINTED HYDROGEL FOR BRANCHING TUBULAR TISSUE CONSTRUCTS**
Tomohiro Morita, Byeongwook Jo, Minghao Nie, and Shoji Takeuchi
University of Tokyo, JAPAN

W09-a **MICROELECTRODES FABRICATED BY VACUUM FILLING WITH LOW MELTING-POINT ALLOY FOR MUSCLE TISSUE STIMULATION**
Tingyu Li, Minghao Nie, Yuya Morimoto, and Shoji Takeuchi
University of Tokyo, JAPAN

M10-a **OPTOELECTRONIC INTEGRATED ULTRAMICROELECTRODE FOR OPTICAL STIMULATION AND ELECTRICAL RECORDING OF SINGLE-CELL**
Qingda Xu, Ye Xi, Zhiyuan Du, Longchun Wang, Tao Ruan, Mengfei Xu, Jiawei Cao, Bin Yang, and Jingquan Liu
Shanghai Jiao Tong University, CHINA

T10-a **THERMOFORMING OF PARYLENE C TO FORM HELICAL STRUCTURES**
Brianna L. Thielen and Ellis Meng
University of Southern California, Los Angeles, USA

Materials for Bio- and Medical MEMS

W10-a **FABRICATION OF BIODEGRADABLE SOFT TISSUE-MIMICKED MICROELECTRODE ARRAYS FOR IMPLANTED NEURAL INTERFACING**
Wei-Chen Huang[1], Wan-Lou Lei[1], and Chih-Wei Peng[2]
[1]*National Yang Ming Chiao Tung University, TAIWAN and* [2]*Taipei Medical University, TAIWAN*

Medical Microsystems

M1-a **AN OPTIMIZATION OF PERFORATION DESIGN ON A PIEZOELECTRIC-BASED SMART STENT FOR BLOOD PRESSURE MONITORING AND LOW-FREQUENCY VIBRATIONAL ENERGY HARVESTING**
Jun Ying Tan[1], Sayemul Islam[2], Yuankai Li[3], Albert Kim[2], and Jungkwun "JK" Kim[1]
[1]*University of North Texas, USA,* [2]*University of South Florida, USA, and* [3]*Kansas State University, USA*

W11-a **DEVELOPMENT OF AN ELECTRICAL-STIMULATION-INDUCED MECHANOMYOGRAM PROBE FOR MUSCLE CONTRACTION CHARACTERISTICS EVALUATION**
Yusuke Takei, Toshihiro Takeshita, Daniel Zymelka, and Takeshi Kobayashi
National Institute of Advanced Industrial Science and Technology (AIST), JAPAN

M12-a **DUAL-FREQUENCY PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCERS FOR FUNDAMENTAL AND HARMONIC IMAGING**
Yanfen Zhai, Waleed Maqsood, Zhou Da, Nikolai Andrianov, Yucheng Zhang, Mohssen Moridi, and Lixiang Wu
Silicon Austria Labs GmbH, AUSTRIA

T12-a **FRACTAL MICROELECTRODES INTEGRATED WITH THE CATHETER FOR LOW-VOLTAGE PULSED FIELD ABLATION**
Mengfei Xu[1], Mu Qin[2], Ziliang Song[3], Wen Hong[1], Qingda Xu[1], Jiawei Cao[1], Kejun Tu[1], Longchun Wang[1], Bin Yang[1], and Jingquan Liu[1]
[1]*Shanghai Jiao Tong University, CHINA,* [2]*Shanghai Chest Hospital Affiliated to Shanghai Jiao Tong University, CHINA, and* [3]*Shanghai General Hospital Shanghai Jiao Tong University School of Medicine, CHINA*

W12-a **HIERARCHICAL BONDING YIELD TEST STRUCTURE FOR FLEXIBLE HIGH CHANNEL-COUNT NEURAL PROBES INTERFACING ASIC CHIPS** **Award Nominee**
Marie C. Odenthal, Victor Claar, Oliver Paul, and Patrick Ruther
University of Freiburg, GERMANY

M13-a **MICROWAVE-INDUCED THERMOACOUSTIC IMAGING USING ALUMINUM NITRIDE PMUT**
Yiwei Wang[1], Lejia Zhang[1], Junxiang Cai[1,2,3], Baosheng Wang[1,2,3], Yuandong Alex Gu[5], Liang Lou[5], Xiong Wang[1,2,3,4], and Tao Wu[1,2,3,4]
[1]*ShanghaiTech University, CHINA,* [2]*Chinese Academy of Sciences, CHINA,* [3]*University of Chinese Academy of Sciences, CHINA,* [4]*Shanghai Engineering Research Center of Energy Efficient and Custom AI IC, CHINA, and* [5]*Shanghai Industrial μTechnology Research Institute, CHINA*

T13-a **NEEDLE-FREE DRUG INJECTION USING A SHOCK WAVE FOCUSING SYSTEM WITH THE FUNCTION OF REAL-TIME MICROBUBBLE-BASED DISTANCE SENSING**
Yibo Ma, Wenjing Huang, Keita Ichikawa, and Yoko Yamanishi
Kyushu University, JAPAN

W13-a **NEW WAFER-LEVEL FABRICATION OF ULTRATHIN SILICON INSERTION SHUTTLES FOR FLEXIBLE NEURAL IMPLANTS**
Kirti Sharma[1], Christian Boehler[1], Maria Asplund[1,2], Oliver Paul[1], and Patrick Ruther[1]
[1]*University of Freiburg, GERMANY and* [2]*Chalmers University of Technology, SWEDEN*

M14-a **REAL-TIME DYNAMIC LACTATE DETECTION IN A PIPELINE USING A MICROSENSING NEEDLE FOR ICU PATIENT MONITORING APPLICATION**
Yuan-Sin Tang[1], Tung-Lin Yang[2], Yu-Ting Cheng[1], Hsiao-En Tsai[2,3], and Yih-Shurng Chen[3,4]
[1]*National Yang Ming Chiao Tung University, TAIWAN,* [2]*National Taiwan Hospital HsinChu Branch, TAIWAN,* [3]*National Taiwan University College of Medicine Graduate Institute of Clinical Medicine, TAIWAN, and* [4]*National Taiwan University Hospital, TAIWAN*

T14-a **THREE-DIMENSIONAL FLEXIBLE NEURAL OPTO-ELECTRONIC ARRAY WITH SILK-BASED SHUTTLE-FREE IMPLANTATION**
Chi Gu[2,3], Huiran Yang[2], Bohan Zhang[2,4], Zhitao Zhou[2], Liuyang Sun[2,3], Meng Li[2,3], Xiaoling Wei[2,3], and Tiger H. Tao[1,2,3,4,5,6]
[1]*Guangdong Institute of Intelligence Science and Technology, CHINA,* [2]*Chinese Academy of Sciences, CHINA,* [3]*University of Chinese Academy of Sciences, CHINA,* [4]*ShanghaiTech University, CHINA,* [5]*Neuroxess Co., Ltd. (Jiangxi), CHINA, and* [6]*Tianqiao and Chrissy Chen Institute for Translational Research, CHINA*

MEMS & BioMEMS for Fighting COVID-19 & Future Pandemic

W14-a **A MICROFLUIDIC BIOSENSOR FOR RAPID DETECTION OF COVID-19**
Sura A. Muhsin[1], Ying He[1], Muthana Al-Amidie[1], Karen Sergovia[1], Amjed Abdullah[1], Yang Wang[1], Omar Alkorjia[1], Robert A. Hulsey[2], Gary L. Hunter[2], Zeynep Erdal[2], Ryan J. Pletka[2], George S. Hyleme[2], Xiu-Feng Wan[1,2], and Mahmoud Almasri[1]
[1]*University of Missouri, USA and* [2]*Black and Veatch, USA*

M15-a **A LOOP-MEDIATED ISOTHERMAL AMPLIFICATION (LAMP)-BASED POINT-OF-CARE SYSTEM FOR RAPID ON-SITE CLINICAL DETECTION OF SARS-COV-2 VIRUSES**
Trieu Nguyen[1], Aaydha Chidambara Vinayaka[1], Van Ngoc Huynh[1], Quyen Than Linh[1], Sune Zoëga Andreasen[1], Mohsen Golabi[1], Dang Duong Bang[1], Jens Kjølseth Møller[2], and Anders Wolff[1]
[1]*Technical University of Denmark, DENMARK and* [2]*University Hospital of Southern Denmark, DENMARK*

MEMS & BioMEMS for Healthcare and Public Health

T15-a **A SOLAR-DRIVEN WEARABLE MULTIPLEXED BIO-SENSING SYSTEM FOR NONINVASIVE HEALTHCARE MONITORING IN SWEAT**
Jujhar Singh, Bianca Ning, Paul Lee, and Lin Liu
Seattle Pacific University, USA

W15-a **HIGH-THROUGHPUT MASS MEASUREMENT OF SINGLE BACTERIAL CELLS BY SILICON NITRIDE MEMBRANE RESONATORS**
Adrián Sanz-Jiménez[1], Oscar Malvar[1], Jose J. Ruz[1], Sergio García-López[1], Priscila M. Kosaka[1], Eduardo Gil-Santos[1], Álvaro Cano[1], Dimitris Papanastasiou[2], Diamantis Kounadis[2], Elias Panagiotopoulos[2], Jesús Mingorance[3], María Rodríguez-Tejedor[3], Álvaro San Paulo[1], Montserrat Calleja[1], and Javier Tamayo[1]
[1]*Instituto de Micro y Nanotecnología, SPAIN,* [2]*Fasmatech Science & Technology, Lefkippos TESPA, Demokritos NCSR, Patriarchou Gregoriou & Neapoleos, GREECE, and* [3]*Hospital Universitario La Paz, Madrid, SPAIN*

M16-a **MICROFABRICATED ISOTHERMAL EG-FET SENSOR FOR LAMP MEDIATED CRISPR/CAS12A DETECTION OF HEPATITIS C VIRUS**
Hsin-Ying Ho, Wei-Sin Kao, Piyush Deval, Ling-Shan Yu, and Che-Hsin Lin
National Sun Yat-sen Universit, TAIWAN

T16-a **SMART ELECTRODE ARRAY FOR COCHLEAR IMPLANTS**
Ahmad Itawi[1], Sofiane Ghenna[1], Guillaume Tourrel[2], Sébastien Grondel[1], Cedric Plesse[3], Tran Minh Giao Nguyen[3], Frédéric Vidal[3], Yinoussa Adagolodjo[4], Lingxiao Xun[4], Gang Zheng[4], Alexandre Kruszewski[4], Christian Duriez[4], and Eric Cattan[1]
[1]*University Polytechnique Hauts-de-France, FRANCE,* [2]*Oticon Medical, FRANCE,* [3]*CY Cergy Paris Université, FRANCE, and* [4]*University of Lille, FRANCE*

Tissue Engineering

W16-a **A THREE-DIMENSIONAL ARTIFICIAL INTESTINAL TISSUE WITH A CRYPT-LIKE INNER SURFACE**
Shuma Tanaka[1], Shun Itai[2], and Hiroaki Onoe[1]
[1]*Keio University, JAPAN and* [2]*Tohoku University, JAPAN*

M17-a **TISSUE-ENGINEERED PENNATE MUSCLES ON A CHIP**
Motoki Ito, Yuya Morimoto, and Shoji Takeuchi
University of Tokyo, JAPAN

T17-a **WEIGHT TRAINING DEVICE TO PROMOTE MATURATION IN SKELETAL MUSCLE TISSUES**
Kentaro Motoi, Byeongwook Jo, Yuya Morimoto, and Shoji Takeuchi
University of Tokyo, JAPAN

Other Bio and Medical MEMS

W17-a **MICROSYSTEM VIBRATING MESH ATOMIZER WITH INTEGRATED MICROHEATER FOR HIGH VISCOSITY LIQUID AEROSOL GENERATION**
Pallavi Sharma, Irma Rocio Vazquez, and Nathan Jackson
University of New Mexico, USA

M18-a **SCALABLE MODULAR MEASUREMENT SYSTEM FOR CONTINUOUS BLOOD MONITORING WITH PIEZOELECTRIC MEMS RESONATORS**
Michael Schneider[1], Bernhard Kößl[1], Suresh Alasatri[1], Ingrid A.M. Magnet[2], and Ulrich Schmid[1]
[1]*TU Wien, AUSTRIA and* [2]*Medical University of Vienna, AUSTRIA*

T18-a **SILICON COMPATIBLE PROCESS TO INTEGRATE IMPEDANCE CYTOMETRY WITH MECHANICAL CHARACTERIZATION**
Quentin Rezard[1], Faruk Azam Shaik[1,2], Jean Claude Gerbedoen[1,2], Fabrizio Cleri[1], Dominique Collard[1,2], Chann Lagadec[1], and Mehmet C. Tarhan[1,2]
[1]*University of Lille, FRANCE and* [2]*University of Tokyo, Lille, FRANCE*

W18-a **SORTING OF EXTRACELLULAR VESICLES BY USING OPTICALLY-INDUCED DIELECTROPHORESIS ON AN INTEGRATED MICROFLUIDIC CHIP**
Wei-Jen Soong, Chih-Hung Wang, Yi-Sin Chen, Chihchen Chen, and Gwo-Bin Lee
National Tsing Hua University, TAIWAN

b - Emerging Technologies and New Opportunities for MEMS/NEMS

Internet of Things (IoT) with MEMS/NEMS

M19-b **A REPROGRAMMABLE MEM SWITCH UTILIZING CONTROLLED CONTACT WELDING**
Tsegereda K. Esatu, Hei Kam, Lars P. Tatum, Xiaoer Hu, Urmita Sikder, Sergio Almeida, Junqiao Wu, and Tsu-Jae King Liu
University of California, Berkeley, USA

T19-b **MICROMECHANICAL RSSI BASED ON FORCE INTERACTION DERIVED TAPPING BANDWIDTH VARIATION IN VIBRO-IMPACT RESONATORS**
Yi-Hsuan Huang, Hong-Sen Zheng, Chun-Pu Tsai, and Wei-Chang Li
National Taiwan University, TAIWAN

W19-b **WAKE-UP IOT WIRELESS SENSING NODE BASED ON A LOW-G THRESHOLD MEMS INERTIAL SWITCH WITH RELIABLE CONTACTS**
Sagnik Ghosh[1], Duan Jian Goh[1], Yul Koh[1], Jaibir Sharma[1], Wei Da Toh[1], Weiguo Chen[1], Yao Zhang[1], Eldwin Ng[1], Amit Lal[2], and Joshua E.-Y. Lee[1]
[1]*Agency for Science, Technology and Research (A*STAR), SINGAPORE and* [2]*Cornell University, USA*

Machine Learning (ML) & Artificial Intelligence (AI) Enhanced MEMS/NEMS Design, Manufacturing, and Applications

M20-b **ARTIFICIAL INTELLIGENCE (AI)-ENHANCED E-SKIN WITH ARTIFICIAL SYNAPSE SENSORY OUTPUT FOR HUMANOID ROBOTIC FINGER OF MULTIMODAL PERCEPTION**
Xinge Guo[1,2] and Chengkuo Lee[1]
[1]*National University of Singapore, SINGAPORE and* [2]*Agency for Science, Technology and Research (A*STAR), SINGAPORE*

T20-b **MULTI-MEMS DIFFERENTIAL PRESSURE SENSOR ELEMENTS-BASED AIRFLOW SENSOR WITH NEURAL NETWORK MODEL**
Kotaro Haneda, Kenei Matsudaira, and Hidetoshi Takahashi
Keio University, JAPAN

W20-b **TRIAL-AND-ERROR LEARNING FOR MEMS STRUCTURAL DESIGN ENABLED BY DEEP REINFORCEMENT LEARNING**
Fanping Sui[1], Wei Yue[1], Ziqi Zhang[2], Ruiqi Guo[1], and Liwei Lin[1,2]
[1]*University of California, Berkeley, USA and* [2]*TSinghua University, CHINA*

New Computing Devices and Systems with MEMS/NEMS

M21-b **FULLY MICROELECTROMECHANICAL NON-VOLATILE MEMORY CELL**
Elliott Worsey, Mukesh K. Kulsreshath, Qi Tang, and Dinesh Pamunuwa
University of Bristol, UK

T21-b **NONVOLATILE STATE CONFIGURATION OF NANO-WATT PARAMETRIC ISING SPINS THROUGH FERROELECTRIC HAFNIUM ZIRCONIUM OXIDE MEMS VARACTORS**
Nicolas Casilli[1], Onurcan Kaya[1], Tahmid Kaisar[2], Benyamin Davaji[1], Philip X.-L. Feng[2], and Cristian Cassella[1]
[1]*Northeastern University, USA and* [2]*University of Florida, USA*

W21-b **PHYSICAL RESERVOIR COMPUTING USING NONLINEAR MEMS RESONATOR HAVING HIGH MEMORY CAPACITY AT "EDGE OF CHAOS"**
Hiroki Takemura, Takahiro Mizumoto, Amit Banerjee, Jun Hirotani, and Toshiyuki Tsuchiya
Kyoto University, JAPAN

M22-b **PROGRAMMABLE FERROELECTRIC HZO NEMS MECHANICAL MULTIPLIER FOR IN-MEMORY COMPUTING**
Shubham Jadhav, Ved Gund, and Amit Lal
Cornell University, USA

T22-b **STORING MEMS INTERFACES WITHOUT ELECTRICAL AUXILIARY ENERGY FOR LONG-TIME MONITORING**
Martin Hoffmann[1], Philip Schmitt[1], Steffen Wittemeier[3], Falk Schaller[2], Alexey Shaporin[3], Chris Stöckel[2,3], Volker Geneiß[3], Roman Forke[3], Christian Hedayat[3], Ulrich Hilleringmann[4], Harald Kuhn[2,3], and Sven Zimmermann[2,3]
[1]*Ruhr-Universität Bochum, GERMANY,* [2]*Chemnitz University of Technology, GERMANY,* [3]*Fraunhofer Institute for Electronic Nano Systems ENAS, GERMANY, and* [4]*University of Paderborn, GERMANY*

Nonlinear Dynamics in MEMS/NEMS

W22-b **A NEW FINDING ON NONLINEAR DAMPING AND STIFFNESS OF FLEXURAL MODE CAPACITIVE MEMS RESONATORS**
Hung-Yu Chen, Ming-Huang Li, and Sheng-Shian Li
National Tsing Hua University, TAIWAN

M23-b **EXPLOITING PARAMETRIC INSTABILITY IN BISTABLE MEMS ACTUATORS**
Daniel Platz, Johannes Fabian, Elisabeth Samm, Mahdi Mortada, Michael Schneider, and Ulrich Schmid
TU Wien, AUSTRIA

T23-b **FIRST PROTOTYPE OF POLYMER MICROMACHINED FLAPPING WING NANO AIR VEHICLE**
Rashmikant, Ryotaro Suetsugu, Minato Onishi, and Daisuke Ishihara
Kyushu Institute of Technology, JAPAN

W23-b **ITERATIVE LEARNING CONTROL FOR QUASI-STATIC MEMS MIRROR WITH SWITCHING OPERATION**
Matthias Macho[1], Han Woong Yoo[1], Richard Schroedter[2], and Georg Schitter[1]
[1]*TU Wien, AUSTRIA and* [2]*TU Dresden, GERMANY*

Quantum Devices and Systems with MEMS/NEMS

M24-b ***Mz* ATOMIC MAGNETOMETER USING A 3D MEMS GLASS ALKALI VAPOR CELL WITH VERTICAL SIDEWALLS**
Jin Zhang, Jianfeng Zhang, Wenqi Li, Ziji Wang, and Jintang Shang
Southeast University, CHINA

T24-b **ON-CHIP HEATING NOISE SUPPRESSION OF 3D CHIP-SCALE ATOMIC MAGNETOMETER USING SINGLE-LAYER SHIFTED HEATER**
Ziji Wang, Junming Wu, Jin Zhang, and Jintang Shang
Southeast University, CHINA

c - Industry MEMS and Advancing MEMS for Products and Sustainability

Barriers to Commercialization & Research Needs for Future Products

W24-c **LABOR-SAVING PLATFORM FOR CHARACTERIZATION OF MEMBRANE PROTEINS BY AUTOMATED MONITORING AND DATA REPORTING**
Kazuto Ogishi[1], Toshihisa Osaki[2], Yuya Morimoto[1], and Shoji Takeuchi[1,2]
[1]*University of Tokyo, JAPAN and* [2]*Kanagawa Institute of Industrial Science and Technology, JAPAN*

MEMS Packaging Techniques

M25-c **MODELLING IMPACT OF VISCOELASTIC PROPERTIES OF DIE-ATTACH MATERIAL ON THE BIAS RESPONSE OF RESONANT INERTIAL SENSORS**
Theo Miani[1], Lokesh Gurung[1], Guillermo Sobreviela-Falces[1], Douglas Young[1], Colin Baker[1], and Ashwin A. Seshia[2]
[1]*Silicon Microgravity Ltd., UK and* [2]*University of Cambridge, UK*

MEMS/NEMS - CMOS Integration

T25-c **CMOS-EMBEDDED 3D MICRO/NANOFLUIDICS EMPLOYING TOP-DOWN BEOL SINGLE-STEP WET-ETCHING TECHNIQUE**
Wei-Yang Weng, Hung-Yu Hou, Yueh-Jung Chao, Shwu-Jen Liaw, and Jun-Chau Chien
National Taiwan University, TAIWAN

W25-c **IMPLEMENTATION OF A MONOLITHIC SOC ENVIRONMENTAL SENSING HUB USING CMOS-MEMS TECHNIQUE**
Ya-Chu Lee[1], Tung-Lin Chien[1], Chi-Te Fang[1], Yuanyuan Huang[1], Wei-Lun Sung[2], Yen-Chang Chu[2], Rongshun Chen[1], and Weileun Fang[1]
[1]*National Tsing Hua University, TAIWAN and* [2]*PixArt Imaging Inc., TAIWAN*

M26-c **MONOLITHICALLY AND VERTICALLY INTEGRATED ENVIRONMENTAL SENSING HUB WITH NOVEL AIR-BASED HUMIDITY SENSOR DESIGN**
Tung-Lin Chien, Yuanyuan Huang, Fuchi Shih, and Weileun Fang
National Tsing Hua University, TAIWAN

New MEMS System Design and Integration Approaches

T26-c **A SELF-CORRECTED, SELF-CLEANED MEMS AND SUITABLE FOR ADVANCED FOUNDRY MULTI-PROJECT WAFER (MPW)**
Sushil Kumar, Dhairya Singh Arya, Manu Garg, and Pushpapraj Singh
Indian Institute of Technology, New-Delhi, INDIA

W26-c **MONOLITHIC INTEGRATION OF HUMIDITY/FLOW/TEMPERATURE SENSORS AS ENVIRONMENT SENSING HUB FOR APPARENT-TEMPERATURE DETECTION**
Yu-Hsuan Li, Tung-Lin Chien, Fuchi Shih, Yuanyuan Huang, and Weileun Fang
National Tsing Hua University, TAIWAN

M27-c **PIEZORESISTIVE PRESSURE SENSOR WITH MONOLITHICALLY INTEGRATED AMPLIFIER BASED ON METAL-OXIDE TRANSISTORS**
Runxiao Shi[1], Dequan Lin[1], Kevin Chau[1,2], and Man Wang[1]
[1]*Hong Kong University of Science and Technology, HONG KONG and* [2]*Chinese Academy of Sciences, CHINA*

d - Materials, Fabrication and Packaging for Generic MEMS and NEMS

Advancement in Conventional Materials for MEMS & NEMS

T27-d **A PERFORMANCE ENHANCEMENT METHOD FOR THERMOPILE SENSORS USING A CHIP PROBE TEST SYSTEM**
Meng Shi[1,2], Mao Li[1,2], Yue Ni[3], Chenchen Zhang[1], Na Zhou[1,2], Haiyang Mao[1,2], and Chengjun Huang[1,2]
[1]*Chinese Academy of Sciences, CHINA,* [2]*University of Chinese Academy of Sciences, CHINA, and* [3]*Jiangsu Hinovaic Technologies Co., Ltd, CHINA*

W27-d **CHARACTERIZING INDUCTIVELY-COUPLED-PLASMA ETCHING OF SINGLE CRYSTALLINE LITHIUM TANTALATE FOR MICRO-ACOUSTIC APPLICATIONS**
Yasaman Majd, Jorge Manrique Castro, Hakhamanesh Mansoorzare, and Reza Abdolvand
University of Central Florida, USA

M28-d **ROBUST POLYCRYSTALLINE 3C-SIC-ON-SI HETEROSTRUCTURES WITH LOW CTE MISMATCH UP TO 900 °C FOR MEMS**
Philipp Moll, Georg Pfusterschmied, and Ulrich Schmid
TU Wien, AUSTRIA

Digital Micromanufacturing

T28-d **A 3D PRINTED FUNCTIONAL MEMS ACCELEROMETER**
Simone Pagliano[1], David E. Marschner[1], Damien Maillard[2], Nils Ehrmann[3], Göran Stemme[1], Stefan Braun[3], Luis Guillermo Villanueva[2], and Frank Niklaus[1]
[1]*KTH Royal Institute of Technology, SWEDEN,* [2]*École Polytechnique Fédérale de Lausanne (EPFL), SWITZERLAND, and* [3]*Hochschule Kaiserslautern, GERMANY*

W28-d **A FULLY 3D PRINTED METHOD FOR MONOLITHIC INTEGRATION OF AN ACCELEROMETER AND A FORCE SENSOR**
Guandong Liu[1,2], Changhai Wang[1], Kexin Wang[1], Zhili Jia[3], Ruiqi Luo[2], and Wei Ma[2,4]
[1]*Heriot-Watt University, UK,* [2]*Zhejiang Lab, CHINA,* [3]*National Institute of Metrology, CHINA, and* [4]*Zhejiang University, CHINA*

Generic MEMS & NEMS Manufacturing Techniques

M29-d **CHARACTERIZATION OF VAPOR HF SACRIFICIAL ETCHING THROUGH SUBMICRON RELASE HOLES FOR WAFER-LEVEL VACUUM PACKAGING BASED ON SILICON MIGRATION SEAL**
Tianjiao Gong[1], Yukio Suzuki[1], Muhammad J. Khan[1], Karla Hiller[2], and Shuji Tanaka[1]
[1]*Tohoku University, JAPAN and* [2]*Fraunhofer Institute for Electronic Nano Systems, GERMANY*

T29-d **DAMAGE PROFILE MODELING AND EXPERIMENT OF SILICON CARBIDE SUBSTRATES IN MICRO-NANO STRUCTURE FABRICATED BY HELIUM FOCUSED ION BEAM**
Shupeng Gao, Xi Chen, Qianhuang Chen, Qi Li, and Yan Xing
Southeast University, CHINA

W29-d **LIQUID-IMMERSION INCLINED-ROTATED UV LITHOGRAPHY FOR MICRO SUCTION CUP ARRAY**
Gakuto Kagawa and Hidetoshi Takahashi
Keio University, JAPAN

New & Emerging Materials for MEMS/NEMS

M30-d **PARAMETRIC AMPLIFICATION AND PHONONIC FREQUENCY COMB GENERATION IN MoS_2 NANOELECTROMECHANICAL RESONATORS**
S M Enamul Hoque Yousuf[1], Yunong Wang[1], Jaesung Lee[1], Steven W. Shaw[2,3], and Philip X.-L. Feng[1]
[1]*University of Florida, USA,* [2]*Florida Institute of Technology, USA, and* [3]*Michigan State University, USA*

T30-d **PARYLENE-N AS A HIGH TEMPERATURE THIN FILM PIEZOELECTRIC MATERIAL**
Nathan Jackson and Deepak Kunwar
University of New Mexico, USA

W30-d **SILICON CARBIDE-ON-INSULATOR THERMAL-PIEZORESISTIVE RESONATOR FOR HARSH ENVIRONMENT APPLICATION**
Baoyun Sun[1,2], Jiarui Mo[1], Hemin Zhang[3], Henk W. van Zeijl[1], Willem D. van Driel[1], and Guoqi Zhang[1]
[1]*Delft University of Technology, NETHERLANDS,* [2]*China University of Petroleum, CHINA, and* [3]*KU Leuven, BELGIUM*

M31-d **SPIN COATING OF HIGHLY ALIGNED AGCN MICROWIRES EPITAXIALLY GROWN ON 2D MATERIALS**
Jimin Ham, Jaemook Lim, Joowon Lim, Gunyoung Jang, Sueng Yoon Lee, Dohyun Lim, Sukjoon Hong, and Won Chul Lee
Hanyang Universit, Ansan, KOREA

T31-d **SUSPENDED TWO-DIMENSIONAL MATERIAL MEMBRANES FOR SENSOR APPLICATIONS FABRICATED WITH A HIGH-YIELD TRANSFER PROCESS**
Sebastian Lukas[1], Ines Kraiem[1,2], Maximilian Prechtl[3], Oliver Hartwig[3], Annika Grundmann[1], Holger Kalisch[1], Satender Kataria[1], Michael Heuken[1,4], Andrei Vescan[1], Georg S. Duesberg[3], and Max C. Lemme[1,2]
[1]*RWTH Aachen University, GERMANY,* [2]*AMO GmbH, GERMANY,* [3]*University of the Bundeswehr Munich, GERMANY, and* [4]*AIXTRON SE, GERMANY*

W31-d **TCF-IMPROVED SH_0 MODE ACOUSTIC RESONATORS BASED ON 30°YX-$LINBO_3$/SIO_2 MEMBRANE**
Shuxian Wu[1], Zonglin Wu[1], Hangyu Qian[1], Feihong Bao[1], Gongbin Tang[2], Feng Xu[1], and Jie Zou[1]
[1]*Fudan University, CHINA and* [2]*Shandong University, CHINA*

M32-d **WAFER SCALE MULTILAYER GRAPHENE BASED BRAIN PROBES BY SPIN-SPRAYING METHODS FOR MAGNETIC RESONANCE IMAGING**
Kejun Tu, Zhejun Guo, Mengfei Xu, Bin Yang, and Jingquan Liu
Shanghai Jiao Tong University, CHINA

New Fabrication Processes for Making MEMS/NEMS

T32-d **3D SELF-ALIGNED FABRICATION OF SUSPENDED NANOWIRES BY CRYSTALLOGRAPHIC NANOLITHOGRAPHY**
Erwin J.W. Berenschot, Yasser Pordeli, Lucas J. Kooijman, Yves L. Janssens, Roald M. Tiggelaar, and Niels R. Tas
University of Twente, NETHERLANDS

W32-d **A SIMPLE PROCESS FOR THE FABRICATION OF PARALLEL-PLATE ELECTROSTATIC MEMS RESONATORS BY GOLD THERMOCOMPRESSION BONDING**
Dolores Manrique Juarez[1], Fabrice Mathieu[1], Guillaume Libaude[1], David Bourrier[1], Samuel Charlot[1], Laurent Mazenq[1], Véronique Conédéra[1], Ludovic Salvagnac[1], Isabelle Dufour[2], Liviu Nicu[1], and Thierry Leïchlé[1,3]
[1]LAAS-CNRS, FRANCE, [2]Université de Bordeaux, IMS UMR-CNRS, FRANCE, and [3]Georgia Tech, USA

M33-d **ELECTROMECHANICALLY STABLE INTERCONNECTION BETWEEN LIG AND THICK DAM-SHAPED METALLIC ELECTRODE VIA STORED AG MICROPARTICLE SOLUTION**
Saeyoung Park, Yoo-Kyum Shin, and Min-Ho Seo
Pusan National University, KOREA

T33-d **FREE-STANDING MEMBRANES WITH SELF-ASSEMBLED NANOPORE ARRAYS FOR TEM OBSERVATION OF LIQUID SAMPLES**
Joowon Lim[1], Jimin Ham[1], Sungho Jeon[1], Yuna Bae[2,3], Minho Kang[2,3], Sueng Yoon Lee[1], Jungwon Park[2,3], and Won Chul Lee[1]
[1]Hanyang University, KOREA, [2]Seoul National University, KOREA, and [3]Institute of Basic Science (IBS), KOREA

W33-d **NONPLANAR NANOFABRICATION VIA INTERFACE ENGINEERING**
Sarah O. Spector, Peter F. Satterthwaite, and Farnaz Niroui
Massachusetts Institute of Technology, USA

Award Nominee

M34-d **WAFER-LEVEL FABRICATION OF CONFORMAL SUB 10-NM NANOGAPS**
Sayali Tope, Seungbeom Noh, and Hanseup Kim
University of Utah, USA

Packaging & Assembly

T34-d **MEMS RESONATOR VACUUM-SEALED BY SILICON MIGRATION AND HYDROGEN OUTDIFFUSION**
Muhammad Jehanzeb Khan, Yukio Suzuki, Tianjiao Gong, Takashiro Tsukamoto, and Shuji Tanaka
Tohoku University, JAPAN

W34-d **MEMS THIN-FILM VACUUM PACKAGE UTILIZING GLOW DISCHARGE GETTER**
Vikram Maharshi[1], Manjeet Kumar[1], Ajay Agarwal[2], and Bhaskar Mitra[1]
[1]Indian Institute of Technology, Delhi, INDIA and [2]Indian Institute of Technology, Jodhpur, INDIA

e – MEMS Actuators and PowerMEMS

Actuator Components & Systems

M35-e **LNOI THIN-FILM DUAL-AXIS RESONANT MICRO-MIRROR WITH E16 TORSIONAL ACTUATION**
Yaoqing Lu[1,2,3], Kangfu Liu[1,2,3], Yuxi Wang[1,2,3], Ran Nie[1], and Tao Wu[1,2,3,4]
[1]ShanghaiTech University, CHINA, [2]Chinese Academy of Sciences, CHINA, [3]University of Chinese Academy of Sciences, CHINA, and [4]Shanghai Engineering Research Center of Energy Efficient and Custom AI IC, CHINA

T35-e **A PIEZOELECTRIC MEMS SPEAKER WITH STRETCHABLE FILM SEALING**
Linbing Xu, Mingchao Sun, Menglun Zhang, Chengze Liu, Xiaopeng Yang, and Wei Pang
Tianjin University, CHINA

W35-e **BROADBAND MEMS SPEAKER BY SINGLE-WAY MULTI-RESONANCE ARRAY WITH ACOUSTIC DAMPING TUNING: A PROOF OF CONCEPT**
Mingchao Sun, Menglun Zhang, Chengze Liu, and Wei Pang
Tianjin University, CHINA

M36-e **IONIC LIQUID ELECTROSPRAY THRUSTER WITH TWO-STAGE ELECTRODES ON GLASS SUBSTRATE**
Akane Nishimura[1], Yoshinori Takao[2], Toshiyuki Tsuchiya[1], and Yoshinori Takao[2]
[1]Kyoto University, JAPAN and [2]Yokohama National University, JAPAN

W36-e **MONOLITHIC INTEGRATION OF PZT ACTUATION UNITS OF VARIOUS ACTIVATED RESONANCES FOR FULL-RANGE MEMS SPEAKER ARRAY**
Hsu-Hsiang Cheng[1], Sung-Cheng Lo[1], Yu-Chen Chen[1], Ming-Ching Cheng[1], Ting-Chou Wei[1], Mingching Wu[2], and Weileun Fang[1]
[1]National Tsing Hua University, TAIWAN and [2]CoretronicMEMS Co., Ltd., TAIWAN

M37-e **PULL-IN VOLTAGE REDUCTION IN ELECTROSTATIC AIRGAP ACTUATOR USING 12 NM-ULTRATHIN INTERNAL DIELECTRIC TRANSDUCTION**
Satish K. Verma and Bhaskar Mitra
Indian Institute of Technology, New Delhi, INDIA

Energy Harvesting Materials, Structures, and Transducers

T37-e **A REVERSE ELECTROWETTING-ON-DIELECTRIC (REWOD) ENERGY HARVESTER USING NONWETTING GALLIUM COATED ELECTRODE AND ULTRATHIN GALLIUM OXIDE SHELL AS DIELECTRIC LAYER**
Jinwon Jeong, Bokyung Suh, and Jeong Bong (JB) Lee
University of Texas at Dallas, USA

W37-e **ASYMMETRIC QUAD LEG ORTHOPLANAR SPRING FOR WIDEBAND PIEZOELECTRIC MICRO ENERGY HARVESTING**
Ali Mohammadi, Shamin Sadrafshari, Alborz Shokrani, and Chris R. Bowen
University of Bath, UK

M38-e **EVALUATION OF THERMOELECTRIC PROPERTIES OF MONOLITHICALLY-INTEGRATED CORE-SHELL Si NANOWIRE BRIDGES**
Akio Uesugi, Shusuke Nishiyori, Koji Sugano, and Yoshitada Isono
Kobe University, JAPAN

T38-e **GLAZE TILE-INSPIRED LIQUID-SOLID POWER GENERATOR FOR CONTINUOUS WATER FLOW ENERGY HARVESTING**
Dezhi Nie[1], Boming Lyu[1], Yongbo Hu[1], Jian Zhang[1], Yongqing Fu[2], Honglong Chang[1], and Kai Tao[1]
[1]Northwestern Polytechnical University, CHINA and [2]Northumbria University, UK

W38-e **MEMS CANTILEVERED ENERGY HARVESTER WITH TAPERED THICKNESS FOR STRESS CONTROL**
Takahito Yokota, Kensuke Kanda, Takayuki Fujita, and Kazusuke Maenaka
University of Hyogo, JAPAN

M39-e **TAPERED HELMHOLTZ RESONATOR WIND ENERGY HARVESTER DRIVEN BY AEROACOUSTICS**
Chen Hua, Liyun Zhen, Jingquan Liu, and Bin Yang
Shanghai Jiao Tong University, CHINA

Manufacturing for Actuators & Power MEMS

T39-e **ANDROMEDA: A FLEXIBLE MEMS TECHNOLOGY PLATFORM FOR A VARIETY OF PIEZOELECTRICALLY ACTUACTED MICROMIRRORS**
Irene Martini, Anna Alessandri, Marta Carminati, Roberto Carminati, Paolo Ferrarini, Daniela A.L. Gatti, Riccardo Gianola, Borka Lazarova, Carla M. Lazzari, Andrea Nomellini, Laura Oggioni, Claudia Pedrini, Carlo L. Prelini, Riccardo Tacchini, and Michele Vimercati
STMicroelectronis, ITALY

W39-e **DESIGN OF BUTTERFLY PLATE PIEZOELECTRIC ACTUATOR WITH DUAL DRIVING ELECTRODES FOR MEMS MICRO-MIRROR**
Si-Han Chen[1], Shih-Chi Liu[1], Hao-Chien Cheng[1], Hung-Yu Lin[1], Kai-Chih Liang[2], Mingching Wu[2], and Weileun Fang[1]
[1]*National Tsing Hua University, TAIWAN and* [2]*Coretronic MEMS Corporation, TAIWAN*

M40-e **FULLY-FLEXIBLE MICRO-SCALE ACTUATOR ARRAY WITH THE LIQUID-GAS PHASE CHANGE MATERIALS**
Sangjun Sim, Kyubin Bae, and Jongbaeg Kim
School of Mechanical Engineering, Yonsei University, KOREA
Award Nominee

Power MEMS Components & Systems

T40-e **A NOVEL COMB DESIGN FOR ENHANCED POWER AND BANDWIDTH IN ELECTROSTATIC MEMS ENERGY CONVERTORS**
Jinglun Li[1], Habilou Ouro-Koura[1], Hannah Arnow[1], Arian Nowbahari[2], Mathew Galarza[1], Meg Obispo[1], Xing Tong[1], Mehdi Azadmehr[2], Mona M. Hella[1], John A. Tichy[1], and Diana-Andra Borca-Tasciuc[1]
[1]*Rensselaer Polytechnic Institute, USA and* [2]*University of South-Eastern Norway, NORWAY*

Self-Powered Devices and Microsystems

W40-e **A HYBRID NANOGENERTOR-DRIVEN SELF-POWERED WEARABLE PERSPIRATION MONITORING SYSTEM**
Md Abu Zahed, S M Sohel Rana, Md Sharifuzzaman, Seonghoon Jeong, Gagan Bahadur Pradhan, Hye Su Song, and Jae Yeong Park
Kwangwoon University, KOREA

M41-e **A MONOLITHIC INTEGRATED AND TRANSPARENT MICROSYSTEM CONSTRUCTED BY USING AMORPHOUS INGAZNO FILM**
Bin Jia, Chao Zhang, and Xiaodong Huang
Southeast University, CHINA

T41-e **FLOWING WATER ENABLES STEERABLE CHARGE DISTRIBUTION ON ELECTRET SURFACE**
Boming Lyu[1], Jian Zhang[1], Yunjia Li[2], Yongqing Fu[3], Honglong Chang[1], Weizheng Yuan[1], and Kai Tao[1]
[1]*Northwestern Polytechnical University, CHINA,* [2]*Xi'an Jiaotong University, CHINA, and* [3]*University of Northumbria, UK*

W41-e **SELF-POWERED FLEXIBLE PIEZOELECTRET ARRAY FOR WEARABLE APPLICATIONS**
Hao Yang[1,2], Rui M.R. Pinto[1], Pedro González[1], Alar Ainla[1], Mohammadmahdi Faraji[1], and K.B. Vinayakumar[1]
[1]*International Iberian Nanotechnology Laboratory, PORTUGAL and* [2]*Xi'an Jiaotong University, CHINA*

f - MEMS Physical and Chemical Sensors

Fluidic Sensors

M42-f **A BULK-TYPE PRESSURE SENSOR WITH FULL-BRIDGE IMPLEMENTATION ENABLED BY STRESS-MODIFYING TRENCHES**
Dequan Lin[1], Man Wong[1], and Kevin Chau[1,2]
[1]*Hong Kong University of Science and Technology, CHINA and* [2]*Chinese Academy of Science, CHINA*

T42-f **A CMOS COMPATIBLE MICRO PIRANI GAUGE WITH STRUCTURE OPTIMIZATION FOR PERFORMANCE ENHANCEMENT**
Rui Jiao[1], Gai Yang[2], Ruoqin Wang[1], Yue Tang[2], Zhongyi Liu[2], Huikai Xie[2,3], Hongyu Yu[1], and Xiaoyi Wang[2,3]
[1]*Hong Kong University of Science and Technology, HONG KONG,* [2]*Beijing Institute of Technology, CHINA, and* [3]*BIT Chongqing Institute of Microelectronics and Microsystems, CHINA*

W42-f **A THERMAL AIRFLOW SENSOR BASED ON MN-CO-NI-O THIN FILM**
Jie Wang, Yunfei Liu, Zhezheng Zhu, Chengchen Gao, Zhenchuan Yang, and Yilong Hao
Peking University, CHINA

M43-f **HIGHLY SENSITIVE WAVE HEIGHT SENSOR WITH MEMS PIEZORESISTIVE CANTILEVER AND WATERPROOF MEMBRANE**
Takuto Hirayama and Hidetoshi Takahashi
Keio University, JAPAN

T43-f **MEMS CAPACITANCE DIAPHRAGM GAUGE WITH TWO SEALED REFERENCE CAVITIES**
Xiaodong Han[1,2], Jingzhen Li[3], Gang Li[4], and Yongjian Feng[1]
[1]*Xiamen University, CHINA,* [2]*University of Twente, NETHERLANDS,* [3]*Beijing University of Technology, CHINA, and* [4]*Lanzhou Institute of Physics, CHINA*

W43-f **TOWARDS A GAS INDEPENDENT THERMAL FLOW METER**
Shirin Azadi Keari[1], Remco J. Wiegerink[1], Remco G.P. Sanders[1], and Joost C. Lotters[1,2]
[1]*University of Twente, NETHERLANDS and* [2]*Bronkhorst High-Tech BV, NETHERLANDS*

Force & Displacement Sensors

M44-f **AN INTEGRATED MEMS DEVICE FOR *IN-SITU* FOUR-PROBE ELECTRO-MECHANICAL CHARACTERIZATION OF PT NANOBEAM**
Yuheng Huang, Meng Nie, Binghui Li, Kuibo Yin, and Litao Sun
Southeast University, CHINA

T44-f **FINGERLIKE TACTILE TEXTURE INTEGRATED SENSOR WITH COLD AND WARM SENSATIONS OF SUB-MM SPATIAL RESOLUTION** **Award Nominee**
Nachi Mise, Mitsuki Kozasa, Kyohei Terao, Fusao Shimokawa, and Hidekuni Takao
Kagawa University, JAPAN

W44-f **MODIFIED BEAM STRUCTURES FOR IMPROVED RESONANT SENSING**
Erfan Ghaderi and Behraad Bahreyni
Simon Fraser University, CANADA

M45-f **OCCLUSAL PAPER-BASED FLEXIBLE PRESSURE SENSOR FOR IN SITU MEASURING ORAL OCCLUSAL FORCE**
Wenduo Wang, Xin Zhang, Ning Zhao, Jingquan Liu, and Bin Yang
Shanghai Jiao Tong University, CHINA

T45-f **SUCTION CUP ARRAY WORKING ALSO AS TACTILE SENSOR TO DETECT CUPS DEFORMATION USING KCF AND CNN**
Toshihiro Shiratori, Jinya Sakamoto, Yuki Kumokita, Masato Suzuki, Tomokazu Takahashi, and Seiji Aoyagi
Kansai University, JAPAN

W45-f **VERTICAL INTEGRATION OF FORCE TRANSMISSION STRUCTURE ON CAPACITIVE CMOS-MEMS TACTILE FORCE SENSOR FOR SENSITIVITY IMPROVEMENT**
Yuanyuan Huang, Yen-Lin Chen, Shihwei Lin, Fuchi Shih, Zihsong Hu, and Weileun Fang
National Tsing Hua University, TAIWAN

Gas & Chemical Sensors

M46-f **1-OCTADECANETHIOL SAM ON CMOS-MEMS GOLD PLATED RESONATOR VIA DIP-CAST FOR VOCs SENSING**
Rafel Perelló-Roig[1,2], Jaume Verd[1,2], Sebastià Bota[1,2], Bartomeu Soberats[1], Antonio Costa[1], and Jaume Segura[1,2]
[1]*University of the Balearic Islands, SPAIN and* [2]*Health Research Institute of the Balearic Islands, SPAIN*

T46-f **APPLICATION OF DEEP LEARNING NETWORK FOR HUMIDITY COMPENSATION OF SEMICONDUCTOR METAL OXIDE GAS SENSORS**
Mingu Kang, Incheol Cho, and Inkyu Park
Korea Advanced Institute of Science and Technology (KAIST), KOREA

W46-f **DEVELOPMENT OF MONOLITHIC MICRO-LED GAS SENSOR BASED E-NOSE SYSTEM FOR REAL-TIME, SELECTIVE GAS PREDICTION**
Kichul Lee, Mingu Kang, and Inkyu Park
Korea Advanced Institute of Science and Technology (KAIST), KOREA

M47-f **ELECTRONIC-NOSE: AN ARRAY OF 16 MOS-GAS SENSORS INTEGRATED WITH TEMPERATURE AND MOISTURE SENSING CAPABILITIES**
Xiawei Yue[1,2], Shuai Wei[1,2], Pingping Zhang[3], Zhitao Zhou[1], Tiger Tao[1,2,4,5,6], and Nan Qin[1]
[1]*Chinese Academy of Sciences (CAS), CHINA,* [2]*University of Chinese Academy of Sciences, CHINA,* [3]*Suzhou Huiwen Nanotechnology Co. Ltd., CHINA,* [4]*ShanghaiTech University, CHINA,* [5]*Shanghai Research Center for Brain Science and Brain-Inspired Intelligence, CHINA and* [6]*Neuroxess Co., Ltd. (Jiangxi), CHINA*

T47-f **ENHANCEMENT OF SENSITIVITY IN PHOTONIC CRYSTAL BASED CHEMICAL SENSOR USING CHEMO-MECHANICAL BILAYER EFFECT**
Seyeon Lee[1], Naik T. Banabathi[1], Dongwon Kang[3], Sookyung Kang[2], Kyungsuk Cho[2], Jungwook Kim[1], and Jungyul Park[1]
[1]*Sogang University, KOREA,* [2]*Iwha University, KOREA, and* [3]*University of California, Los Angeles, USA*

W47-f **METAL ION RECOGNITION SENSOR BASED ON RESISTANCE SWITCHING EFFECT**
Tian Kang, Yusa Chen, Guanzhou Lin, Shengxiao Jin, Liye Li, Hongshun Sun, Senyong Hu, and Wengang Wu
Peking University, CHINA

M48-f **MULTI-HOTSPOT MID-IR NANOANTENNAS WITH MATCHED LOSS AND HIGH-INTENSITY NEAR-FIELD FOR SUB-PPM-LEVEL GAS DETECTION**
Hong Zhou, Zhihao Ren, Cheng Xu, Liangge Xu, Xinge Guo, and Chengkuo Lee
National University of Singapore, SINGAPORE **Award Nominee**

T48-f **PALLADIUM BASED MEMS HYDROGEN SENSORS**
Max Hoffmann[1], Marion Wienecke[1], Maren Lengert[2], Michael H. Weidner[2], and Jan Heeg[2]
[1]*Hochschule Wismar, Institut für Oberflächen- und Dünnschichttechnik, GERMANY and* [2]*Materion GmbH, GERMANY*

W48-f **SELECTIVE DISCRIMINATION OF PPB-LEVEL VOCS USING MOS GAS SENSOR IN PULSE-HEATING MODE WITH THE MODIFIED HILL'S MODEL**
Gaoqiang Niu, Yi Zhuang, Yushen Hu, Zong Liu, and Fei Wang
Southern University of Science and Technology, CHINA

M49-f **THERMAL CONDUCTIVITY DETECTOR (TCD)-TYPE GAS SENSOR BASED ON THE SUSPENDED 1D NANOHEATER FOR IOT APPLICATIONS**
Wootaek Cho, Jong-Hyun Kwak, Taejung Kim, and Heungjoo Shin
Ulsan National Institute of Science and Technology (UNIST), KOREA

Inertial Sensors

T49-f **120 PPM QUALITY FACTOR THERMAL STABILITY FROM -40°C TO +60°C OF A DUAL-AXIS MEMS GYROSCOPE BASED ON JOULE EFFECT DYNAMIC CONTROL**
Jian Cui[1,2] and Qiancheng Zhao[1,2]
[1]*Peking University, CHINA and* [2]*Beijing Advanced Innovation Center for Integrated Circuits, CHINA*

W49-f **A FORCE-BANLANCE CAPACITIVE MEMS GRAVIMETER WITH SUPERIOR RESPONSE TIME, SELF-NOISE AND DRIFT**
Le Gao[1], Fangzheng Li[1], Jian Zhang[1], Bingyang Cai[1], Wenjie Wu[1], and Liangcheng Tu[2]
[1]*Huazhong University of Science and Technology, CHINA and* [2]*Sun Yat-sen University, CHINA*

M50-f **A MEMS-BASED GRAVIMETER FOR SIMULTANEOUS VERTICAL AND HORIZONTAL EARTH TIDES MEASUREMENTS**
Lujia Yang[1], Xiaochao Xu[1], Qian Wang[1], Ji'ao Tian[1], Yanyan Fang[1], Chun Zhao[1], Wenjie Wu[1], Fangjing Hu[1], and Liangcheng Tu[1,2]
[1]*Huazhong University of Science and Technology, CHINA and* [2]*Sun Yat-sen University, CHINA*

T50-f **A NOVEL MULTIPLE FOLDED BEAM DISK RESONATOR FOR MAXIMIZING THE THERMOELASTIC QUALITY FACTOR**
Xiaopeng Sun[1], Xin Zhou[1], Lei Yu[2], Kaixuan He[2], Xuezhong Wu[1], and Dingbang Xiao[1]
[1]*National University of Defense Technology, CHINA and* [2]*East China Institute of Photo-Electronic IC, CHINA*

W50-f **A TIME-SERIES CONFIGURATION METHOD OF MODE REVERSAL MEMS GYROSCOPES UNDER DIFFERENT TEMPERATURE-VARYING CONDITIONS**
Liangqian Chen, Tongqiao Miao, Qingsong Li, Peng Wang, Junjian Li, Xuezhong Wu, Dingbang Xiao, and Xiang Xi
National University of Defense Technology, CHINA

M51-f **ACOUSTICALLY ISOLATED MEMS BAW GYROSCOPES**
Diego Emilio Serrano, Amir Rahafrooz, Duane Younkin, Kieran Nunan, Mitul Dalal, Sagnik Pal, and Ijaz Jafri
Panasonic Device Solutions Laboratory of Massachusetts, USA

T51-f **ACTIVE QUALITY FACTOR STABILIZATION OF MEMS RESONATOR UTILIZING ELECTRICAL DISSIPATION REGULATION**
Yang Zhao, Qin Shi, Guoming Xia, and Anping Qiu
Nanjing University of Science and Technology, CHINA

W51-f **DEMONSTRATION OF GYRO-LESS NORTH FINDING USING A T-SHAPED MEMS DIFFERENTIAL RESONANT ACCELEROMETER**
Kei Masunishi, Etsuji Ogawa, Daiki Ono, Fumito Miyazaki, Hiroki Hiraga, Kengo Uchida, Jumpei Ogawa, Hideaki Murase, and Yasushi Tomizawa
Toshiba Corporation, JAPAN

M52-f **ENHANCED STIFFNESS SENSITIVITY IN A MODE LOCALIZED SENSOR USING INTERNAL RESONANCE ACTUATION**
Jianlin Chen[1], Hemin Zhang[2], Takashiro Tsukamoto[1], Michael Kraft[2], and Shuji Tanaka[1]
[1]*Tohoku University, JAPAN and* [2]*KU Leuven, BELGIUM*

T52-f **MODELING STRESS EFFECTS ON FREQUENCIES OF A MEMS RING GYROSCOPE**
Mehran Hosseini-Pishrobat, Baha Erim Uzunoglu, and Erdinc Tatar
Bilkent University, TURKEY

W52-f **RATE INTEGRATING GYROSCOPE TUNED BY FOCUS ION BEAM TRIMMING AND INDEPENDENT CW/CCW MODES CONTROL**
Jianlin Chen[1], Takashiro Tsukamoto[1], Giacomo Langfelder[2], and Shuji Tanaka[1]
[1]*Tohoku University, JAPAN and* [2]*Politecnico di Milano, ITALY*

M53-f **TEMPERATURE DEPENDENCE OF QUALITY FACTORS AT HIGH FREQUENCIES IN MEMS GYROSCOPES**
Daniel Schiwietz[1,2], Eva M. Weig[2], and Peter Degenfeld-Schonburg[1]
[1]*Robert Bosch GmbH, GERMANY and* [2]*Technical University of Munich, GERMANY*

Manufacturing Techniques for Physical Sensors

T53-f **0.5MM×0.5MM 150KPA-MEASURE-RANGE HIGH-TEMPERATURE PRESSURE SENSOR WITH HIGH-PERFORMANCE AND LOW FABRICATION-COST**
Peng Li[1,2], Wei Li[1], Changnan Chen[1,3], Ke Sun[1], Min Liu[1], Sheng Wu[1], Pichao Pan[1,3], Jiachou Wang[1,3], and Xinxin Li[1,2,3]
[1]*Chinese Academy of Sciences, CHINA,* [2]*Fudan University, CHINA, and* [3]*University of Chinese Academy of Sciences, CHINA*

W53-f **AUTOMATIC PICO LASER TRIMMING SYSTEM FOR SILICON MEMS RESONANT DEVICES BASED ON IMAGE RECOGNITION**
Yuxian Liu[1], Qiancheng Zhao[1,2], Dacheng Zhang[1], and Jian Cui[1,2]
[1]*Peking University, CHINA and* [2]*Beijing Advanced Innovation Center for Integrated Circuits, CHINA*

M54-f **MICROMACHINING FUSED SILICA MICRO SHELL RESONATOR WITH QUARTZ GLASS MOLD BY THERMAL REFLOW**
Zhaoxi Su, Bin Luo, Qiankai Tang, Linqian Zhu, and Jintang Shang
Southeast University, CHINA

T54-f **WAFER-LEVEL PATTERNING OF TIN OXIDE NANOSHEETS FOR MEMS GAS SENSORS**
Mingjie Li, Wenxin Luo, Xiaojiang Liu, Gaoqiang Niu, and Fei Wang
Southern University of Science and Technology, CHINA

Materials for Physical Sensors

W54-f **AIR DAMPING EFFECTS ON DIFFERENT MODES OF AlN-on-Si MICROELECTROMECHANICAL RESONATORS**
Yuncong Liu[1], S M Enamul Hoque Yousuf[1], Afzaal Qamar[2], Mina Rais-Zadeh[2,3], and Philip X.-L. Feng[1]
[1]*University of Florida, USA,* [2]*University of Michigan, USA, and* [3]*California Institute of Technology, USA*

M55-f **A NOVEL PIEZORESISTIVE PRESSURE SENSOR BASED ON CR-DOPED V2O3 THIN FILM**
Michiel Gidts, Wei-Fan Hsu, María Recaman Payo, Shashwat Kushwaha, Chen Wang, Frederik Ceyssens, Dominiek Reynaerts, Jean-Pierre Locquet, and Michael Kraft
KU Leuven, BELGIUM

Metrology and Measurement Techniques for MEMS/NEMS Sensors

T55-f **A NOVEL FEEDTHROUGH CANCELLATION TECHNIQUE FOR PIEZOELECTRIC MEMS RESONANT SENSORS IN IONIC LIQUID MEDIUM**
Cheng-Yen Wu, Zhong-Wei Lin, and Sheng-Shian Li
National Tsing Hua University, TAIWAN

W55-f **CHARACTERIZATION OF PACKAGING STRESS WITH A CAPACITIVE STRESS SENSOR ARRAY**
Tolga Veske[1], Derin Erkan[1], and Erdinc Tatar[1,2]
[1]*Bilkent University, TURKEY and* [2]*National Nanotechnology Research Center (UNAM), TURKEY*

M56-f **MILLISECOND-LEVEL PULSE-HEATING SENSING SYSTEM FOR MEMS-BASED GAS SENSORS**
Yi Zhuang, Gaoqiang Niu, Lang Wu, and Fei Wang
Southern University of Science and Technology, CHINA

T56-f **MULTIPLE PARAMETER DECOUPLING USING A SINGLE RESONANT MEMS SENSOR VIA BLUE SIDEBAND EXCITATION**
Jingqian Xi[1], Lei Xu[1], Yuan Wang[2], Fangjing Hu[1], Chengxin Li[4], Linlin Wang[4],Huafeng Liu[1], Chen Wang[4], Michael Kraft[4], and Chun Zhao[3]
[1]*Huazhong University of Science and Technology, CHINA,* [2]*University of Macau, CHINA,* [3]*University of York, UK, and* [4]*University Leuven, BELGIUM*

Nanoscale Physical Sensors

W56-f **DIAMOND NANOWIRES ARRAY PREPARED BY ANNEALING NANO-CRYSTALLINE DIAMOND IN AIR AND ITS APPLICATION IN FIELD EMISSION**
Yang Wang, Chen Lin, and Jinwen Zhang
Peking University, CHINA

M57-f **QUANTIFIED STRESS RELAXATION IN CARBON NANOTUBE RESONATORS**
Morten Vollmann, Cosmin Roman, Miroslav Haluska, and Christofer Hierold
ETH Zürich, SWITZERLAND

T57-f **SELF-REFERENCED TEMPERATURE SENSORS BASED ON CASCADED SILICON RING RESONATOR**
Xiantao Zhu, Minmin You, Zude Lin, Bin Yang, and Jingquan Liu
Shanghai Jiao Tong University, CHINA

Sonic & Ultrasonic MEMS Transducers

W57-f **A 0.35 mm² SYSTEM ON CHIP LEVEL DETECTOR BASED ON AN ANNULAR PMUT-ON-CMOS ARRAY**
Eyglis Ledesma, Iván Zamora, Francesc Torres, Arantxa Uranga, and Núria Barniol
Universitat Autònoma de Barcelona, SPAIN

M58-f **AN ALSCN PMUT-ON-CMOS SENSOR FOR MONITORING FLUIDS' DENSITY, VISCOSITY, SOUND VELOCITY, AND COMPRESSIBILITY**
Eyglis Ledesma, Iván Zamora, Jesús Yanez, Arantxa Uranga, and Núria Barniol
Universitat Autònoma de Barcelona, SPAIN

T58-f **AUTO-POSITIONING AND HAPTIC STIMULATIONS VIA A 35 MM SQUARE PMUT ARRAY**
Wei Yue[1], Yande Peng[1], Hanxiao Liu[1], Fan Xia[1], Fanping Sui[1], Seiji Umezawa[2], Shinsuke Ikeuchi[2], Yasuhiro Aida[2], and Liwei Lin[1]
[1]*University of California, Berkeley, USA and* [2]*Murata Manufacturing Co., Ltd., JAPAN*

W58-f **BODY FORCE BASED DROPLET EJECTION BY GHZ ACOUSTIC MICRO-TRANSDUCER**
Haitao Zhang, Yangchao Zhou, Menglun Zhang, Wenlan Guo, Chen Sun, Xuexin Duan, and Wei Pang
Tianjin University, CHINA

M59-f **BONE CONDUCTION PICKUP BASED ON PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCERS**
Chongbin Liu[1], Xiangyang Wang[1], Yong Xie[2], and Guoqiang Wu[1]
[1]*Wuhan University, CHINA and* [2]*Xidian University, CHINA*

T59-f **BREAKING THE DEAD ZONE LIMITATION OF PMUTS BASED ON A PHASE SHIFT OF DRIVING WAVEFORM WITH WINDOW FUNCTION**
Chun-You Liu, Chin-Yu Chang, and Sheng-Shian Li
National Tsing Hua University, TAIWAN

W59-f **DRONE-MOUNTED LOW-FREQUENCY PMUTS FOR > 6-METER RANGEFINDER IN AIR**
Hanxiao Liu[1], Yande Peng[1], Wei Yue[1], Seiji Umezawa[2], Shinsuke Ikeuchi[2], Yasuhiro Aida[2], Chunming Chen[1], Peggy Tsao[1], and Liwei Lin[1]
[1]*University of California, Berkeley, USA and* [2]*Murata Manufacturing Co., Ltd., JAPAN*

M60-f **MASS PRODUCED MICROMACHINED ULTRASONIC TIME-OF-FLIGHT SENSORS OPERATING IN DIFFERENT FREQUENCY BANDS**
Richard J. Przybyla[1], Stefon E. Shelton[1], Cathy Lee[1], Ben Eovino[1], Quy Chau[1], Mitchell H. Kline[1], Oleg I. Izyumin[1], and David A. Horsley[1,2]
[1]*TDK Invensense, USA and* [2]*University of California, Davis, USA*

T60-f **MEMS FIRST-ORDER BESSEL BEAM ACOUSTIC TRANSDUCER FOR PARTICLE TRAPPING AND CONTROLLABLE ROTATING**
Jiaqi L[i1], Zhenhuan Sun[1], Yuyu Jia[1], Teng Li[1], Haojian Lu[2], Lurui Zhao[3], Hai Liu[3], and Song Liu[1]
[1]*ShanghaiTech University, CHINA,* [2]*Zhejiang University, CHINA, and* [3]*University of Southern California, Los Angeles, USA*

W60-f **NON-INVASIVE CAROTID ARTERY MONITORING BY USING ALUMINUM NITRIDE PMUT CLOSE-PACKED ARRAYS**
Sheng Wu[1,2,3], Kangfu Liu[2], Shuai Shao[2], Wei Li[1,3], Ying Chen[1,3], Tao Wu[2], and Xinxin Li[1,3]
[1]*Chinese Academy of Sciences, CHINA,* [2]*ShanghaiTech University, CHINA, and* [3]*University of Chinese Academy of Sciences, CHINA*

M61-f **NON-LINEAR BEHAVIORAL MODELING OF CAPACITIVE MEMS MICROPHONES**
Sebastian Anzinger[1,2], Hutomo Suryo Wasisto[1], Abhiraj Basavanna[1], and Alfons Dehé[2,3]
[1]*Infineon Technologies AG, GERMANY,* [2]*University of Freiburg, GERMANY, and* [3]*Hahn-Schickard-Gesellschaft, GERMANY*

T61-f **VORTEX-BEAM ACOUSTIC TRANSDUCER FOR UNDERWATER PROPULSION**
Jaehoon Lee, Kianoush Sadeghian Esfahani, and Eun S. Kim
University of Southern California, USA

W61-f **WIDEBAND AND HIGHLY SENSITIVE MICROMACHINED PZT FILM-BASED ULTRASONIC MICROPHONE WITH PARYLENE FILM AND FLEXIBLE HELMHOLTZ RESONATOR ENHANCEMENT**
Chung-Hao Huang and Guo-Hua Feng
National Tsing Hua University, TAIWAN

Other Physical Sensors

M62-f **HALBACH-ARRAY MAGNETIC COIL ARRANGEMENT ON CMOS CHIP FOR SENSITIVITY ENHANCEMENT OF INDUCTIVE TACTILE SENSOR**
Tien Chou, Zih-Song Hu, and Weileun Fang
National Tsing Hua University, TAIWAN

T62-f ***ON-MEMS-CHIP*** **COMPACT TEMPERATURE SENSOR FOR LARGE-VOLUME, LOW-COST SENSOR CALIBRATION**
Paolo Frigerio[1], Andrea Fagnani[1], Valentina Zega[1], Gabriele Gattere[2], Attilio Frangi[1], and Giacomo Langfelder[1]
[1]*Politecnico di Milano, ITALY and* [2]*STMicroelectronics, ITALY*

W62-f **PARTICULATE MATTER SENSOR BASED ON TWO STAGE CASCADE VIRTUAL IMPACTORS AND THERMOPHORETIC MICROHEATERS**
Kwang-Wook Choi[1], Ilhwan Kim[1], Seokwhan Chung[1], Gi-Bong Sung[2], and Se-Jin Yook[2]
[1]*Samsung Advanced Institute of Technology, KOREA and* [2]*Hanyang University, KOREA*

g – Micro- and Nanofluidics

Biological and Medical Microfluidics and Nanofluidics

M63-g **A MICROFLUIDIC OXYGEN GRADIENT GENERATOR FOR THE STUDY OF AEROTROPISM IN HYPHAE OF OOMYCETES**
Ayelen Tayagui[1,2], Yiling Sun[1,2], Ashley Garrill[1], and Volker Nock[1,2]
[1]*University of Canterbury, NEW ZEALAND and* [2]*MacDiarmid Institute for Advanced Materials and Nanotechnology, NEW ZEALAND*

T63-g **A PAPER-BASED DUAL APTAMER ASSAY ON AN INTEGRATED MICROFLUIDIC SYSTEM FOR DETECTION OF HNP 1 AS A BIOMARKER FOR PERIPROSTHETIC JOINT INFECTIONS**
Rishabh Gandotra[1], Feng-Chih Kuo[2], Mel S. Lee[3], and Gwo-Bin Lee[1]
[1]*National Tsing Hua University, TAIWAN,* [2]*Kaohsiung Chang Gung Memorial Hospital, TAIWAN, and* [3]*Paochien Hospital, TAIWAN*

W63-g **AN INTEGRATED MICROFLUIDIC PLATFORM FOR TUMOR CELL SEPARATION AND FLUORESCENCE IN SITU HYBRIDIZATION AT SINGLE CELL LEVEL**
Shihui Qiu[1,2], Na Li[1,2], Zhenhua Wu[1,2], Jianlong Zhao[1,2], and Hongju Mao[1,2]
[1]*Chinese Academy of Science, CHINA and* [2]*University of Chinese Academy of Sciences, CHINA*

M64-g **CHARACTERIZATION OF OOCYTE HARDENING USING A MICROFLUIDIC ASPIRATION-ASSISTED ELECTRICAL IMPEDANCE SPECTROSCOPY SYSTEM**
Yuan Cao, Julia Floehr, and Uwe Schnakenberg
RWTH Aachen University, GERMANY

T64-g **DOUBLE PULSE IRRADIATION OF FS LASER FOR ENHANCING THE PERFORMANCE OF PRECISE LASER SORTING METHOD**
Ryota Kiya[1], Yoshinaga Rintaro[1], Yo Tanaka[2], Yaxiaer Yalikun[1,2], and Yoichiroh Hosokawa[1]
[1]*Nara Institute of Science and Technology, JAPAN and* [2]*Institute of Physical and Chemical Research (RIKEN), JAPAN*

W64-g **DROPLET BASED HIGH THROUGHPUT SINGLE-SPERM CRYOPRESERVATION PLATFORM**
Na Li[1,2], Shihui Qiu[1,3], Zhenhua Wu[1,3], and Hongju Mao[1,3]
[1]*Chinese Academy of Sciences, CHINA,* [2]*ShanghaiTech University, CHINA, and* [3]*University of Chinese Academy of Sciences, CHINA*

M65-g **DUAL ION-SELECTIVE MEMBRANE DEPOSITED ION-SENSITIVE FIELD-EFFECT TRANSISTOR (DISM-ISFET) INTEGRATING WHOLE BLOOD PROCESSING MICROCHAMBER FOR IN SITU BLOOD ION TESTING**
Xiao-Wen Chen, Syuan-Rong Huang, and Nien-Tsu Huang
National Taiwan University, TAIWAN

Generic Microfluidics & Nanofluidics

W65-g **STRONG MICROSTREAMING FROM A PINNED OSCILLATING MEMBRANE AND APPLICATION TO GAS EXCHANGE**
Anthony L. Mercader and Sung Kwon Cho
University of Pittsburgh, USA

M66-g **TUNABLE NANOPORE-INTEGRATED MICRO-/NANOFLUIDIC PLATFORM FOR ION TRANSPORT CONTROL IN THE PRESENCE OF CONCENTRATION AND TEMPERATURE GRADIENTS** **Award Nominee**
Dongwoo Seo[1], Dongjun Kim[1], Jongwan Lee[1], Cong Wang[2], Jungyul Park[2], and Taesung Kim[1]
[1]*Ulsan National Institute of Science and Technology (UNIST), KOREA and* [2]*Sogang University, KOREA*

Integrated/Embedded Microfluidics and Nanofluidic Systems & Platforms

W66-g **QUANTITATIVE ASSESSMENT OF CAPTURED MAGNETIC NANOPARTICLES USING SELF-POWERED MAGNETOELECTRIC PLATFORM FOR BIOLOGICAL APPLICATIONS**
Pankaj Pathak, Vinit K. Yadav, Samaresh Das, and Dhiman Mallick
Indian Institute Of Technology Delhi, INDIA

M67-g **REAL-TIME OPERATION OF MICROCANTILEVER-BASED IN-PLANE RESONATORS PARTIALLY IMMERSED IN A MICROFLUIDIC SAMPLER**
Jiushuai Xu, Entian Cao, Michael Fahrbach, Vladislav Agluschewitsch, Andreas Waag, and Erwin Peiner
Technische Universität Braunschweig, GERMANY

T67-g **SUSPENDED NANOCHANNEL RESONATORS MADE BY NANOIMPRINT AND GAS PHASE DEPOSITION**
Manuel Müller[1], Jeremy Teuber[1], Rukan Nasri[1], Francesc Torres Canals[2], Núria Barniol[2], Jordi Llobet Sixto[3], Xavier Borrise[3], Francesc Perez-Murano[3], and Irene Fernandez-Cuesta[1]
[1]*University of Hamburg, GERMANY,* [2]*Universitat Autónoma de Barcelona, SPAIN, and* [3]*IMB-CNM CSIC, SPAIN*

Manufacturing for Micro- and Nanofluidics

W67-g **DEVELOPING AN EXTREMELY HIGH FLOW RATE PNEUMATIC PERISTALTIC MICROPUMP FOR BLOOD PLASMA SEPARATION WITH INERTIAL PARTICLE FOCUSING TECHNIQUE FROM FINGERTIP BLOOD WITH LANCETS**
Tuan N.A. Vo[1,2,3], Pin-Chuan Chen[1], and Pai-Shan Chen[4]
[1]*National Taiwan University of Science and Technology, TAIWAN,* [2]*Ho Chi Minh City University of Technology (HCMUT), VIETNAM,* [3]*Vietnam National University, VIETNAM, and* [4]*National Taiwan University, TAIWAN*

M68-g **DIRECT PATTERNING ON POROUS SURFACE USING DROP IMPACT PRINTING**
Bheema Sankar Reddy[1], Chandantaru Dey Modak[1,2], Rutvik Lathia[1], Bhawana Agarwal[1,3], Ebinesh Abraham R[1], and Prosenjit Sen[1]
[1]*Indian Institute of Science, Bangalore, INDIA,* [2]*CNRS - ESPCI PSL, FRANCE, and*
[3]*Johns Hopkins University, USA*

T68-g **MANUFACTURING 3D-PRINTED PAPER MICROFLUIDICS INTEGRATED WITH IONIZATION MASS-SPECTROMETRY FOR ILLICIT DRUGS ANALYSIS AND ON-CHIP CHROMATOGRAPHY**
Muhammad Faizul Zaki[1], Pin-Chuan Chen[1], Yi-Xin Wu[2], and Pai-Shan Chen[2]
[1]*National Taiwan University of Science and Technology, TAIWAN and* [2]*National Taiwan University, TAIWAN*

Materials for Micro & Microfluidics

W68-g **DETECTION LIMITS IN NANOMECHANICAL MASS FLOW SENSING FOR NANOFLUIDICS WITH NANOWIRE OPEN CHANNELS** — Award Nominee
Javier E. Escobar, Juan Molina, Eduardo Gil-Santos, José J. Ruz, Óscar Malvar, Priscila M. Kosaka, Javier Tamayo, Álvaro San Paulo, and Montserrat Calleja
Instituto de Micro y Nanotecnología, IMN-CNM (CSIC), SPAIN

Modeling of Micro & Nanofluidics

M69-g **CONTROLLING PARTICLE AGGREGATION AND SEPARATION IN LIQUID ON MEMBRANE RESONATORS**
Haoran Zhang[1,2], Hao Jia[1,2], and Xinxin Li[1,2]
[1]*Chinese Academy of Sciences, CHINA and* [2]*University of Chinese Academy of Sciences, CHINA*

T69-g **DEVELOPMENT OF BOAT MODEL POWERED BY ELECTRO-HYDRODYNAMIC PROPULSION SYSTEM**
Luan Ngoc Mai[1,2], Tuan-Khoa Nguyen[3], Trung Hieu Vu[3], Thien Xuan Dinh[4], Canh-Dung Tran[5], Hoang-Phuong Phan[6], Toan Dinh[5], Thanh Nguyen[5], Nam-Trung Nguyen[3], Dzung Viet Dao[3], and Van Thanh Dau[3]
[1]*Ho Chi Minh City University of Technology, VIETNAM,* [2]*Vietnam National University Ho Chi Minh City, VIETNAM,* [3]*Griffith University, AUSTRALIA,* [4]*Explosion Research Institute Inc., JAPAN,* [5]*University of Southern Queensland, AUSTRALIA, and* [6]*University of New South Wales, AUSTRALIA*

W69-g **HEMODYNAMIC ANALYSIS OF CARDIOMEMS: ADVERSE HEMODYNAMIC EFFECTS**
Zhenhao Liu[1], Jiangli Han[2], and Xing Chen[1]
[1]*Beihang University, CHINA and* [2]*Peking University Third Hospital, CHINA*

M70-g **MODAL QUALITY FACTOR INVERSION OF NON-SLENDER MEMS RESONATORS BETWEEN GASES AND LIQUIDS**
Andre L. Gesing, Thomas Tran, Daniel Platz, and Ulrich Schmid
TU Wien, AUSTRIA

Other Micro- and Nanofluidics

T70-g **CLASSIFYING CELL CYCLE BY ELECTRICAL PROPERTIES USING MACHINE LEARNING**
Jian Wei and Xiaoxing Xing
Beijing University of Chemical Technology, CHINA

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Pohang University of Science and Technology (POSTECH), KOREA

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[1]*Keio University, JAPAN and* [2]*Tokyo University of Agriculture and Technology, JAPAN*

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[1]*Indian Institute of Science, INDIA,* [2]*CNRS - ESPCI PSL, FRANCE, and* [3]*Texas A&M University, USA*

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[1]*Peking University, CHINA and* [2]*Chinese Academy of Science, CHINA*

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[1]*Si-Ware Systems, EGYPT,* [2]*Ain Shams University, EGYPT, and* [3]*Université Gustave Eiffel, FRANCE*

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[1]*Silicon Austria Labs GmbH, AUSTRIA and* [2]*TDK Electronics GmbH & Co OG, AUSTRIA*

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[1]*Beijing Institute of Technology, CHINA,* [2]*Yangtze Delta Region Academy of Beijing Institute of Technology, CHINA, and* [3]*Technische Universität Braunschweig, GERMANY*

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[1]*Huawei Technologies Company Ltd., CHINA and* [2]*Wuhan University, CHINA*

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[1]*University of Electro-Communications, JAPAN and* [2]*University of Tokyo, JAPAN*

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[1]*Georgia Institute of Technology, USA and* [2]*Wuhan University, CHINA*

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[1]*Tsinghua University, CHINA and* [2]*Jiangnan University, CHINA*

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[1]*Institute of Microelectronics, SINGAPORE,* [2]*ST Microelectronics, SINGAPORE, and* [3]*ST Microelectronics, ITALY*

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[1]*Hahn-Schickard Institute for Applied Research e.V., GERMANY and* [2]*University of Freiburg, GERMANY*

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[1]*Robert Bosch GmbH, GERMANY and* [2]*Technical University Chemnitz, GERMANY*

Skyline – Munich, Germany. *Image by Ric Sti from Pixabay*

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