

AUSTIN, TEXAS  21-25 JANUARY

# MEMS 2024



THE 37TH IEEE INTERNATIONAL CONFERENCE ON MICRO ELECTRO MECHANICAL SYSTEMS

# FINAL PROGRAM

## Conference Co-Chairs:

Wen Li

*Michigan State University, USA*

&

Dana Weinstein

*Purdue University, USA*

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MEMS  
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# CONFERENCE AT A GLANCE

## SUNDAY, 21 JANUARY

13:00-17:00	Industry Session
17:00-19:00	Conference Registration and Check-In
17:00-19:00	Welcome Reception

## MONDAY, 22 JANUARY

08:00-08:30	Welcome Address
08:30-08:50	<ul style="list-style-type: none"><li>• IEEE Fellows Recognition in the Field of MEMS/NEMS</li><li>• IEEE EDS Robert Bosch Micro and Nano Electro Mechanical Systems Award</li></ul>
08:50-09:35	Plenary Presentation I <i>Alina Alexeenko – Purdue University, USA</i>
09:35-10:35	Session I - Physical Sensors
10:35-11:15	Break and Exhibit Inspection
11:15-12:30	Session II - RF Acoustic Wave Technology
12:30-13:55	Lunch and Exhibit Inspection
13:55-14:55	Session III - Magnetometers and Novel Structures
14:55-16:55	Poster Session I
16:25-16:55	Break and Exhibit Inspection
16:55-17:00	MEMS Community Announcement
17:00-18:15	Session IV - Biological Sensors
18:15	Adjourn for the day
18:15-19:45	Young Professionals and Industry Mixer

## TUESDAY, 23 JANUARY

08:30-09:15	Plenary Presentation II <i>Chwee Teck Lim – National University of Singapore, SINGAPORE</i>
09:15-10:15	Session V - AI-Enhanced Sensor Technologies
10:15-10:55	Break and Exhibit Inspection
10:55-12:10	Session VI - Wearables
12:10-13:40	Lunch and Exhibit Inspection
13:40-14:55	Session VII - Acoustics and Ultrasound
14:55-16:55	Poster Session II
16:25-16:55	Break and Exhibit Inspection
16:55-18:10	Session VIII - RF MEMS: Tunability and Stability
18:10	Adjourn for the day

# CONFERENCE AT A GLANCE

## WEDNESDAY, 24 JANUARY

08:30-09:15	Plenary Presentation III Kevin Yasumura – <i>Google, USA</i>	
09:15-10:00	Session IX - Optical MEMS	
10:00-10:30	Break and Exhibit Inspection	
10:30-11:45	Session Xa - Applications in Physical MEMS	Session Xb - Novel Materials & Manufacturing
11:45-13:00	Lunch and Exhibit Inspection	
11:45-13:00	Women in Engineering-MEMS Group Networking Event	
13:00-14:00	Session XIa - Thermal Sensors & Actuators	Session XIb - Microfluidics Technologies
14:00-14:10	Transition	
14:10-15:25	Session XIIa - Neural Interface Devices	Session XIIb - MEMS Actuators and Robots
15:25-17:25	Poster Session III	
16:15-16:45	Break and Exhibit Inspection	
17:25	Adjourn for the day	
19:30-22:00	Conference Banquet	

## THURSDAY, 25 JANUARY

08:30-09:15	Plenary Presentation IV Jörg Wrachtrup – <i>University of Stuttgart, GERMANY</i>	
09:15-10:15	Session XIII - Environmental and Biotechnology Innovations	
10:15-10:55	Break and Exhibit Inspection	
10:55-11:55	Session XIV - Novel Sensors	
11:55-12:15	Awards Ceremony and Final Remarks	
12:15	Conference Adjourns	



Austin, Texas. By Reagan; Adobe Stock.

**We are excited to welcome you all to the 37th IEEE  
International Conference on Micro Electro Mechanical  
Systems (MEMS 2024) in Austin, Texas, USA!**

**Since 1987**, this flagship conference has brought the MEMS community together to share in the latest advancements and has created opportunities for networking, professional development, mentorship, collaboration, partnership, entrepreneurship, and sales. Over the last decade, the field has experienced immense progress in the science and technology of miniaturization, as well as increasing technical maturity and commercialization of ever-smarter and more accessible products. More than ever, it is imperative that we use our technical expertise to address Grand Challenges given increasing risks, disasters, and conflicts at the global scale. Can MEMS help to solve critical issues for the environment, electrified and autonomous transport, wireless communication, artificial intelligence and big data, space mining and exploration, quantum computation, pandemics and access to medical treatment, or cyber/hardware security? How do we position ourselves to best leverage the sweeping renewed interest in micromanufacturing, packaging, metrology, and system-on-chip (SoC)/system-in-package (SoP)? How do we continue to thrive as a unified MEMS community given growing tension and competition in our modern socio-economic and political climate?

**We have** an engaging lineup of plenaries aimed at providing some insight into these important questions, seeking the best opportunities for MEMS to maximize its impact. We hope all registrants can partake in Sunday's Industry Session addressing critical needs and opportunities for MEMS. Through two sessions on micromanufacturing and industry innovation, participants from all sectors of the MEMS community will benefit from new and insightful perspectives. We are also grateful for the many high-quality contributed abstracts which round out the technical program. It's always so inspiring to see all the great work generated each year by our community. We're looking forward to many provoking questions and engaging discussions.

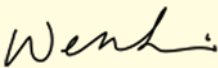
**A total** of 306 papers out of 659 submitted abstracts were carefully selected by 48 experts comprising the Technical Program Committee (TPC) in a double-blind review process that ensures scientific quality. The TPC comprises academic and industrial members, with equal representation from the Americas, Europe & Africa, and Asia & Oceania. We are so grateful to all TPC members who volunteered their valuable time for paper selection. The conference arranges the presentation of accepted papers in a mixed single/parallel session format with four plenary, two invited, 72 oral, 229 poster, and 12 open poster presentations. In addition, the TPC collectively nominated abstract submissions as finalists for the Outstanding Student Paper Awards. These awards recognize excellence amongst work presented by students and will be announced in a special ceremony to conclude the conference late Thursday morning.



**We also** deeply value the generous support of the exhibitors, industrial groups, academic sponsors, and benefactors, without whom the conference would not be possible. Please make sure to stop by the various booths and table-tops and check out the latest and greatest products, resources, and services. We'd like to extend a special thank you to the IEEE MEMS Technical Community (MEMS TC) for their sponsorship of the Women in MEMS event and the Student/Young Professional Industry Networking event. Please consider becoming a member of MEMS TC to receive more information on activities and opportunities in the community and to get involved in defining its future!

**Finally, we** are forever indebted to Sara Stearns, Shirley Galloway, and the rest of the PMMI team for their dedicated and relentless effort in managing this conference.

**We hope you enjoy the networking, technical presentations, exhibition booths, and events of the 2024 IEEE International MEMS Conference this week in Austin!**



**Wen Li**

*Michigan State University, USA*



**Dana Weinstein**

*Purdue University, USA*





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Complimentary wireless internet is available throughout the AT&T Hotel and Conference Center.

- Select “**utguest**” from the list of available networks.
- No password needed.



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 1.5 Mbps per device.

## Conference App Features

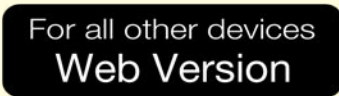
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**Registration & Information Desk**

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, 21 January	17:00 – 19:00
Monday, 22 January	07:00 – 18:15
Tuesday, 23 January	08:00 – 18:10
Wednesday, 24 January	08:00 – 17:25
Thursday, 25 January	08:00 – 12:15

**Breaks**

All scheduled breaks will be held in the Zlotnick Ballroom, Level 1. Coffee will be served during scheduled mid-morning and afternoon breaks only.

**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**

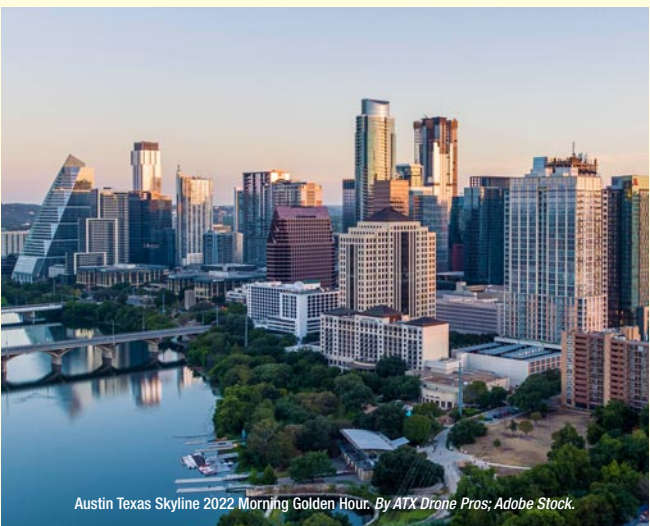
The Job Board will be located in the Zlotnick Ballroom, Level 1. See floor plan at the end of this program.

**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.



Austin Texas Skyline 2022 Morning Golden Hour. By ATX Drone Pros; Adobe Stock.





### **Wine and Cheese Welcome Reception**

Foyer, Level 3  
Sunday, 21 January  
17:00 – 19:00

An informal Welcome Reception will be held in conjunction with registration on Level 3 Foyer at the AT&T Hotel and Conference Center. This will allow you the opportunity to enjoy Austin with your colleagues for the remainder of the evening.

### **Young Professionals and Industry Mixer**

Zlotnick Ballroom, Level 1  
Monday, 22 January  
18:15 – 19:45

Please join us Monday evening for a Young Professionals and Industry Mixer in the Exhibit and Poster Hall. This opportunity is open to students, postdocs, and industry professionals looking to connect, share inspiring ideas, explore exciting advancements in MEMS technologies, and boost your careers.

### **Women in Engineering-MEMS Group Networking Event**

Room 301, Level 3  
Wednesday, 24 January  
11:45 – 13:00

Join us for a Past, Present and Future of MEMS panel discussion. Open to all conference attendees. Lunch will be served.

### **Conference Banquet**

Grand Ballroom, Level 3  
Wednesday, 24 January  
19:30 – 22:00

No conference is complete without a banquet. Join us on Wednesday evening in the Grand Ballroom where you will enjoy a delicious meal and a chance to network with colleagues.

Your registration includes one (1) ticket. 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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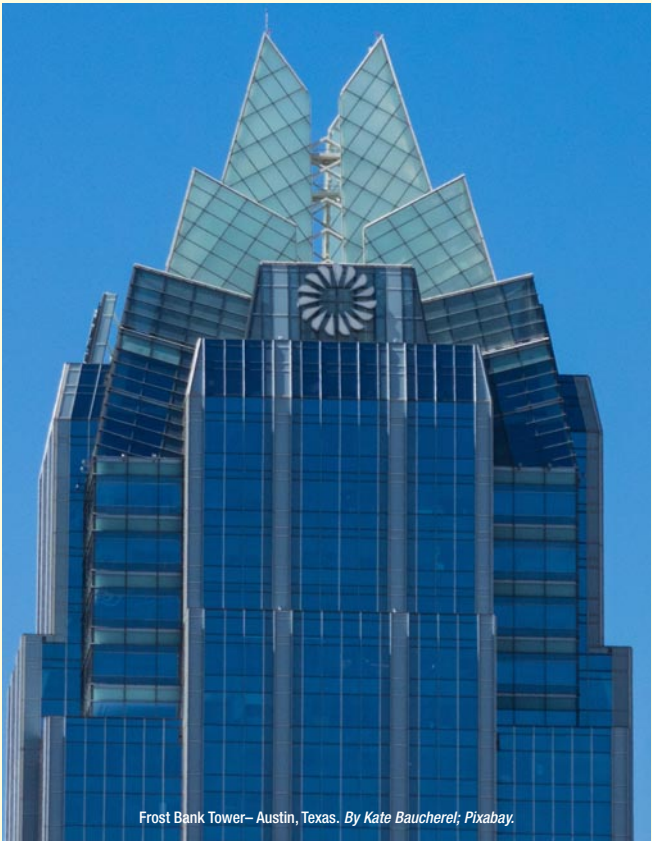
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IEEE Micro Electro Mechanical Systems (MEMS) Technical Community will keep you abreast of the latest in MEMS ideas, designs, and manufacturing methodologies, many of which could very well spark new thinking and enable new capabilities in a myriad of 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.

**Visit IMTC at Booth 32**



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MEMS 2025 / NSTC Taiwan



The National Science and Technology Council (NSTC Taiwan) is a statutory agency of Taiwan for the promotion and funding of academic research, science and technology development, and science parks. The NSTC, together with TECO-Houston (Taipei Economic and Cultural Office in Houston), Association of Chinese American Professionals (ACAP), and NTHU (National Tsing Hua University), have sponsored 2024 IEEE MEMS Conference to further promote the event of the 2025 IEEE MEMS Conference in Kaohsiung, Taiwan.

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## EXHIBIT HOURS

<b>Monday, 22 January</b>	10:00 – 18:00
<b>Tuesday, 23 January</b>	09:45 – 18:00
<b>Wednesday, 24 January</b>	09:30 – 17:30
<b>Thursday, 25 January</b>	09:45 – 11:00

### Exhibitor

### Booth

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<b>Exhibitor</b>	<b>Booth</b>
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<b>IEEE MEMS Technical Community</b> .....	<b>32</b>
	<i>ieeememstc.org</i>

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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<b>IntelliSense Software Corporation</b> .....	<b>28</b>
info@intellisense.com	<i>www.intellisense.com</i>

IntelliSense Software Corporation provides total MEMS Simulation solutions. "IntelliSuite", is our software that seamlessly walks you from designing layout, simulation related to microfabrication, Multiphysics with a link to EDA and 3D package. Our process simulation helps you figure out bottle necks in MEMS fabrication processes and hints to eliminate them completely, thereby optimizing your recipe. The process imperfections are brought into Multiphysics simulation, system integration even package analysis.

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<b>Kayaku Advanced Materials</b> .....	<b>23</b>
sales@kayakuam.com	<i>www.kayakuam.com</i>

Kayaku Advanced Materials manufactures products for MEMS, microelectronics, and semiconductor fabrication. Recent additions to our full line of American-made Photoresists and Specialty Chemicals include KMSF® 2000, a Low Dk/Df Photo-dielectric, TempKoat™ Thick Positive & Negative Plating Resists, and UniLOR® N, a Negative Single-layer Lift-off Resist. Additionally, we distribute DuPont Electronic Materials along with Micro Resist Technology's hybrid polymers and resists.

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<b>KLA Corporation</b> .....	<b>30</b>
info@kla-tencor.com	<i>www.kla.com</i>

KLA Corporation is a leading supplier of wafer processing, process control and yield management solutions for the semiconductor industry. Products for MEMS device manufacturing include Si DRIE and other plasma etch processes; vapor release etch using HF or XeF<sub>2</sub>; molecular vapor deposition (MVD®); plasma-enhanced CVD; PVD processes; and a range of inspection and metrology solutions.





Exhibitor	Booth
<b>Lyncée Tec SA</b> ..... 10 info@lynceetec.com	<i>www.lynceetec.com</i>

**LANYARD BENEFACTOR**

Lyncée Tec – Digital Holographic Microscope (DHM®). Lyncée Tec offers matured holographic microscopes based on the revolutionary patented Digital Holographic Microscope (DHM®) technology as MEMS vibration analyzer and 4D profilometry. Additionally of having a standard product portfolio, Lyncée Tec has expert competences for customizing system to specific needs, and supplies OEM solutions. Lyncée Tec is making the invisible visible enabling you to characterize your samples like you couldn't before!

<b>MEMS 2025 / NSTC Taiwan</b> ..... 31	<i>www.mems25.org</i>
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**DIAMOND BENEFACTOR**

The National Science and Technology Council (NSTC Taiwan) is a statutory agency of Taiwan for the promotion and funding of academic research, science and technology development, and science parks. The NSTC, together with TECO-Houston (Taipei Economic and Cultural Office in Houston), Association of Chinese American Professionals (ACAP), and NTHU (National Tsing Hua University), have sponsored 2024 IEEE MEMS Conference to further promote the event of the 2025 IEEE MEMS Conference in Kaohsiung, Taiwan.

<b>memsstar Ltd</b> ..... 2 info@memsstar.com	<i>www.memsstar.com</i>
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memsstar is a leading supplier of vapour phase processing equipment for the global MEMS industry. With our class leading processing capability, we offer leading edge performance enabling the worlds most advanced MEMS devices. With solutions from lab to fab, contact us for your HF, XeF<sub>2</sub> and SAM coating needs.

<b>Michigan State University – Department of Electrical and Computer Engineering</b> ..... Table Top 3	<i>www.ece.msu.edu</i>
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The Electrical and Computer Engineering (ECE) department has strong interdisciplinary research and educational programs on a foundation of core ECE disciplines and provides first-class education while engaging in research at the frontiers of knowledge. The Department has strong research programs with annual research expenditures of \$16.2M. Current enrollment is approximately 200 full-time graduate students and 860 undergraduate students. For additional information visit <https://ece.msu.edu/>.

<b>microfab Service GmbH</b> ..... 26 info@microfab.de	<i>www.microfab.de</i>
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microfab is an independent service provider of silicon-based MEMS-technology and a global supplier of customised and own developed microsystems. Our production lines, located in three cleanrooms, features state-of-the-art facilities that permit wafers of 100 to 150 mm to be processed. We provide foundation of knowledge & experience, seamless integration from design to fabrication, and technologies unique in the MEMS world.



**Exhibitor** **Booth**

**Microsystems & Nanoengineering/Springer Nature** ..... **3**  
 mine@aircas.ac.cn *www.nature.com/micronano*

Microsystems & Nanoengineering, with a target for a high-end journal for years to come, seeks to promote research on all aspects of microsystems and nanoengineering from fundamental to applied research. This journal will provide a home for the latest research and a platform for more exchange and collaboration among scientists in the new multidisciplinary area. Submit your research today!

**Nextron** ..... **22**  
 sales@nextron.co.kr *www.microprobesystem.com*

NEXTRON has developed researcher-centered equipment. Micro Probe System is suitable to measure and analyze the Electrical & Optical properties of the materials under various environmental conditions; Temperature, Vacuum, Humidity, Gas flow, and Irradiation of light. The inner volume of MPS is less than 100cc, making the target test condition quickly and easily. The uniquely designed manual type probe makes an electrical contact on the sample holding it on the stage at the same time.

**OxideMEMS Lab** ..... **Table Top 1**  
**Purdue University**  
 bhave@purdue.edu *engineering.purdue.edu/oxidemems*

The OxideMEMS Lab at Purdue University explores inter-domain coupling in Opto-mechanical, Spin-Acoustic and YIG-MEMS devices. We strive to leverage our understanding of these coupled systems to design and fabricate inertial, IR and atmospheric sensors, quantum phonon transducers, frequency combs and computing and microwave sub-systems.

**Plasma-Therm** ..... **15**  
 info@plasmatherm.com *www.plasmatherm.com*

Plasma-Therm is a global manufacturer of advanced plasma processing equipment. Its tools and processes are used to support manufacturing needs in etch, deposition, rapid thermal processing, and plasma dicing technologies. The company serves the semiconductor and compound semiconductor industries in developing solutions for several markets including wireless, power device, MEMS, photonics, advanced packaging, and data storage markets.

**Polytec, Inc.** ..... **20**  
 info@polytec.com *www.polytec.com*

Polytec's Micro System Analyzer (MSA) offers robust tools for both dynamic and static characterization of MEMS. The latest addition to our lineup, the MSA-600, introduces advanced measurement capabilities and unparalleled performance. Utilizing laser Doppler vibrometry (LDV), this system delivers real-time response measurement with exceptional resolution down to sub-picometer and a frequency bandwidth extending to 6 GHz. Automated scanning vibrometry ensures comprehensive display and animation of 3D deflection shapes. Additional features for planar motion analysis and topography provide a comprehensive analysis system. Explore the new MSA IRIS Micro System Analyzer, an all-in-one measurement workstation designed for analyzing encapsulated MEMS, fully automated for seamless integration. Visit our booth to discover how our technology's advantages can elevate your application.



<b>Exhibitor</b>	<b>Booth</b>
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<b>Quanscient</b> .....	<b>17</b>
info@quanscient.com	<a href="http://www.quanscient.com">www.quanscient.com</a>

Quanscient Allsolve is a cloud-based FEM multiphysics simulation tool capable of running complex 3D simulations of hundreds of millions of degrees-of-freedom in minutes. MEMS related simulations is a major focus area for Quanscient Allsolve with versatile multiphysics capabilities and STEP / GDS import features.

<b>Research, a Science Partner Journal</b> .....	<b>8</b>
	<a href="http://spj.science.org/journal/research">spj.science.org/journal/research</a>

*Research* is an online Open Access journal distributed by the American Association for the Advancement of Science in association with Science and Technology Review Publishing House, the publishing house under the leadership of China Association for Science and Technology.

<b>Samco, Inc.</b> .....	<b>19</b>
info@samcointl.com	<a href="http://www.samcointl.com">www.samcointl.com</a>

SAMCO Inc. (<https://www.samcointl.com/company-overview/>) is a process equipment company that develops and manufactures dry etching (RIE, ICP, DRIE), thin film deposition (PECVD and ALD) and surface treatment (UV-Ozone, aqua plasma and plasma cleaning) systems for industrial customers and academic facilities. We provide process expertise and turnkey systems to manufacturers of MEMS, microfluidic, compound semiconductor, photonics and silicon devices and are the partners in progress for our customers, from lab to fab.

<b>scia Systems GmbH</b> .....	<b>13</b>
info@scia-systems.com	<a href="http://www.scia-systems.com">www.scia-systems.com</a>

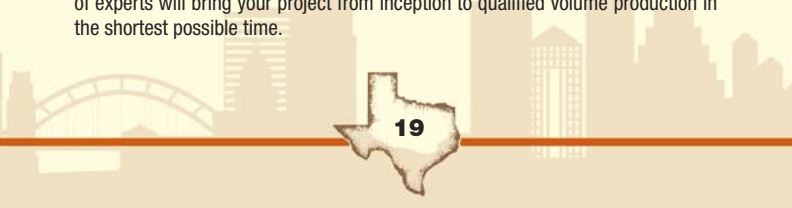
scia Systems develops precise surface processing equipment based on advanced ion beam and plasma technologies. The systems are applicable for coating, etching, and cleaning processes, mainly in the MEMS, microelectronics, and precision optics industries. Due to the flexible and modular design, our process equipment can be configured easily for research applications and high-volume production, for example, in a cluster configuration.

<b>Science Corporation</b> .....	<b>33</b>
foundry@science.xyz	<a href="http://www.science.xyz">www.science.xyz</a>

Science develops advanced technologies to blur the line between medical devices and consumer electronics over time. Our MEMS Foundry is your fastest path from design to device. Choose from our comprehensive multi-project wafers or take advantage of our vast array of capabilities for a custom process run.

<b>Silex Microsystems</b> .....	<b>12</b>
info@silexmicrosystems.com	<a href="http://www.silexmicrosystems.com">www.silexmicrosystems.com</a>

Silex Microsystems is the world's largest pure-play MEMS foundry. MEMS process development requires deep specialized knowledge as a new device goes from concept to volume production. The industry's most extensive line of MEMS manufacturing capabilities combined with our responsive and collaborative team of experts will bring your project from inception to qualified volume production in the shortest possible time.



<b>Exhibitor</b>	<b>Booth</b>
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<b>SilTerra Malaysia Sdn Bhd</b> .....	<b>21</b>
sales_inquiry@silterra.com	<a href="http://www.silterra.com">www.silterra.com</a>

SilTerra, a pure-play wafer foundry, offers various CMOS technologies from 180nm to 110nm nodes. It serves a wide range of end-market applications, including IoT, power management, consumer electronics, medical and communication products. Besides CMOS technologies, SilTerra also provides MEMS foundry services, unique and patented MEMS-on-CMOS technologies, silicon photonics, bio-photonics, and power. Its excellent customer service team helps customers realize working prototypes from proof of concept to high volume manufacturing.

<b>SmarAct Metrology GmbH &amp; Co.KG</b> .....	<b>7</b>
metrology@smaract.com	<a href="http://www.smaract.com/en/metrology">www.smaract.com/en/metrology</a>

The **PICOSCALE Vibrometer** is a turnkey solution to measure vibrations of micromechanical structures with sizes that range from just a few  $\mu\text{m}$  to multiple cm. Applications include the testing of MEMS, sensors, miniature loudspeakers but also bearings and actuators. Because the instrument is equipped with an integrated microscope, it is excellently suited to visualize vibrational modes at high spatial and temporal resolution.

<b>SoftMEMS LLC</b> .....	<b>34</b>
info@softmems.com	<a href="http://www.softmems.com">www.softmems.com</a>

<b>STMicroelectronics</b> .....	<b>29</b>
	<a href="http://www.st.com">www.st.com</a>

**GOLD BENEFACTOR**

At ST, we are more than 50,000 creators and makers of semiconductor technologies mastering the semiconductor supply chain with state-of-the-art manufacturing facilities. An integrated device manufacturer, we work with more than 200,000 customers and thousands of partners to design and build products, solutions, and ecosystems that address their challenges and opportunities, and the need to support a more sustainable world. Our technologies enable smarter mobility, more efficient power and energy management, and the wide-scale deployment of the Internet of Things and connectivity. We are committed to achieving our goal to become carbon neutral on scope 1 and 2 and partially scope 3 by 2027.

<b>Sumitomo Precision Products Co., Ltd.</b> .....	<b>6</b>
mems-infinity@spp.co.jp	<a href="http://www.spp.co.jp/mems/ict/en">www.spp.co.jp/mems/ict/en</a>

**DIAMOND BENEFACTOR**

Sumitomo Precision Products (SPP) group offers a unique lineup of MEMS manufacturing equipment and integrated services for device design, process development, and manufacturing. Using the advantages of its international affiliate companies, SPP group fully supports MEMS businesses—from concept study through prototyping to volume production—to realize their ideas for MEMS devices and related systems.



Exhibitor	Booth
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<b>SUSS MicroTec Inc.</b> ..... 11 <a href="mailto:info@suss.com">info@suss.com</a>	<a href="http://www.suss.com">www.suss.com</a>
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SUSS MicroTec is a leading supplier of equipment and process solutions for microstructuring in the semiconductor industry and related markets. Our portfolio covers a comprehensive range of products and solutions for backend lithography, wafer bonding and photomask processing, complemented by micro-optical components. In close cooperation with research institutes and industry partners SUSS MicroTec contributes to the advancement of next-generation technologies such as 3D Integration and Imprint Lithography as well as key processes for Wafer-Level Packaging, MEMS and LED manufacturing. With its global infrastructure for applications and service, SUSS MicroTec supports more than 8,000 installed systems worldwide.

<b>Teledyne MEMS</b> ..... 16 <a href="mailto:mems_sales@teledyne.com">mems_sales@teledyne.com</a>	<a href="http://www.teledynemems.com">www.teledynemems.com</a>
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**GOLD BENEFACTOR**

Teledyne MEMS (formerly Teledyne DALSA Semiconductor and Teledyne Micralyne) offers unmatched production capability. Whether you need prototyping on 150mm wafers, volume 200mm production, or something in between, Teledyne provides customers a scalable suite of MEMS and microfabrication capabilities to meet your business goals. Our two Canadian locations provide our clients high value, exceptional quality and service while keeping intellectual property secure.

<b>Tousimis</b> ..... 24 <a href="mailto:trc@tousimis.com">trc@tousimis.com</a>	<a href="http://www.tousimis.com">www.tousimis.com</a>
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Tousimis designs and manufactures robust CPD systems for MEMS and other CPD applications. We have been based in the USA since 1962 and supply global sales and service support. Our CPD process is reliable and enables one to eliminate surface tensions forces and preserve delicate Micro-Structures during the drying process.

<b>Ulvac Technologies</b> ..... 4 <a href="mailto:sales@ulvac.us.com">sales@ulvac.us.com</a>	<a href="http://www.ulvac.com">www.ulvac.com</a>
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ULVAC offers the most extensive and comprehensive portfolio of vacuum technologies specializing in vacuum pumps, components, and systems for ashing, etching, PVD, gas analysis, and Helium leak detection. With 6,235 dedicated employees, a strong presence across 41 group companies, and 11 strategic R&D locations, ULVAC is committed to delivering exceptional service and unmatched solutions in the field of vacuum technology.

<b>University of Kansas Nanofabrication Facility</b> ..... <b>Table Top 2</b> <a href="mailto:kunanofab@ku.edu">kunanofab@ku.edu</a>	<a href="http://nanofab.ku.edu">nanofab.ku.edu</a>
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The University of Kansas Nanofabrication Facility (KUNF) primarily caters to researchers who are interested in small-scale manufacturing of micro- and nanofabricated devices. Contract services and usage of the facility are available to researchers from all public and private institutions. Training on fabrication procedures and equipment is provided to all users. The KUNF is supported by the NIH (NIGMS P30GM145499).





**Exhibitor** **Booth**

**VS Particle** ..... **1**  
 info@vsparticle.com *www.vsparticle.com*

VS Particle accelerates materials development to power next-generation products. Our technology enables the generation of nanoparticles from pure materials, which are synthesized and deposited at the push of a button. This allows university researchers and commercial R&D teams across the world to create new materials combinations that form the basis of new, revolutionary solutions.

**Zurich Instruments** ..... **14**  
 info@zhinst.com *www.zhinst.com/americas/en*

Zurich Instruments makes cutting-edge instrumentation for scientists and technologists who work in advanced laboratories and are passionate about phenomena often difficult to measure. Our offering includes lock-in amplifiers, arbitrary waveform generators, impedance analyzers, phase-locked loops, digitizers, boxcar averagers, and quantum computing control systems.



Bullock Texas State History Museum – Austin, Texas. *By f11photo; Adobe Stock.*



**MONDAY, 22 JANUARY — 08:50 – 09:35**

**PLENARY PRESENTATION I**



**Alina Alexeenko**

*Purdue University, USA*

**POWER MEMS FOR CISLUNAR  
SPACE UTILIZATION**

**TUESDAY, 23 JANUARY — 08:30 – 09:15**

**PLENARY PRESENTATION II**



**Chwee Teck Lim**

*National University of Singapore,  
SINGAPORE*

**TRANSFORMING HEALTHCARE  
WITH SMART WEARABLES AND  
THE HEALTH METAVERSE**

**WEDNESDAY, 24 JANUARY — 08:30 – 09:15**

**PLENARY PRESENTATION III**



**Kevin Yasumura**

*Google, USA*

**LIGHTWAVE FABRICS: AT-SCALE OPTICAL  
CIRCUIT SWITCHING FOR DATACENTER  
AND MACHINE LEARNING SYSTEMS**

**THURSDAY, 25 JANUARY — 08:30 – 09:15**

**PLENARY PRESENTATION IV**



**Jörg Wrachtrup**

*University of Stuttgart, GERMANY*

**APPLYING QUANTUM TECHNOLOGIES**



WEDNESDAY, 24 JANUARY — 10:30 – 11:00



INVITED SPEAKER

**Xin Zhang**

*Boston University, USA*

TOWARDS FUNCTIONAL  
METAMATERIALS AND METADEVICES

WEDNESDAY, 24 JANUARY — 11:15 – 11:45



INVITED SPEAKER

**Xiuling Li**

*University of Texas, Austin, USA*

S-RUM TECHNOLOGY FOR EXTREME  
MINIATURIZATION AND INTEGRATION  
OF PASSIVE ELECTRONICS AND  
MICROFLUIDICS



McKinney Falls State Park – Austin, Texas. By Zak Zeinert; Adobe Stock.



# THE 2024 IEEE *Robert Bosch* MICRO and NANO ELECTRO MECHANICAL SYSTEMS AWARD



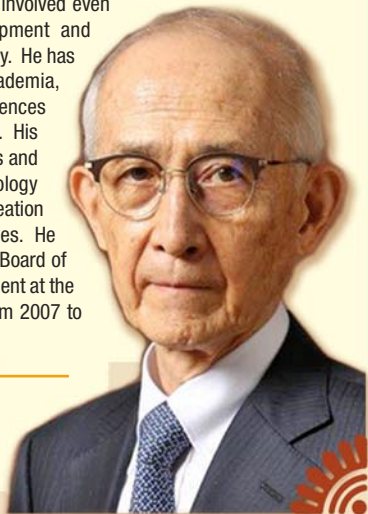
The Robert Bosch Micro and Nano Electro Mechanical Systems Award was established by the IEEE Electron Devices Society in 2014 to recognize and honor advances in the invention, design, and/or fabrication of micro- or nano- electromechanical systems and/or devices.

The 2024 Bosch Award will be presented on  
Monday, 22 January at 08:30.

## SUSUMU KAMINAGA

For Development and Commercialization of  
Deep Reactive Ion Etching Technology

**Susumu Kaminaga** studied mechanical engineering at the University of Tokyo before joining Sumitomo Precision Products (SPP), Japan in 1969. Through his career with technological background in the industry, he made a lot of achievements for MEMS, especially, R&D and commercialization of deep reactive ion etching (DRIE) technology based on Robert Bosch invented Bosch Process. Initially, he ran Surface Technology Systems (STS) in U.K. to take initiative of the R&D and commercialization of DRIE technology under collaboration with Robert Bosch. The world first DRIE tool was introduced into the market in 1995. The technology has enabled many new MEMS devices to emerge and contribute to rapid growth of MEMS application for automotive, inkjet printers, displays, smartphones, healthcare and IoT. It has been said in the MEMS society that those applications could not be made available without the development and commercialization of DRIE technology. He founded SPTS Technologies and SPP Technologies (SPT) as SPP's affiliated companies to focus on further development and commercialization of MEMS technologies. He is keeping involved even now in supporting further development and commercialization of DRIE technology. He has given hundreds of speeches at academia, industry and international conferences including many IEEE organized ones. His talks inspired researchers, engineers and managers to develop MEMS technology for the purpose of new business creation in the world of IoT and smart societies. He was a member of External Advisory Board of the Mechanical Engineering Department at the University of California, Berkeley from 2007 to 2014.



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



### Oral Sessions

Oral sessions will be held in the Grand Ballroom, Level 3, with the Wednesday parallel concurrent sessions in Amphitheater 204, Level 2. See floor plans at the end of this program

### Posters

Three (3) poster sessions will be held in the Zlotnick Ballroom, Level 1 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.



**SUNDAY AT A GLANCE**

13:00-17:00	Industry Session
17:00-19:00	Conference Registration and Check-In
17:00-19:00	Welcome Reception

**SUNDAY**



**SUNDAY, 21 JANUARY**

12:45 Welcome and Introduction

**INDUSTRY SESSION I:  
A NEW ERA IN MEMS MANUFACTURING AND PACKAGING**

Session Chairs:  
Andreu Llobera, *Silicon Austria Labs, AUSTRIA*

Amphitheatre 204, Level 2

**13:00 MEMS & SENSORS INDUSTRY GROUP UPDATE ON MEMS MARKET AND INDUSTRY SUPPORT INITIATIVES**  
Tim Brosnihan  
*SEMI MEMS and Sensors Industry Group, USA*

**13:20 HOW DO WE PROVIDE EASIER ACCESS TO MEMS PROTOTYPING AND PACKAGING?**  
Gordon Harling  
*CMC Microsystems, CANADA*

**13:40 HOW TO COMBINE OUR STRENGTHS IN NORTH AMERICA TO HAVE A COMPLETE AND EFFICIENT SEMICONDUCTOR ECOSYSTEM**  
Alan Renaudin  
*G2MI, CANADA*

**14:00 BONDED SOI AND CAVITY SOI WAFERS ENABLING ENHANCED MEMS DESIGNS**  
Petri Santala  
*Okmetic, USA*

14:20 Panel Discussion

14:45 Break







## INDUSTRY SESSION II: COMPETITIVE INNOVATION IN MEMS INDUSTRY

Session Chairs:

Tim Brosnihan, *SEMI MEMS and Sensors Industry Group, USA*

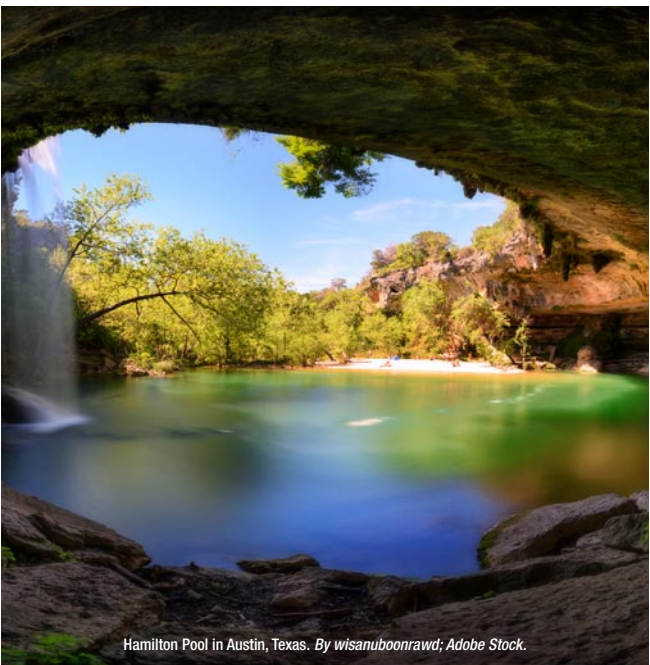
Amphitheatre 204, Level 2

- 15:15 NEW APPLICATION SPACES IN AUTOMOTIVE, INDUSTRIAL & MEDICAL SEGMENTS REQUIRING IMMUTABLE MEMS/SENSORS**  
Sandra Vos  
*NXP, USA*
- 15:35 MEMS BASED SMART SENSOR SYSTEM AND ITS FUTURE**  
Shanshan Gu-Stoppel  
*Fraunhofer Institute for Silicon Technology (ISIT), GERMANY*
- 15:55 FAST-TRACKING TIME-TO-MARKET AND MITIGATING DEVELOPMENT RISK IN MEMS: TACTICS THAT WIN**  
Andrew Fung  
*AMFitzgerald, USA*
- 16:15 INNOVATIVE MEMS BASED ON GRAPHENE AND 2D MATERIALS**  
Aravind Vijayaraghavan  
*Atomic Mechanics Ltd. and University of Manchester, UK*

**16:35 Panel Discussion**

**17:00 – 19:00 Conference Registration and Check-In**

**17:00 – 19:00 Welcome Reception**



Hamilton Pool in Austin, Texas. By wisanuboonrawd; Adobe Stock.



**MONDAY AT A GLANCE**

**MONDAY**

08:00-08:30	<b>Welcome Address</b>
08:30-08:50	<ul style="list-style-type: none"> <li>• IEEE Fellows Recognition in the Field of MEMS/NEMS</li> <li>• IEEE EDS Robert Bosch Micro and Nano Electro Mechanical Systems Award</li> </ul>
08:50-09:35	<b>Plenary Presentation I</b> Alina Alexeenko – <i>Purdue University, USA</i>
09:35-10:35	<b>Session I - Physical Sensors</b>
10:35-11:15	<b>Break and Exhibit Inspection</b>
11:15-12:30	<b>Session II - RF Acoustic Wave Technology</b>
12:30-13:55	<b>Lunch and Exhibit Inspection</b>
13:55-14:55	<b>Session III - Magnetometers and Novel Structures</b>
14:55-16:55	<b>Poster Session I</b>
16:25-16:55	<b>Break and Exhibit Inspection</b>
16:55-17:00	<b>MEMS Community Announcement</b>
17:00-18:15	<b>Session IV - Biological Sensors</b>
18:15	<b>Adjourn for the day</b>
18:15-19:45	<b>Young Professionals and Industry Mixer</b>



**MONDAY, 22 JANUARY**

**Welcome Address**

**Grand Ballroom, Level 3**

**08:00 MEMS 2024 Conference Chairs**  
 Wen Li, *Michigan State University, USA*  
 Dana Weinstein, *Purdue University, USA*





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

Grand Ballroom, Level 3

- 08:30** IEEE EDS Robert Bosch Micro and Nano Electro Mechanical Systems Award Recipient  
**Susumu Kaminaga** – SPP Technologies Co., Ltd., JAPAN

### Plenary Presentation I

Chair: Dana Weinstein, *Purdue University, USA*

Grand Ballroom, Level 3

- 08:50** POWER MEMS FOR Cislunar SPACE UTILIZATION  
**Alina Alexeenko**  
*Purdue University, USA*

### Session I - Physical Sensors

Chair: Sunil Bhawe, *Purdue University, USA*

Grand Ballroom, Level 3

- 09:35** TA 0.34DEG/HOUR BULK ACOUSTIC WAVE GYROSCOPE IN 4H SILICON-CARBIDE WITH AN ELEVATED-TEMPERATURE ENHANCED  $Q$ -FACTOR OF 4.6 MILLION  
 Zhenming Liu<sup>1,2</sup>, Yaoyao Long<sup>1</sup>, Charlotte M. Wehner<sup>1</sup>, Haoran Wen<sup>2</sup>, and Farrokh Ayazi<sup>1,2</sup>  
<sup>1</sup>*Georgia Institute of Technology, USA and*  
<sup>2</sup>*StethX Microsystem Inc., USA*
- 09:50** 0.018 °/√hr, SUB-0.2 °/hr MEMS PITCH/ROLL PIEZORESISTIVE GYROSCOPE WITH DECOUPLED TILT OF THE MASS AND OF THE GAUGES LEVER  
 Marco Gadola<sup>1</sup>, Andrea Buffoli<sup>1,2</sup>, Thierry Verdot<sup>2</sup>, Philippe Robert<sup>2</sup>, Marc Sansa<sup>2</sup>, and Giacomo Langfelder<sup>1</sup>  
<sup>1</sup>*Politecnico di Milano, ITALY and*  
<sup>2</sup>*CEA-Leti, Université Grenoble Alpes, FRANCE*
- 10:05** A MECHANICALLY AMPLIFIED QUAD MASS GYROSCOPE WITH PARAMETRIC  $\Sigma$ - $\Delta$  MODULATION FOR OFFSET DRIFT CANCELLATION  
 Fang Chen<sup>1,2</sup>, Jingchuan Zhou<sup>1,2</sup>, Wei Zhou<sup>1,2</sup>, Ruihong Xiong<sup>1,2</sup>, and Xinxin Li<sup>1,2</sup>  
<sup>1</sup>*Chinese Academy of Sciences, CHINA and*  
<sup>2</sup>*University of Chinese Academy of Sciences, CHINA*
- 10:20** IN-PLANE AND OUT-OF-PLANE FM ACCELEROMETERS WITH 130 DB DYNAMIC RANGE THROUGH NEMS-BASED OSCILLATORS  
 Christian Padovani<sup>1</sup>, Leonardo Gaffuri Pagani<sup>1</sup>, Marc Sansa<sup>2</sup>, Patrice Rey<sup>2</sup>, Philippe Robert<sup>2</sup>, and Giacomo Langfelder<sup>2</sup>  
<sup>1</sup>*Politecnico di Milano, ITALY and*  
<sup>2</sup>*CEA-Leti, Université Grenoble Alpes, FRANCE*

- 10:35** Break & Exhibit Inspection





**Session II - RF Acoustic Wave Technology**  
Chair: Ruochen Lu, *University of Texas, Austin, USA*

Grand Ballroom, Level 3

- 11:15 TRANSFERRED THIN FILM LITHIUM NIOBATE AS MILLIMETER WAVE ACOUSTIC FILTER PLATFORMS**  
Omar Barrera<sup>1</sup>, Sinwoo Cho<sup>1</sup>, Kenny Hyunh<sup>2</sup>, Jack Kramer<sup>1</sup>, Michael Liao<sup>2</sup>, Vakhtang Chulukhadze<sup>1</sup>, Lezli Matto<sup>2</sup>, Mark S. Goorsky<sup>2</sup>, and Ruochen Lu<sup>1</sup>  
<sup>1</sup>*University of Texas, Austin, USA and*  
<sup>2</sup>*University of California, Los Angeles, USA*
- 11:30 A DISPERSION-ENGINEERED YX-LN/SIO2/SAPPHIRE SH-SAW RESONATOR FOR ENHANCED ELECTROMECHANICAL COUPLING AND RAYLEIGH MODE SUPPRESSION**  
Tzu-Hsuan Hsu<sup>1,2</sup>, Zhi-Qiang Lee<sup>1</sup>, Chia-Hsien Tsai<sup>1</sup>, Vakhtang Chulukhadze<sup>2</sup>, Cheng-Chien Lin<sup>1</sup>, Ya-Ching Yu<sup>1</sup>, Ruochen Lu<sup>2</sup>, and Ming-Huang Li<sup>1</sup>  
<sup>1</sup>*National Tsing Hua University, TAIWAN and*  
<sup>2</sup>*University of Texas, Austin, USA*
- 11:45 UP-SCALING MICROACOUSTICS: 20 TO 35 GHZ ALN RESONATORS WITH  $f \cdot Q$  PRODUCTS EXCEEDING 14 THZ**  
Gabriel Giribaldi<sup>1</sup>, Luca Colombo<sup>1</sup>, Matteo Castellani<sup>2</sup>, Mohammed Ayaz Masoud<sup>3</sup>, Gianluca Piazza<sup>3</sup>, and Matteo Rinaldi<sup>1</sup>  
<sup>1</sup>*Northeastern University, USA,* <sup>2</sup>*Massachusetts Institute of Technology, USA, and* <sup>3</sup>*Carnegie Mellon University, USA*
- 12:00 OVER-1 GHZ BANDWIDTH FILTER BASED ON Y-128° CUT LITHIUM NIOBATE ON AMORPHOUS SILICON**  
Junyan Zheng, Jiashuai Xu, Fangsheng Qian, and Yansong Yang  
*Hong Kong University of Science and Technology, HONG KONG*
- 12:15 A THIN-FILM LITHIUM NIOBATE ON INSULATOR MULTIMODE SH-SAW RESONATOR EXPLOITING GRATING WAVEGUIDE STRUCTURE**  
Cheng-Chien Lin, Tzu-Hsuan Hsu, Zhi-Qiang Lee, Chia-Hsien Tsai, Ya-Ching Yu, Shao-Shiang Tung, and Ming-Huang Li  
*National Tsing Hua University, TAIWAN*

**12:30 Lunch & Exhibit Inspection**

**Session III - Magnetometers and Novel Structures**  
Chair: Franz Laermer, *Robert Bosch GmbH, GERMANY*

Grand Ballroom, Level 3

- 13:55 A TWO-AXIS SENSING MEMS MAGNETOMETER WITH MONOLITHIC MOVING PARTS IN ORTHOGONAL RESONANCE ORDER**  
Yohan Jung, Eunhwan Jo, and Jongbaeg Kim  
*Yonsei University, KOREA*



## Session III (continued)

- 14:10 3D HALL-EFFECT MAGNETOMETER USING A SINGLE INVERTED PYRAMID STRUCTURE**  
Jacopo Ruggeri, Jannik Strube, and Karen M. Dowling  
*Delft University of Technology, NETHERLANDS*
- 14:25 USING PEACOCK SHAPE ANISOTROPIC MAGNETORESISTANCE (AMR) AND NI MUSHROOM ARRAY TO ACHIEVE TRI-AXIS MAGNETIC SENSOR**  
Shihwei Lin, Meifeng Lai, and Weileun Fang  
*National Tsing Hua University, TAIWAN*
- 14:40 FABRICATION OF FLEXIBLE AND REENTRANT LIQUID-SUPERREPELLENT SURFACES ENABLED BY PROXIMITY AND SOFT LITHOGRAPHY**  
Kai Liu, Baoqing Li, and Jiaru Chu  
*University of Science and Technology of China, CHINA*

## Poster/Oral Session I

Zlotnick Ballroom, Level 1

- 14:55 Poster/Oral Session I**  
Poster presentations are listed by topic category with their assigned number starting on Page 50.

- 16:25 Break & Exhibit Inspection**

## MEMS Community Announcement

Grand Ballroom, Level 3

- 16:55** Clark T.-C. Nguyen, *University of California, Berkeley, USA*

## Session IV - Biological Sensors

Chair: Andreu Llobera, *Silicon Austria Labs, AUSTRIA*

Grand Ballroom, Level 3

- 17:00 MICROWELL-PATTERNED MICROFLUIDIC DEVICE FOR RAPID IDENTIFICATION OF HIGH-AFFINITY ANTI-TUMOR T CELLS**  
Kavya L. Singampalli<sup>1,2</sup>, Desh Deepak Dixit<sup>1</sup>, Peixin Jiang<sup>3</sup>, Alexandre Reuben<sup>3</sup>, and Peter B. Lillehoj<sup>1</sup>  
<sup>1</sup>Rice University, USA, <sup>2</sup>Baylor College of Medicine, USA, and <sup>3</sup>University of Texas MD Anderson Cancer Center, USA
- 17:15 FLOW CYTOMETRIC MECHANO-INDEXING REVEALS TIME-TRANSITION OF BIOPARTICLES**  
Nariaki Kiyama<sup>1</sup>, Makoto Saito<sup>1</sup>, Niko Kimura<sup>1,2</sup>, Yoko Yamanishi<sup>1</sup>, and Shinya Sakuma<sup>1</sup>  
<sup>1</sup>Kyushu University, JAPAN and <sup>2</sup>Tokyo University of Agriculture and Technology, JAPAN
- 17:30 A SERF-BASED MAGNETIC SCANNING PLATFORM FOR MULTIPLE CARDIOVASCULAR DISEASE BIOMARKER DETECTION**  
Bo Bao, Ridong Wang, and Dachao Li  
*Tianjin University, CHINA*

**Session IV (continued)**

- 17:45**    **FREESTANDING MICRO-CALORIMETER FOR BIO-THERMAL DETECTION WITH SINGLE THERMOCOUPLE STRUCTURE**  
 Jingru Liao, Zhen Peng, Yuanlin Xia, Cao Xia, Yubo Huang, Dan Liu, and Zhuqing Wang  
*Sichuan University, CHINA*
- 18:00**    **STUDY OF A SINGLE-INPUT SINGLE-OUTPUT SENSING SCHEME FOR THREE ANALYTES VIA NONLINEAR MODE LOCALIZATION**  
 Gang Xiao<sup>1</sup>, Han Gao<sup>1</sup>, Wei Zhang<sup>1</sup>, Lijia Zhang<sup>1</sup>, Jie Song<sup>2</sup>, Yuanlin Xia<sup>1</sup>, Cao Xia<sup>1</sup>, and Zhuqing Wang<sup>1</sup>  
<sup>1</sup>*Sichuan University, CHINA* and <sup>2</sup>*Jiangsu University, CHINA*

**18:15**    **Adjourn for the Day**

**Young Professionals and Industry Mixer**

Zlotnick Ballroom, Level 1

- 18:15 –**    **Young Professionals and Industry Mixer**  
**19:45**    Sponsored by IEEE MEMS Technical Community

See page 7 for additional information.



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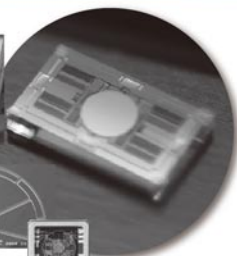
**MONDAY**



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**TUESDAY AT A GLANCE**

08:30-09:15	<b>Plenary Presentation II</b> Chwee Teck Lim – <i>National University of Singapore, SINGAPORE</i>
09:15-10:15	<b>Session V - AI-Enhanced Sensor Technologies</b>
10:15-10:55	<b>Break and Exhibit Inspection</b>
10:55-12:10	<b>Session VI - Wearables</b>
12:10-13:40	<b>Lunch and Exhibit Inspection</b>
13:40-14:55	<b>Session VII - Acoustics and Ultrasound</b>
14:55-16:55	<b>Poster Session II</b>
16:25-16:55	<b>Break and Exhibit Inspection</b>
16:55-18:10	<b>Session VIII - RF MEMS: Tunability and Stability</b>
18:10	<b>Adjourn for the day</b>

**TUESDAY**



**TUESDAY, 23 JANUARY**

**Plenary Presentation II**  
Chair: Wen Li, *Michigan State University, USA*

Grand Ballroom, Level 3

**08:30** **TRANSFORMING HEALTHCARE WITH SMART WEARABLES AND THE HEALTH METAVERSE**

**Chwee Teck Lim**  
*National University of Singapore, SINGAPORE*





### Session V - AI-Enhanced Sensor Technologies

Chair: John Zhang, *Dartmouth College, USA*

Grand Ballroom, Level 3

- 09:15 FLUID VISCOSITY AND DENSITY DETERMINATION WITH MACHINE LEARNING-ENHANCED CORIOLIS MASS FLOW SENSORS**  
 Romas Zubavicius<sup>1</sup>, Dennis Alveringh<sup>1</sup>, Mannes Poel<sup>1</sup>,  
 Jarno Groenesteijn<sup>1,2</sup>, Remco G.P. Sanders<sup>1</sup>,  
 Remco J. Wiegerink<sup>1</sup>, and Joost C. Lötters<sup>1,2</sup>  
<sup>1</sup>University of Twente, NETHERLANDS and <sup>2</sup>Bronkhorst High-Tech  
 BV, NETHERLANDS
- 09:30 MICROFLUIDIC DEVICE FOR FLOW-BASED IMMUNE CELL QUANTIFICATION IN WHOLE BLOOD USING MACHINE LEARNING**  
 Desh Deepak Dixit, Tyler P. Graf, Kevin  
 J. McHugh, and Peter B. Lillehoj  
*Rice University, USA*
- 09:45 A CUFFLESS BLOOD PRESSURE MONITORING EPIDERMAL PATCH ENABLED BY DEEP LEARNING**  
 Sudeep Sharma, Gagan Bahadur Pradhan, Seonghoon Jeong,  
 and Jae Yeong Park  
*Kwangwoon University, KOREA*
- 10:00 AN AI-ENHANCED HYDROGEL E-SKIN FOR INTEGRATION OF TACTILE PERCEPTION AND UAV CONTROL VIA TRIBOELECTRIFICATION**  
 Jiyuan Zhang, Jiahao Yu, Wen Zeng, Bowen Ji,  
 Honglong Chang, and Kai Tao  
*Northwestern Polytechnical University, CHINA*

**10:15 Break & Exhibit Inspection**

### Session VI - Wearables

Chair: Karsten Seidl, *Fraunhofer IMS /  
 University of Duisburg-Essen, GERMANY*

Grand Ballroom, Level 3

- 10:55 A NOVEL ALL SILICON BONE CONDUCTION MICROPHONE WITH BROAD BANDWIDTH (100HZ~10KHZ)**  
 Sung-Cheng Lo<sup>1</sup>, Hsi-Wen Tung<sup>1</sup>, Hung-Yu Lin<sup>1</sup>, Feng-Chieh Su<sup>1</sup>,  
 Chung-Chieh Chen<sup>1</sup>, and Weileun Fang<sup>2</sup>  
<sup>1</sup>Upbeat Technology Co., Ltd., TAIWAN and  
<sup>2</sup>National Tsing Hua University, TAIWAN
- 11:10 WEARABLE STETHOSCOPE BASED ON RESONANT MICROPHONE ARRAY WITH WIRELESS DATA TRANSFER**  
 Anik Sengupta, Akash Roy, Hongxiang Gao, Matin Barekataan,  
 Hai Liu, and Eun Sok Kim  
*University of Southern California, USA*



## Session VI (continued)

- 11:25 A POROUS SEBS-BASED BREATHABLE TRIBOELECTRIC NANOGENERATOR FOR HUMAN GESTURE RECOGNITION**  
Kumar Shrestha, Gagan Bahadur Pradhan,  
Md Selim Raza, and Jae Yeong Park  
*Kwangwoon University, KOREA*
- 11:40 AN ARTERIAL STIFFNESS MEASURING WRISTWATCH WITH FLEXIBLE TACTILE SENSING DENSE-ARRAY**  
Yi Sun<sup>1</sup>, Ke Sun<sup>1</sup>, Fang Wang<sup>1,2</sup>, Yue He<sup>1,3</sup>, Heng Yang<sup>1,2</sup>,  
Xikun Zheng<sup>4</sup>, Jingqing Hu<sup>4</sup>, and Xinxin Li<sup>1,2,4</sup>  
<sup>1</sup>*Chinese Academy of Sciences, CHINA*, <sup>2</sup>*University of Chinese Academy of Sciences, CHINA*, <sup>3</sup>*Jiangsu University, CHINA*, and <sup>4</sup>*Xin-Huangpu Joint Innovation Institute of Chinese Medicine, CHINA*
- 11:55 STRETCHABLE MXENE/PVDF PIEZOELECTRIC SENSOR FOR FINGER MOTION DETECTION AND TACTILE RECOGNITION**  
Yizhi Li, Xingyu Bai, Jingquan Liu, and Bin Yang  
*Shanghai Jiao Tong University, CHINA*

**12:10 Lunch & Exhibit Inspection**

## Session VII - Acoustics and Ultrasound

Chair: Cristian Cassella, *Northeastern University, USA*

Grand Ballroom, Level 3

- 13:40 A NANOFORREST-BASED HUMIDITY SENSOR FOR SILENT SPEECH DETECTION AND RECOGNITION**  
Fengyu Liu<sup>1,2</sup>, Guidong Chen<sup>1,2</sup>, Yizhi Shi<sup>1,2</sup>, Meng Shi<sup>1,2</sup>,  
Na Zhou<sup>1,2</sup>, Chengjun Huang<sup>1,2</sup>, and Haiyang Mao<sup>1,2</sup>  
<sup>1</sup>*Chinese Academy of Sciences, CHINA* and  
<sup>2</sup>*University of Chinese Academy of Sciences, CHINA*
- 13:55 INKJET-PRINTED, PAPER-BASED THERMOACOUSTIC LOUDSPEAKERS WITH MECHANICAL ROBUSTNESS AND VERSATILE FORM-FACTOR**  
Hyungyu Im<sup>1</sup>, Eunhwan Jo<sup>1</sup>, Yunsung Kang<sup>2</sup>, and Jongbaeg Kim<sup>1</sup>  
<sup>1</sup>*Yonsei University, KOREA* and <sup>2</sup>*Kyungpook National University, KOREA*
- 14:10 9-METER-LONG 3D ULTRASONIC OBJECTS DETECTION VIA PACKAGED LITHIUM-NIOBATE PMUTS**  
Yande Peng<sup>1</sup>, Hanxiao Liu<sup>1</sup>, Chun-Ming Chen<sup>1</sup>, Wei Yue<sup>1</sup>,  
Megan Teng<sup>1</sup>, Pei-Chi Tsao<sup>1</sup>, Seiji Umezawa<sup>2</sup>,  
Shinsuke Ikeuchi<sup>2</sup>, Yasuhiro Aida<sup>2</sup>, and Liwei Lin<sup>1</sup>  
<sup>1</sup>*University of California, Berkeley, USA* and  
<sup>2</sup>*Murata Manufacturing Co., Ltd., JAPAN*
- 14:25 SONIC FOURIER TRANSFORM IMAGING USING GHZ ULTRASONIC TRANSDUCER ARRAY**  
Juneho Hwang<sup>1</sup>, Justin Kuo<sup>2</sup>, Anuj Baskota<sup>2</sup>, and Amit Lal<sup>1</sup>  
<sup>1</sup>*Cornell University, USA* and <sup>2</sup>*Geegah Inc., USA*



## Session VII (continued)

**14:40 FAR-FIELD ACOUSTIC SENSING VIA PMUT-BASED SUBHARMONIC TAGS: A BATTERY-FREE APPROACH FOR HYBRID RF-ULTRASOUND WIRELESS SENSOR NETWORKS**

Hussein M. E. Hussein<sup>1</sup>, Omer Mohamed Osman Abdalla<sup>2</sup>,  
Pietro Simeoni<sup>1</sup>, Luca Colombo<sup>1</sup>, Alberto Corigliano<sup>2</sup>,  
Matteo Rinaldi<sup>1,3</sup>, and Cristian Cassella<sup>1</sup>

<sup>1</sup>*Northeastern University, USA*, <sup>2</sup>*Politecnico di Milano, ITALY*, and

<sup>3</sup>*Institute for NanoSystems Innovation, USA*

## Poster/Oral Session II

Zlotnick Ballroom, Level 1

**14:55 Poster/Oral Session II**

Poster presentations are listed by topic category with their assigned number starting on Page 50.

**16:25 Break & Exhibit Inspection**

**Session VIII - RF MEMS: Tunability and Stability**

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

Grand Ballroom, Level 3

**16:55 AN INSTINCTUALLY ADAPTIVE LAMB-WAVE FILTER USING NONLINEAR HAFNIA-ZIRCONIA FERROELECTRIC TRANSDUCER**

Troy Tharpe and Roozbeh Tabrizian  
*University of Florida, USA*

**17:10 TCF-TAILORING VERTICALLY STEPPED STRUCTURES FOR TEMPERATURE INSENSITIVE CMOS-MEMS RESONATORS**

Kai-Wei Lan, I-Fei Chung, Chun-Pu Tsai, Ting-Yi Chen,  
and Wei-Chang Li  
*National Taiwan University, TAIWAN*

**17:25 TEMPERATURE COMPENSATION USING AN IN-SITU GAP-BASED TEMPERATURE SENSOR**

Xintian Liu, Qianyi Xie, Alper Ozgurluk, Qiutong Jin,  
and Clark T.-C. Nguyen  
*University of California, Berkeley, USA*

**17:40 TEMPERATURE AND BIAS-DEPENDENT SWITCHABILITY AND TUNEABILITY OF VERY HIGH-QUALITY FACTOR GHZ RESONATORS**

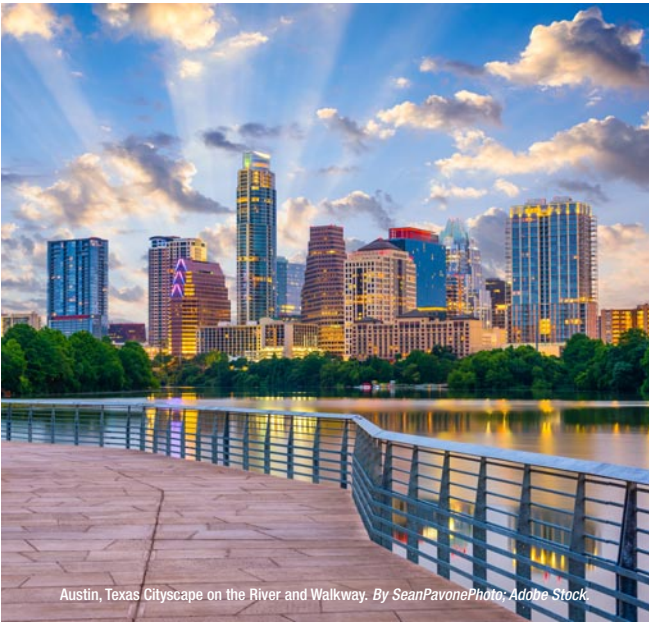
Kongbrailatpam Sandeep Sharma<sup>1</sup>, Akhil Raman T.S.<sup>2</sup>,  
Chandrashekar L.N.<sup>1</sup>, James Raju K.C.<sup>2</sup>, and Gayathri Pillai<sup>1</sup>  
<sup>1</sup>*Indian Institute of Science, Bengaluru, INDIA* and  
<sup>2</sup>*University of Hyderabad, INDIA*

**17:55 ULTRA-HIGH Q SELF-OVENIZED ALSCN-ON-SI X-LAMÉ RESONATOR FOR STABLE CLOCK GENERATION**

Shaurya Dabas, Dicheng Mo, Baibhab Chatterjee,  
and Roozbeh Tabrizian  
*University of Florida, USA*

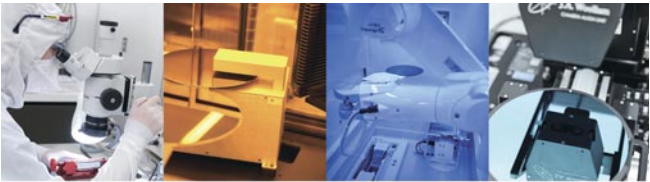


18:10 Adourn for the Day



Austin, Texas Cityscape on the River and Walkway. By SeanPavonePhoto: Adobe Stock.

**TUESDAY**



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**TUESDAY**

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## WEDNESDAY AT A GLANCE

08:30-09:15	Plenary Presentation III Kevin Yasumura – <i>Google, USA</i>	
09:15-10:00	Session IX - Optical MEMS	
10:00-10:30	Break and Exhibit Inspection	
10:30-11:45	Session Xa - Applications in Physical MEMS	Session Xb - Novel Materials & Manufacturing
11:45-13:00	Lunch and Exhibit Inspection	
11:45-13:00	Women in Engineering-MEMS Group Networking Event	
13:00-14:00	Session XIa - Thermal Sensors & Actuators	Session XIb - Microfluidics Technologies
14:00-14:10	Transition	
14:10-15:25	Session XIIa - Neural Interface Devices	Session XIIb - MEMS Actuators and Robots
15:25-17:25	Poster Session III	
16:15-16:45	Break and Exhibit Inspection	
17:25	Adjourn for the day	
19:30-22:00	Conference Banquet	

WEDNESDAY



## WEDNESDAY, 24 JANUARY

### Plenary Presentation III

Chair: Wen Li, *Michigan State University, USA*

Grand Ballroom, Level 3

**08:30 LIGHTWAVE FABRICS: AT-SCALE OPTICAL CIRCUIT SWITCHING FOR DATACENTER AND MACHINE LEARNING SYSTEMS**  
 Hong Liu, Ryohei Urata, **Kevin Yasumura**, Xiang Zhou, Roy Bannon, Jill Berger, Pedram Dashti, Norm Jouppi, Cedric Lam, Sheng Li, Erji Mao, Daniel Nelson, George Papen, Mukarram Tariq, and Amin Vahdat  
*Google, USA*





### Session IX - Optical MEMS

Chair: Kentaro Iwami, *Tokyo University of Agriculture and Technology, JAPAN*

Grand Ballroom, Level 3

- 09:15**    **3.8×3.8 MM<sup>2</sup> TINY PIEZOELECTRIC RESONANT MEMS SCANNER USING FORK-SHAPED AND RING-SHAPED ACTUATORS**  
Yuki Okamoto, Sucheta Gorwadkar, Yusuke Takei, and Hironao Okada  
*National Institute of Advanced Industrial Science and Technology (AIST), JAPAN*
- 09:30**    **BIAXIAL LISSAJOUS SCANNING PIEZOELECTRIC MEMS MIRROR BASED ON HIGH FILL FACTOR AND LARGE OPTICAL APERTURE**  
Hao Huang<sup>1,2</sup>, Lihao Wang<sup>1</sup>, Yang Wang<sup>1,2</sup>, Yichen Liu<sup>1,2</sup>, Yongquan Su<sup>1,3</sup>, Weihong Zhu<sup>3,4</sup>, Yonggui Zhang<sup>1</sup>, and Zhenyu Wu<sup>1,2,3,4</sup>  
<sup>1</sup>*Chinese Academy of Sciences, CHINA*, <sup>2</sup>*University of Chinese Academy of Sciences, CHINA*, <sup>3</sup>*Shanghai University, CHINA*, and <sup>4</sup>*Shanghai Industrial Technology Research Institute, CHINA*
- 09:45**    **AN ELECTROTHERMAL MICROMIRROR ARRAY INTEGRATED WITH THERMAL CONVECTION-BASED MIRROR POSITION SENSING**  
Anrun Ren, Yingtao Ding, Hengzhang Yang, Teng Pan, Ziyue Zhang, and Huikai Xie  
*Beijing Institute of Technology, CHINA*

**10:00**    **Break & Exhibit Inspection**

### Session Xa - Applications in Physical MEMS

Chair: Nuria Barniol, *Universitat Autònoma de Barcelona, SPAIN*

Grand Ballroom, Level 3

- 10:30**    **INVITED**  
**TOWARDS FUNCTIONAL METAMATERIALS AND METADEVICES**  
**Xin Zhang** and Zhiwei Yang  
*Boston University, USA*
- 11:00**    **TOWARD HIGH-BIT-RATE CMOS-MEMS RESOSWITCHES**  
Cheng-Ming Lee, Ting-Jui Liou, Chun-Pu Tsai, Ting-Yi Chen, and Wei-Chang Li  
*National Taiwan University, TAIWAN*
- 11:15**    **A MACH-ZEHNDER PHOTONIC MEMS MICROPHONE WITH HIGH SENSITIVITY, 1/F NOISE SUPPRESSION AND BROADBAND RESPONSE**  
Xingyu Wei, Xiaoyong Fang, Lei Shao, and Wenming Zhang  
*Shanghai Jiao Tong University, CHINA*



## Session Xa (continued)

**11:30 DEMONSTRATION OF ARTIFICIAL SPIN STATES USING SUB-HARMONIC INJECTION LOCKING IN AIN-on-Si LENGTH-EXTENSIONAL MODE MEMS SELF-SUSTAINING OSCILLATOR**

Tahmid Kaisar<sup>1</sup>, S M Enamul Hoque Yousuf<sup>1</sup>, Nicolas Casilli<sup>2</sup>, Mina Rais-Zadeh<sup>3,4</sup>, Soumyajit Mandal<sup>5</sup>, Cristian Cassella<sup>2</sup>, and Philip X.-L. Feng<sup>1</sup>

<sup>1</sup>University of Florida, USA, <sup>2</sup>Northeastern University, USA, <sup>3</sup>University of Michigan, Ann Arbor, USA, <sup>4</sup>NASA Jet Propulsion Laboratory (JPL), USA, and <sup>5</sup>Brookhaven National Laboratory, USA

**Session Xb - Novel Materials & Manufacturing**

Chair: Farnaz Niroui, *Massachusetts Institute of Technology, USA*

## Amphitheater 204, Level 2

**10:30 AIN SELF-ROLLED-UP MICROTUBE RESONATORS WITH MULTIMODE RESONANCES FOR ON-CHIP OPTOMECHANICAL SENSING**

Yuncong Liu<sup>1</sup>, Apratim Khandelwal<sup>2</sup>, Zhongjie Ren<sup>3</sup>, Allen Wang<sup>3</sup>, Xiuling Li<sup>3</sup>, and Philip X.-L. Feng<sup>1</sup>

<sup>1</sup>University of Florida, USA, <sup>2</sup>University of Illinois, Urbana-Champaign, USA, and <sup>3</sup>University of Texas, Austin, USA

**10:45 NEEDLE-TYPE OXYGEN MICROSENSOR MADE BY HYBRID 3D MICROFABRICATION**

Juntaro Nomaru, Taisuke Masuda, Satoshi Amaya, Shiro Watanabe, and Fumihito Arai  
*University of Tokyo, JAPAN*

**11:00 PERFORMANCE OF ALUMINUM NITRIDE CURVED PMUT ARRAYS FABRICATED USING GLASS BLOWING TECHNIQUE**

Shubham P. Khandare<sup>1</sup>, Chichen Huang<sup>2</sup>, Sri-Rajasekhar Kothapalli<sup>1</sup>, and Srinivas Tadigadapa<sup>2</sup>

<sup>1</sup>Pennsylvania State University, USA and <sup>2</sup>Northeastern University, USA

**11:15 INVITED S-RUM TECHNOLOGY FOR EXTREME MINIATURIZATION AND INTEGRATION OF PASSIVE ELECTRONICS AND MICROFLUIDICS**

Zhendong Yang<sup>1</sup>, Apratim Khandelwal<sup>2</sup>, Paul Froeter<sup>2</sup>, Kristen Nguyen<sup>1</sup>, Allen Wang<sup>1</sup>, Scott Wicker<sup>1</sup>, and **Xiuling Li**<sup>1</sup>

<sup>1</sup>University of Texas, Austin, USA and

<sup>2</sup>University of Illinois, Urbana-Champaign, USA

**11:45 Lunch & Exhibit Inspection****Women in Engineering-MEMS Group Networking Event**

Room 301, Level 3

**11:45 – Women in Engineering-MEMS Group Networking Event**

**13:00** Join us for a Past, Present and Future of MEMS panel discussion. Open to all conference attendees.

See page 7 for additional information.

**Session XIa - Thermal Sensors & Actuators**Chair: Cecile Jung, *NASA Jet Propulsion Laboratory (JPL), USA*

Grand Ballroom, Level 3

- 13:00 HYBRID SOFT ACTUATOR DRIVEN BY TEMPERATURE-RESPONSIVE HYDROGEL AND SOFT GRID SKELETON WITH RESIDUAL STRESS**  
Haruna Kozuki<sup>1</sup>, Koki Yoshida<sup>2</sup>, Hiroki Yasuga<sup>3</sup>, and Yuta Kurashina<sup>1</sup>  
<sup>1</sup> *Tokyo University of Agriculture and Technology, JAPAN*, <sup>2</sup> *Tokyo Institute of Technology, JAPAN*, and <sup>3</sup> *National Institute of Advanced Industrial Science and Technology (AIST), JAPAN*
- 13:15 INTEGRATED RESONANT CANTILEVER WITH DUAL THERMOANALYTICAL FUNCTIONS OF THERMALGRAVIMETRIC ANALYSIS AND DIFFERENTIAL THERMAL ANALYSIS**  
Yuhang Yang<sup>1,2</sup>, Hao Jia<sup>1,2</sup>, Zhi Cao<sup>1,3</sup>, Haozhi Zhang<sup>1,2</sup>, Pengcheng Xu<sup>1,2</sup>, and Xinxin Li<sup>1,2</sup>  
<sup>1</sup> *Chinese Academy of Sciences, CHINA*, <sup>2</sup> *University of Chinese Academy of Sciences, CHINA*, and <sup>3</sup> *Shanghai Institute of Technology, CHINA*
- 13:30 POWER-COMPENSATED SINGLE-CRYSTAL SILICON THERMOPILES FOR DIFFERENTIAL SCANNING CALORIMETRY (DSC)**  
Hao Jia<sup>1,2</sup>, Zhi Cao<sup>1,3</sup>, Zechun Li<sup>1,2</sup>, Haozhi Zhang<sup>1,2</sup>, Pengcheng Xu<sup>1,2</sup>, and Xinxin Li<sup>1,2</sup>  
<sup>1</sup> *Chinese Academy of Sciences, CHINA*, <sup>2</sup> *University of Chinese Academy of Sciences, CHINA*, and <sup>3</sup> *Shanghai Institute of Technology, CHINA*
- 13:45 QUANTITATIVE MEASUREMENTS OF CATALYTIC ACTIVITY OF SINGLE-ATOM AND NANOPARTICLE PALLADIUM CATALYSTS FOR SENSITIVE DETECTION OF METHANE USING CANTILEVER-BASED TEMPERATURE-PROGRAMMED REDUCTION TECHNIQUE**  
Qiaoyuan Yang<sup>1,2</sup>, Ming Li<sup>1,2</sup>, Yanlong Zheng<sup>1,2</sup>, Xinyu Li<sup>1,2</sup>, Ying Chen<sup>1,2</sup>, Xinxin Li<sup>1,2</sup>, and Pengcheng Xu<sup>1,2</sup>  
<sup>1</sup> *Chinese Academy of Sciences, CHINA* and <sup>2</sup> *University of Chinese Academy of Sciences, CHINA*

**Session XIb - Microfluidics Technologies**Chair: Frank Goldschmidtboeing, *University Freiburg, GERMANY*

Amphitheater 204, Level 2

- 13:00 3D-MICROPRINTED PDMS-BASED MICROFLUIDIC VESSELS FOR ORGAN-ON-A-CHIP APPLICATIONS**  
Xin Xu<sup>1</sup>, Chen-Yu Chen<sup>1</sup>, Ziteng Wen<sup>1</sup>, Olivia M. Young<sup>1</sup>, Bailey M. Felix<sup>1</sup>, Bidhan C. Bandyopadhyay<sup>2</sup>, William E. Bentley<sup>1</sup>, and Ryan D. Sochol<sup>1</sup>  
<sup>1</sup> *University of Maryland, USA* and <sup>2</sup> *Veterans Affairs Medical Center, USA*
- 13:15 ELECTRO-“WICKING” INTO DIELECTRIC-COATED MICROSTRUCTURES**  
Hiroki Yasuga<sup>1</sup>, Ko Okumura<sup>2</sup>, and Yusuke Takei<sup>1</sup>  
<sup>1</sup> *National Institute of Advanced Industrial Science and Technology (AIST), JAPAN* and <sup>2</sup> *Ochanomizu University, JAPAN*



## Session XIb (continued)

- 13:30 MONOLITHIC INTEGRATION OF  $\mu$ PID ON  $\mu$ COLUMNS FOR COMPACT MICRO-GAS CHROMATOGRAPHY**  
Xiaheng Huang, Shuo Yang, Wencheng Li, Ruchi Sharma, Anjali Devi Sivakumar, Chandrakalavathi Thota, Robert Nidetz, Hongbo Zhu, Weishu Wu, Seong-Yong Jeong, and Xudong Fan  
*University of Michigan, USA*
- 13:45 CAPILLARY ELECTROPHORESIS ELECTROCHEMICAL DETECTION ON A THREAD-BASED MICROFLUIDIC PLATFORM WITH PENETRATED NANOSTRUCTURED GRAPHENE OXIDE NEEDLES**  
Wei-Ren Hou and Che-Hsin Lin  
*National Sun Yat-sen University, TAIWAN*

**14:00 Transition**

## Session XIIIa - Neural Interface Devices

Chair: Hyunjoo Jenny Lee, *Korea Advanced Institute of Science & Technology (KAIST), KOREA*

Grand Ballroom, Level 3

- 14:10 DIAMOND-LIKE-CARBON COATED ULTRAMICROELECTRODE WITH CONTRALLABLE EXPOSED LENGTH BASED ON MICROPLASMA JET**  
Zhiyuan Du, Qingda Xu, Ye Xi, Mengfei Xu, Jiawei Cao, Xiantao Zhu, Longchun Wang, Xiuyan Li, Bin Yang, and Jingquan Liu  
*Shanghai Jiao Tong University, CHINA*
- 14:25 A FLEXIBLE ORIGAMI OPTO-ELECTRO ARRAY FOR IN VIVO OPTOGENETIC NEUROSTIMULATION AND NEUROPHYSIOLOGY RECORDING**  
Yan Gong, Xiang Liu, Yifan Liu, Zhen Qiu, Arthur Weber, and Wen Li  
*Michigan State University, USA*
- 14:40 MULTIPOINT SELECTIVE STIMULATION OF NEURAL SPHEROID NETWORK WITH MICROELECTRODE ARRAY**  
Ryo Furukawa<sup>1</sup>, Midori Kato-Negishi<sup>2</sup>, Jun Sawayama<sup>1</sup>, Minghao Nie<sup>1</sup>, and Shoji Takeuchi<sup>1</sup>  
<sup>1</sup>*University of Tokyo, JAPAN* and <sup>2</sup>*Musashino University, JAPAN*
- 14:55 FLEXIBLE DUAL-SIDED POLYMER MICROELECTRODE ARRAY FOR NEUROPHYSIOLOGICAL RECORDINGS FROM AN INSECT BRAIN**  
Xiang Liu, Simon Sanchez, Yan Gong, Zebin Jiang, Trevor Stevens, Hasan Banan, Debajit Saha, and Wen Li  
*Michigan State University, USA*
- 15:10 STRETCHABLE FRACTAL ELECTRODES INTEGRATED ON MINIATURE SEMI-EXPANDED MICROBALLOON CATHETER FOR DIRECTIONAL NERVE STIMULATION**  
Xiaoli You<sup>1</sup>, Fanqi Sun<sup>1</sup>, Kai Xue<sup>1</sup>, Xianxia Yan<sup>2</sup>, Le Zhou<sup>2</sup>, Minghao Wang<sup>3</sup>, Zekai Liang<sup>1</sup>, Kai Tao<sup>1</sup>, Honglong Chang<sup>1</sup>, and Bowen Ji<sup>1</sup>  
<sup>1</sup>*Northwestern Polytechnical University, CHINA*, <sup>2</sup>*Second Affiliated Hospital of Xi'an Jiaotong University, CHINA*, and <sup>3</sup>*Hangzhou Dianzi University, CHINA*





**Session XIIb - MEMS Actuators and Robots**  
 Chair: Nathan Jackson, *University of New Mexico, USA*

Amphitheater 204, Level 2

- 14:10 10-AMP POWER-MEMS IRREVERSIBLE TOGGLE SWITCH WITH DRIE-ETCHED SIDE-WALL AU PLATING AND MAGNETIC ACTUATION**  
 Yves Kuster<sup>1</sup>, David Eggenberger<sup>1</sup>, Bruno Zemp<sup>2</sup>, and Samuel Huber<sup>1</sup>  
<sup>1</sup>*OST Eastern Switzerland University of Applied Sciences, SWITZERLAND* and <sup>2</sup>*Schurter AG, SWITZERLAND*
- 14:25 A SYNTHETIC JETS COOLING DEVICE BASED ON PIEZOELECTRIC ALN MEMS ACTUATORS**  
 Boyun Zhang, Mingchao Sun, Wei Pang, Chen Sun, Yi Gong, and Menglun Zhang  
*Tianjin University, CHINA*
- 14:40 A BIO-INSPIRED LIGHT-DRIVEN SOFT CLIMBING ROBOT WITH CAPABILITIES OF RAPID LOCOMOTION, CARGO TRANSPORT, AND DIRECTION TURNING**  
 Yan-Jun Chen, Chih-Lin Huang, Yun-Li Chi, and Yao-Joe Yang  
*National Taiwan University, TAIWAN*
- 14:55 SERIALLY-ARRANGED BIOHYBRID MUSCLE RING ACTUATORS FOR LARGE-SCALE BENDING MOTION**  
 Tomohiro Morita, Minghao Nie, and Shoji Takeuchi  
*University of Tokyo, JAPAN*
- 15:10 A HIGH-SPEED MICRO CRAWLING ROBOT WITH CANCELLATION OF RESIDUAL ELECTROADHESION USING REVERSAL POLARITY METHOD**  
 Yingzhi Wang<sup>1</sup>, Ziwen Tang<sup>1</sup>, Jiaquan Xu<sup>1</sup>, Yejia Wu<sup>1</sup>, Hong Ding<sup>1</sup>, Yong Wang<sup>2</sup>, and Jin Xie<sup>1</sup>  
<sup>1</sup>*Zhejiang University, CHINA* and <sup>2</sup>*Hangzhou City University, CHINA*

**Poster/Oral Session III**

Zlotnick Ballroom, Level 1

- 15:25 Poster/Oral Session III**  
 Poster presentations are listed by topic category with their assigned number starting on Page 50.
- 
- 16:15 Break & Exhibit Inspection**
- 
- 17:25 Adjourn for the Day**

**Conference Banquet**

Grand Ballroom, Level 3

- 19:30 – Conference Banquet**  
**22:00** Join us in the Grand Ballroom where you will enjoy a delicious meal, and a chance to network with colleagues.

See page 7 for additional information.



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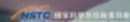
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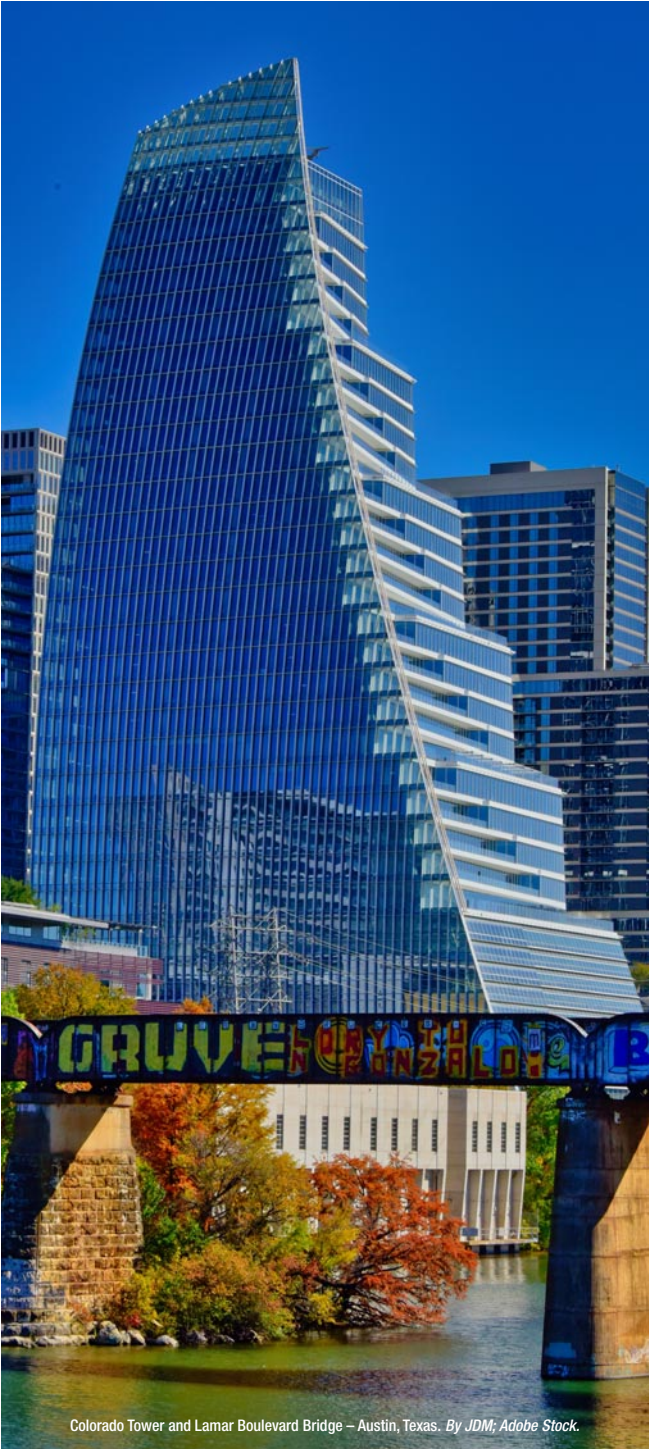
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WEDNESDAY



WEDNESDAY



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**THURSDAY AT A GLANCE**

08:30-09:15	<b>Plenary Presentation IV</b> <i>Jörg Wrachtrup – University of Stuttgart, GERMANY</i>
09:15-10:15	<b>Session XIII - Environmental and Biotechnology Innovations</b>
10:15-10:55	<b>Break and Exhibit Inspection</b>
10:55-11:55	<b>Session XIV - Novel Sensors</b>
11:55-12:15	<b>Awards Ceremony and Final Remarks</b>
12:15	<b>Conference Adjourns</b>



**THURSDAY**

**THURSDAY, 25 JANUARY**

**Plenary Presentation IV**  
Chair: Dana Weinstein, *Purdue University, USA*

Grand Ballroom, Level 3

**08:30** **APPLYING QUANTUM TECHNOLOGIES**  
**Jörg Wrachtrup**  
*University of Stuttgart, GERMANY*



**Session XIII - Environmental and Biotechnology Innovations**Chair: Seokheun Sean Choi, *State University of New York, USA*

Grand Ballroom, Level 3

- 09:15 TOWARDS GHZ ULTRASOUND ENABLED NONINVASIVE HYDROGEL METROLOGY FOR MECHANOBIOLOGY**  
Yilmaz Arin Manav<sup>1</sup>, Frederick Sebastian<sup>1</sup>, Anuj Baskota<sup>2</sup>, Justin C. Kuo<sup>2</sup>, Rouzbeh Amini<sup>1</sup>, Amit Lal<sup>2,3</sup>, and Benyamin Davaji<sup>1</sup>  
<sup>1</sup>*Northeastern University, USA*, <sup>2</sup>*Geegah LLC, USA*, and <sup>3</sup>*Cornell University, USA*
- 09:30 MICROALGAE-ENABLED ARTIFICIAL PLANTS FOR INDOOR AIR QUALITY IMPROVEMENT AND ELECTRICITY GENERATION**  
Maryam Rezaie and Seokheun Choi  
*State University of New York, Binghamton, USA*
- 09:45 A WIRELESS MEMS MICROBIAL FUEL CELL BIOSENSOR WITH RECORD ULTRA-SHORT RESPONSE TIME FOR COPPER ION IN WATER MONITORING**  
Yining Wang, Fengxiang Tang, Ruohan Zhang, Yifan Wu, and Hao Ren  
*ShanghaiTech University, CHINA*
- 10:00 THIN, FLEXIBLE, AND INKJET PRINTED BIOPHOTOVOLTAIC CELL BASED ON THYLAKOID MEMBRANE**  
Jeonghyeop Son<sup>1</sup>, JaeHyoung Yun<sup>1</sup>, Yunsung Kang<sup>2</sup>, WonHyoung Ryu<sup>1</sup>, and Jongbaeg Kim<sup>1</sup>  
<sup>1</sup>*Yonsei University, KOREA* and <sup>2</sup>*Kyungpook National University, KOREA*

**10:15 Break & Exhibit Inspection****Session XIV - Novel Sensors**Chair: Michael Kraft, *KU Leuven, BELGIUM*

Grand Ballroom, Level 3

- 10:55 THERMOGRAVIMETRIC ANALYSIS ABOVE 200°C/MIN USING INTEGRATED RESONANT MICROCANTILEVERS**  
Hao Jia<sup>1,2</sup>, Zhi Cao<sup>1,3</sup>, Yuhang Yang<sup>1,2</sup>, Dan Zheng<sup>3</sup>, and Xinxin Li<sup>1,2</sup>  
<sup>1</sup>*Chinese Academy of Sciences, CHINA*, <sup>2</sup>*University of Chinese Academy of Sciences, CHINA*, and <sup>3</sup>*Shanghai Institute of Technology, CHINA*
- 11:10 UNCERTAINTY ANALYSIS OF MEMS DEVICES WITH DEEP NEURAL NETWORKS USING BI-FIDELITY DATA**  
Lin-Feng Zhao, Gong-Zeng Liu, Zai-Fa Zhou, and Qing-An Huang  
*Southeast University, CHINA*
- 11:25 WRINKLED MEMBRANE-INTEGRATED FLEXIBLE ACTUATOR WITH LARGE OPERATING DISPLACEMENT FOR WEARABLE TACTILE DISPLAY**  
Sangjun Sim, Kyuhyun Hwang, Kyubin Bae, Seungtaek Jang, and Jongbaeg Kim  
*Yonsei University, KOREA*





**Session XIV (continued)**

**11:40 DUAL-DETECTIONS OF TACTILE FORCE AND PROXIMITY WITH AN ULTRA-SENSITIVE INTEGRATED MICROCANTILEVER SENSOR**  
Yi Liu, Xincheng Zhu, Cong Lin, Jiahao Miao, Zhanxuan Zhou, Xueliang Wang, and Xiaomei Yu  
*Peking University, CHINA*

**Awards Ceremony**

**Grand Ballroom, Level 3**

**11:55 Awards Ceremony**

**12:05 Final Remarks**

**12:15 Conference Adjourns**



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**THURSDAY**





## Zlotnick Ballroom, Level 1

MONDAY  
14:55 – 16:55TUESDAY  
14:55 – 16:55WEDNESDAY  
15:25 – 17:25

## 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** **MICROFLUIDIC BIOSENSOR FOR RAPID DETECTION OF SALMONELLA IN RAW CHICKEN PRODUCTS**  
 Mohammed Almalaysha<sup>1</sup>, Arshdeep Singh<sup>1</sup>, Sura A. Muhsin<sup>1</sup>, Amit Morey<sup>2</sup>, Shuping Zhang<sup>1</sup>, Lakshmikantha H. Channaiah<sup>2</sup>, and Mahmoud Almasri<sup>1</sup>  
<sup>1</sup>University of Missouri, USA and <sup>2</sup>Auburn University, USA
- T01-a** **THE LOD ENHANCEMENT STUDY OF MIP-BASED TROPONIN T IN URINE SENSING ELECTRODES USING MODIFIED METHYLENE BLUE/ANODIC ALUMINUM OXIDE (MIP/MB/AAO) NANOCOMPOSITE STRUCTURES**  
 Chieh Chen<sup>1</sup>, Cheng-Yu Tsai<sup>1</sup>, Yu-Ting Cheng<sup>1</sup>, Hsiao-En Tsai<sup>2</sup>, and Yung-Chieh Lo<sup>3</sup>  
<sup>1</sup>National Yang Ming Chiao Tung University, TAIWAN,  
<sup>2</sup>National Taiwan University Hospital, TAIWAN, and  
<sup>3</sup>Google LLC, USA
- W01-a** **SWEAT SENSING USING A PHOTONIC SYNAPTIC TRANSISTOR INTEGRATED WITH ELECTROCHEMICAL GATE**  
 Jaeho Han, Jungwon Woo, and Kwang-Seok Yun  
 Sogang University, KOREA

**Biosensors and Bioreactors**

- M02-a** **ULTRA-FLEXIBLE MULTICHANNEL NEURAL MICROELECTRODES MODIFIED BY PEDOT:PSS/IROX FOR ENHANCED SENSING AND LOCALIZED STIMULATION**  
Wanqi Jiang<sup>1,2</sup>, Xueying Wang<sup>1,2</sup>, Huiran Yang<sup>1</sup>, Dujuan Zou<sup>1,2</sup>, Chen Tao<sup>1,3</sup>, Ziyi Zhu<sup>1,2</sup>, Jianbo Jiang<sup>1,2</sup>, Zhitao Zhou<sup>1,2</sup>, Liuyang Sun<sup>1,2</sup>, Tiger H. Tao<sup>1,2,3,4,5,6</sup>, and Xiaoling Wei<sup>1,2</sup>  
<sup>1</sup>Chinese Academy of Sciences, CHINA, <sup>2</sup>University of Chinese Academy of Sciences, CHINA, <sup>3</sup>Shanghai Tech University, CHINA, <sup>4</sup>Neuroxess Co., Ltd., CHINA, <sup>5</sup>Guangdong Institute of Intelligence Science and Technology, CHINA, and <sup>6</sup>Tianqiao and Chrissy Chen Institute for Translational Research, CHINA
- T02-a** **DUAL-SENSING MECHANICAL HYDROGEL BIOSENSOR COMPOSED BY APTAMER RECOGNITION AND DNA LOGIC GATES**  
Satofumi Kato<sup>1</sup>, Masahiro Takinoue<sup>2</sup>, and Hiroaki Onoe<sup>1</sup>  
<sup>1</sup>Keio University, JAPAN and <sup>2</sup>Tokyo Institute of Technology, JAPAN
- W02-a** **A HIGHLY SENSITIVE GLUCOSE SENSOR WITH ANTI-SWELLING ZWITTERIONIC HYDROGEL ENZYME MEMBRANE**  
Chengcheng Li<sup>1</sup>, Yuxiao Ma<sup>1</sup>, Wenjun Li<sup>1</sup>, Hao Zheng<sup>1</sup>, Xingguo Zhang<sup>1</sup>, Xiaochen Lai<sup>2</sup>, Dachao Li<sup>1</sup>, and Zhihua Pu<sup>1</sup>  
<sup>1</sup>Tianjin University, CHINA and <sup>2</sup>Nanjing University of Information Science & Technology, CHINA

**a - Bio and Medical MEMS****Devices & Systems for Cellular and Molecular Studies**

- M03-a** **SINGLE-CELLULAR DYNAMIC MECHANICAL ANALYSIS OF LIVE 3D ORGANOID UNDER LIGHT-SHEET FLUORESCENCE MICROSCOPY**  
Venkatanathan Kidambi, Yuji Tomizawa, Manav Surti, Mitchell Modarelli, and Kazunori Hoshino  
*University of Connecticut, USA*
- T03-a** **FORMING SPHEROID USING HYDROGEL MICROWELL AND PNEUMATIC SOFT ACTUATOR**  
Ryota Kawamae<sup>1</sup>, Atsushi Takata<sup>1</sup>, Kenjiro Takemura<sup>2</sup>, and Yuta Kurashina<sup>1</sup>  
<sup>1</sup>Tokyo University of Agriculture and Technology, JAPAN and <sup>2</sup>Keio University, JAPAN
- W03-a** **LASER-MANUFACTURED MAGNETIC MICROCHIPS FOR EXOSOME ISOLATION AND PATTERNING**  
John H. Molinski, Siddhant Parwal, and John X.J. Zhang  
*Dartmouth College, USA*
- M04-a** **MIXING, TRAPPING, AND EJECTION OF SINGLE MICROPARTICLE WITH SIZE AND MATERIAL SELECTIVITY USING ACOUSTIC TWEEZERS**  
Baptiste Neff, Akash Roy, Kianoush Sadeghian Esfahani, and Eun S. Kim  
*University of Southern California, USA*

**Devices & Systems for Cellular and Molecular Studies****T04-a 3D FLUORESCENCE IMAGING OF LATE-STAGE ZEBRAFISH EMBRYO WITH ACOUSTIC TWEEZERS**

Kianoush Sadeghian Esfahani, Baptiste Neff, Akash Roy,  
Matin Barekattain, and Eun S. Kim  
*University of Southern California, USA*

**a - Bio and Medical MEMS****Flexible and Wearable Devices and Systems****W04-a FINGER PLETHYSMOGRAPHY USING A SENSITIVE WAFER-LEVEL-PACKAGED CAPACITIVE MEMS STRAIN SENSOR**

Xinyu Jiang<sup>1</sup>, Arash Shokouhmand<sup>2</sup>, Negar Ebadi<sup>2</sup>,  
and Farrokh Ayazi<sup>1</sup>

<sup>1</sup>*Georgia Institute of Technology, USA and*

<sup>2</sup>*Stevens Institute of Technology, USA*

**M05-a MATERIALS CHARACTERIZATION FOR MICRONEEDLE-BASED MOLECULAR SENSING PLATFORM**

Christopher Larson<sup>1</sup>, Kevin Plaxco<sup>2</sup>, and Ellis Meng<sup>1</sup>

<sup>1</sup>*University of Southern California, USA and*

<sup>2</sup>*University of California, Santa Barbara, USA*

**T05-a ELECTRONIC COMPONENT MOUNTING WITH LIQUID METAL FOR HIGHLY STRETCHABLE ELECTRONIC DEVICES**

Takashi Sato and Eiji Iwase

*Waseda University, JAPAN*

**W05-a A STRETCHABLE HIGH-DENSITY ELECTROMYOGRAPHY MEMS SENSOR FOR EFFICIENT SILENT SPEECH RECOGNITION**

Shuihan Shao, Chunpeng Jiang, Gencai Shen, Yirong Wang,  
Kunyu Zheng, Nan Zhao, Bin Yang, and Jingquan Liu

*Shanghai Jiao Tong University, CHINA*

**M06-a ROLLED DEVICES FORMED BY USING THIN PLASTIC FILM/ELASTOMER BILAYER SYSTEM FOR WEARABLE ELECTRONICS**

Atsush Takei, Kazunori Kuribara, Yasuyuki Kusaka,  
and Manabu Yoshida

*National Institute of Advanced Industrial Science and  
Technology (AIST), JAPAN*

**T06-a FLEXIBLE HIGH-SENSITIVITY STRAIN SENSOR FABRICATED WITH PDMS MICRO-CHANNEL ARRAY USING LASER TRANSMISSION PYROLYSIS TECHNOLOGY**

Shaogang Wang<sup>1</sup>, Qihang Zong<sup>2</sup>, Huiru Yang<sup>2</sup>, Qianming Huang<sup>2</sup>,  
Huaiyu Ye<sup>2</sup>, and Paddy French<sup>1</sup>

<sup>1</sup>*Delft University of Technology, NETHERLANDS and*

<sup>2</sup>*Southern University of Science and Technology, CHINA*

**Flexible and Wearable Devices and Systems**

- W06-a WEARABLE IMPEDANCE SENSOR FOR WIRELESS MEASUREMENTS OF PROTEIN BIOMARKERS IN DERMAL INTERSTITIAL FLUID**  
Elizabeth C. Wilkerson<sup>1</sup>, Yan Gong<sup>2</sup>, Wen Li<sup>2</sup>, and Peter B. Lillehoj<sup>1</sup>  
<sup>1</sup>Rice University, USA and <sup>2</sup>Michigan State University, USA
- M07-a HIGH-DENSITY IRIIDIUM OXIDE MICRONEEDLE ELECTRODE BASED ON SELF-CONSTRICTION PURPLE CLAY MOLD FOR EEG RECORDING**  
Kunyu Zheng, Gencai Shen, Chunpeng Jiang, Shuihan Shao, Qingda Xu, Bin Yang, and Jingquan Liu  
Shanghai Jiao Tong University, CHINA
- T07-a ACCURATE NON-INVASIVE GLUCOSE MONITORING BASED ON PH-CALIBRATION**  
Wangwang Zhu, Haixia Yu, Zhihua Pu, Chenxi Jin, Yuxiao Ma, Hao Zheng, Wenjun Li, Chengcheng Li, Xingguo Zhang, and Dachao Li  
Tianjin University, CHINA
- W07-a SOFT PACKAGING OF FLEXIBLE PIEZOELECTRIC ACTUATORS FOR APPLICATIONS IN WEARABLE HAPTIC DEVICES**  
Daniel Zymelka<sup>1</sup>, Toshihiro Takeshita<sup>1</sup>, Yusuke Takei<sup>1</sup>, Takeshi Kobayashi<sup>1</sup>, and Takashi Hanakawa<sup>2</sup>  
<sup>1</sup>National Institute of Advanced Industrial Science and Technology (AIST), JAPAN and <sup>2</sup>Kyoto University Graduate School of Medicine, JAPAN

**a - Bio and Medical MEMS****Manufacturing for Bio- & Medical MEMS**

- M08-a CARBON NANO TUBES-INCORPORATED SMART STENTS TO IMPROVE MECHANICAL STRENGTH AND SENSOR RELIABILITY**  
Nomin-Erdene Oyunbaatar and Dong-Weon Lee  
Chonnam National University, KOREA
- T08-a ARTICULATED BIOHYBRID HAND POWERED BY MULTIPLE MUSCLE TISSUE ACTUATORS**  
Xinzhu Ren<sup>1</sup>, Yuya Morimoto<sup>1,2</sup>, and Shoji Takeuchi<sup>1</sup>  
<sup>1</sup>University of Tokyo, JAPAN and <sup>2</sup>Waseda University, JAPAN
- W08-a ASIC INTEGRATION VIA POLYMER ULTRASONIC BUMP BONDING TO A 64-CHANNEL PENETRATING PARYLENE MULTIELECTRODE ARRAY**  
James Jung Yoo and Ellis Meng  
University of Southern California, USA

**Manufacturing for Bio- & Medical MEMS****M09-a IMPLANTABLE ELECTRODE BASED ON PRE-STRETCHED SILK FILM FOR IN VIVO APPLICATION**

Ziyi Zhu<sup>1,2</sup>, Zhiwen Yan<sup>3</sup>, Huiran Yang<sup>1</sup>, Xueying Wang<sup>1,2</sup>, Siyuan Ni<sup>1,2</sup>, Dujuan Zou<sup>1,2</sup>, Wanqi Jiang<sup>1,2</sup>, Chen Tao<sup>1</sup>, Jianbo Jiang<sup>1,2</sup>, Zhitao Zhou<sup>1,2</sup>, Liuyang Sun<sup>1,2,4</sup>, Keyin Liu<sup>1</sup>, Tiger H. Tao<sup>1,2,4,5,6,7</sup>, and Xiaoling Wei<sup>1,2</sup>

<sup>1</sup>Chinese Academy of Sciences, CHINA, <sup>2</sup>University of Chinese Academy of Sciences, CHINA, <sup>3</sup>Shanghai Jiao Tong University, CHINA,

<sup>4</sup>ShanghaiTech University, CHINA, <sup>5</sup>Neuroxess Co., Ltd. (Jiangxi), CHINA, <sup>6</sup>Guangdong Institute of Intelligence Science and Technology, CHINA, and <sup>7</sup>Tianqiao and Chrissy Chen Institute for Translational Research, CHINA

**a - Bio and Medical MEMS****Materials for Bio- and Medical MEMS****T09-a CULTIVATED MEAT ASSEMBLED BY MICROFIBERS**

Kensei Okada, Byeongwook Jo, Minghao Nie, and Shoji Takeuchi  
University of Tokyo, JAPAN

**a - Bio and Medical MEMS****Medical Microsystems****W09-a BACTERIAL ENDOSPORE BASED WEARABLE BIOSENSORS FOR SELECTIVE AND SENSITIVE GLUCOSE MONITORING**

Yang Gao, Anwar Elhadad, and Seokheun Choi  
State University of New York, Binghamton, USA

**M10-a FLEXIBLE NEURAL ELECTRODE ARRAY WITH VERTICALLY ALIGNED CARBON NANOTUBES MICROSTRUCTURE FOR HIGH SENSITIVITY MEASUREMENT OF NEUROCHEMICALS**

Hyunjun Han<sup>1</sup>, Sorim Han<sup>2</sup>, Sangjun Sim<sup>1</sup>, Il-Joo Cho<sup>2</sup>, and Jongbaeg Kim<sup>1</sup>

<sup>1</sup>Yonsei University, KOREA and <sup>2</sup>Korea University, KOREA

**T10-a ELASTIC 3D MICROELECTRODES WITH JELLYFISH-LIKE MICROBUMPS AND GRAPPING STRIPS AS A RELIABLE NEURAL INTERFACE**

Fanqi Sun<sup>1</sup>, Qing Liu<sup>2</sup>, Xiaoli You<sup>1</sup>, Zekai Liang<sup>1</sup>, Kai Xue<sup>1</sup>, Jun Guo<sup>1</sup>, Minghao Wang<sup>3</sup>, Jiahao Wang<sup>1</sup>, Kai Tao<sup>1</sup>, Honglong Chang<sup>1</sup>, and Bowen Ji<sup>1</sup>

<sup>1</sup>Northwestern Polytechnical University, CHINA, <sup>2</sup>Tsinghua University, CHINA, and <sup>3</sup>Hangzhou Dianzi University, CHINA

**W10-a MODULATION OF CALCIUM METABOLISM ON OSTEOSARCOMA CELLS USING ULTRASOUND-ACTUATED PIEZOELECTRIC NANOGENERATORS**

Laura Lefaix<sup>1</sup>, Marc Navarro<sup>1</sup>, Carme Nogués<sup>2</sup>, Andreu Blanquer<sup>2</sup>, and Gonzalo Murillo<sup>1</sup>

<sup>1</sup>Institute of Microelectronics of Barcelona (IMB-CNM), SPAIN and <sup>2</sup>Autonomous University of Barcelona (UAB), SPAIN



## Medical Microsystems

- M11-a ANCHORING INJECTOR FOR PROLONGED DOSING OF DRUGS IN THE GASTROINTESTINAL TRACT**  
Joshua A. Levy, Michael A. Straker, Adira Colton,  
Ryan D. Sochol, and Reza Ghodssi  
*University of Maryland, USA*
- T11-a A SILICON NEURAL PROBE MONOLITHICALLY INTEGRATED WITH 20  $\mu\text{M}$ -PITCHED DUAL-COLOR MICRO-LED ARRAYS**  
Dacheng Mao, Feng Sun, Bradley Driscoll, Zhihao Li, and Guangyu Xu  
*University of Massachusetts, USA*
- W11-a A HIGH-SPEED CONFOCAL LASER ENDOMICROSCOPE USING AN ELECTROTHERMAL MEMS MIRROR ACTUATED IN LINEAR-RESONANT RASTER SCAN**  
Teng Pan, TingXiang Qi, Hengzhang Yang, Jia Pu,  
Qian Chen, and Huikai Xie  
*Beijing Institute of Technology, CHINA*
- M12-a GEOMETRIC DETERMINANTS OF CELL VIABILITY FOR 3D-PRINTED HOLLOW MICRONEEDLE ARRAY-MEDIATED DELIVERY**  
Sunandita Sarker<sup>1</sup>, Jinghui Wang<sup>2</sup>, Shrey A. Shah<sup>1</sup>,  
Christopher M. Jewell<sup>1</sup>, Kinneret Rand-Yadin<sup>3</sup>,  
Miroslaw Janowski<sup>2</sup>, Piotr Walczak<sup>2</sup>, Yajie Liang<sup>2</sup>,  
and Ryan D. Sochol<sup>1</sup>  
<sup>1</sup>University of Maryland, USA, <sup>2</sup>University of Maryland School of  
Medicine, USA, and <sup>3</sup>SeeTrue Technology, LLC., USA
- T12-a TOWARD CONTROLLED-RELEASE DRUG DELIVERY MICROCARRIERS ENABLED BY DIRECT LASER WRITING 3D PRINTING**  
Sunandita Sarker<sup>1</sup>, Kimia Forghani<sup>1</sup>, Ziteng Wen<sup>1</sup>, Ryan N. Halli<sup>1</sup>,  
Stephen Hoag<sup>2</sup>, Sharon Flank<sup>3</sup>, and Ryan D. Sochol<sup>1</sup>  
<sup>1</sup>University of Maryland, USA, <sup>2</sup>University of Maryland School of  
Pharmacy, USA, and <sup>3</sup>InfraTrac, Inc., USA
- W12-a A PARYLENE-BASED MEMS INTRAVASCULAR IMPLANT FOR WIRELESS CARDIAC PACING**  
Kuang-Ming Shang<sup>1</sup>, Tzung Hsiai<sup>2</sup>, and Yu-Chong Tai<sup>1</sup>  
<sup>1</sup>California Institute of Technology, USA and  
<sup>2</sup>University of California, Los Angeles, USA
- M13-a DEVELOPMENT OF A MULTI-MODAL ELECTROCHEMICAL SENSING (MES) DEVICE FOR REAL-TIME MONITORING OF TUMOR MICROENVIRONMENT PARAMETERS IN CANCER IMMUNOTHERAPY**  
Jun Ying Tan<sup>1</sup>, Malea Williams<sup>2</sup>, Santosh Kumar Mandal<sup>2</sup>,  
Anna Bottiglieri<sup>3</sup>, Aabila Tharzeen<sup>3</sup>, Rahul Sheth<sup>2</sup>,  
Balasubramaniam Natarajan<sup>3</sup>, Punit Prakash<sup>3</sup>,  
and Jungkwun "JK" Kim<sup>1</sup>  
<sup>1</sup>University of North Texas, USA, <sup>2</sup>University of Texas MD Anderson  
Cancer Center, USA, and <sup>3</sup>Kansas State University, USA





## Medical Microsystems

- W13-a** **ORIENTED CRYSTALLIZATION SILK-BASED ELECTRONIC INTERFACE TOWARDS CHRONICAL RECORDING**  
Huiran Yang<sup>1</sup>, Ziyi Zhu<sup>1,2</sup>, Xueying Wang<sup>1,2</sup>, Dujuan Zou<sup>1,2</sup>, Wanqi Jiang<sup>1,2</sup>, Zhitao Zhou<sup>1,2</sup>, Liuyang Sun<sup>1,2</sup>, Keyin Liu<sup>1,2</sup>, Tiger H. Tao<sup>1,2,3,4,5</sup>, and Xiaoling Wei<sup>1,2</sup>  
<sup>1</sup>Chinese Academy of Sciences, CHINA, <sup>2</sup>University of Chinese Academy of Sciences, CHINA, <sup>3</sup>Neuroxess Co., Ltd., CHINA, <sup>4</sup>Guangdong Institute of Intelligence Science and Technology, CHINA, and <sup>5</sup>Tianqiao and Chrissy Chen Institute for Translational Research, CHINA
- M14-a** **TEA WING BUG INSPIRED FLEXIBLE DEEP BRAIN PROBE MINIMALLY INVASIVE IMPLANTATION**  
Dujuan Zou<sup>1,2</sup>, Xueying Wang<sup>1,2</sup>, Huiran Yang<sup>1,2</sup>, Wanqi Jiang<sup>1,2</sup>, Ziyi Zhu<sup>1,2</sup>, Chen Tao<sup>1,2</sup>, Zhitao Zhou<sup>1,2</sup>, Liuyang Sun<sup>1,2</sup>, Tiger H. Tao<sup>1,2,3,4,5,6</sup>, and Xiaoling Wei<sup>1,2</sup>  
<sup>1</sup>Chinese Academy of Sciences, CHINA, <sup>2</sup>University of Chinese Academy of Sciences, CHINA, <sup>3</sup>Shanghai Tech University, CHINA, <sup>4</sup>Neuroxess Co., Ltd. (Jiangxi), CHINA, <sup>5</sup>Guangdong Institute of Intelligence Science and Technology, CHINA, and <sup>6</sup>Tianqiao and Chrissy Chen Institute for Translational Research, Shanghai, CHINA.

## a - Bio and Medical MEMS

## MEMS &amp; BioMEMS for Healthcare and Public Health

- T14-a** **A WEARABLE SELF-AID MICRONEEDLE PATCH BASED ON ACTIVELY TRANSDERMAL DELIVERY OF ADRENALINE**  
Zhihua Pu, Chenxi Jin, Wangwang Zhu, Chengcheng Li, Peng Guo, and Dachao Li  
Tianjin University, CHINA
- W14-a** **BIOMIMETIC, PHASE-CHANGE MICROSYSTEMS FOR BREATH CONDENSATE BASED POINT-OF-CARE DIAGNOSTICS**  
Pablo Morales-Cruz<sup>1</sup>, Maria Tregansin<sup>1</sup>, Joshua Fnu<sup>1</sup>, Jorge Manrique Castro<sup>1</sup>, and Swaminathan Rajaraman<sup>1,2</sup>  
<sup>1</sup>University of Central Florida, USA and <sup>2</sup>Primordia Biosystems, USA
- M15-a** **LASER DIRECT WRITE PASSIVE SENSORS FOR SMART ORTHOPEDIC IMPLANTS BASE ON POLY-ETHER-ETHER-KETONE (PEEK) AND CARBON FIBER REINFORCED (CFR)-PEEK**  
Qingang Li<sup>1</sup>, Yiwei He<sup>1</sup>, Zhixin Han<sup>2</sup>, Zehao Jin<sup>1</sup>, Zhe Zhao<sup>1</sup>, and Xining Zang<sup>1</sup>  
<sup>1</sup>Tsinghua University, CHINA and <sup>2</sup>University of Western, Ontario, CANADA
- T15-a** **AN EMOTION ASSESSMENT ASSISTANT BASED ON A HIGH-PERFORMANCE HUMIDITY SENSOR**  
Huabin Yang<sup>1,2</sup>, Qirui Zhang<sup>1,2</sup>, Yizhi Shi<sup>1,2</sup>, Qiming Guo<sup>1,2</sup>, Fengyu Liu<sup>1,2</sup>, Na Zhou<sup>1,2</sup>, Chengjun Huang<sup>1,2</sup>, and Haiyang Mao<sup>1,2</sup>  
<sup>1</sup>Chinese Academy of Sciences, CHINA and <sup>2</sup>University of Chinese Academy of Sciences, CHINA
- W15-a** **WEARABLE IFEMG SENSOR FOR MUSCLE STRENGTH EVALUATION**  
Peikai Zou, Junhan Wang, Ruya Li, and Yubo Fan  
Beihang University, CHINA



## a - Bio and Medical MEMS

## Nanobiotechnology

**M16-a SEQUENTIAL ASSEMBLY OF LIPID MOLECULES BROADENS DESIGNABILITY OF LIPID-BASED NANOPARTICLES**Niko Kimura<sup>1</sup> and Shinya Sakuma<sup>2</sup><sup>1</sup>Tokyo University of Agriculture and Technology, JAPAN and<sup>2</sup>Kyushu University, JAPAN

## a - Bio and Medical MEMS

## Tissue Engineering

**T16-a COLLAGEN HOLLOW MICROBEADS FOR ENGINEERED HOLLOW ORGAN MODEL IN VITRO**Satona Abeta<sup>1</sup>, Akari Masuda<sup>1</sup>, Aiki Hioki<sup>1</sup>, Kayoko Shoji<sup>2</sup>, and Hiroaki Onoe<sup>1</sup><sup>1</sup>Keio University, JAPAN and <sup>2</sup>Oslo University Hospital, NORWAY**W16-a 3D-PRINTED PILLAR MICROELECTRODE ARRAY FOR THE SELECTIVE STIMULATION OF BIOHYBRID ACTUATORS**

Tingyu Li, Minghao Nie, and Shoji Takeuchi

University of Tokyo, JAPAN

**M17-a ORIGAMI-INSPIRED CULTURE DEVICE FOR MECHANICAL FOLDING STIMULATION OF SKIN TISSUE EQUIVALENT**

Yuto Matsushima, Dina Mikimoto, Minghao Nie, and Shoji Takeuchi

University of Tokyo, JAPAN

**T17-a MUCIN-LAYER-SECRETING IN VITRO INTESTINAL TUBE-SHAPED DEVICE WITH CRYPTIC STRUCTURE FOR BACTERIAL CO-CULTURE**Shota Uramoto<sup>1</sup>, Shuma Tanaka<sup>1</sup>, Shun Itai<sup>2</sup>, and Hiroaki Onoe<sup>1</sup><sup>1</sup>Keio University, JAPAN and <sup>2</sup>Tohoku University, JAPAN

## a - Bio and Medical MEMS

## Other Bio and Medical MEMS

**W17-a ADVANCING DRUG DELIVERY WITH POCKET MICRONEEDLE ACHIEVING DUAL-DRUG SYNCHRONIZATION**Rawda Ahmed<sup>1</sup>, Jun Ying Tan<sup>1</sup>, Yuankai Li<sup>2</sup>, Albert Kim<sup>3</sup>,Donghoon Yoon<sup>4</sup>, Crystal S. Shin<sup>5</sup>, and Jungkwon "JK" Kim<sup>1</sup><sup>1</sup>University of North Texas, USA, <sup>2</sup>Kansas State University, USA,<sup>3</sup>University of South Florida, USA, <sup>4</sup>University of Arkansas forMedical Sciences, USA, and <sup>5</sup>Baylor College of Medicine, USA**M18-a NOVEL FABRICATION OF 4D PRINTED OPTICAL PROBE ARRAY WITH NANOMETER APERTURE AND OPTICAL SPOT SIZE TUNNING**Dominique Decanini<sup>1</sup>, Abdelmounaim Harouri<sup>1</sup>, Ayako Mizushima<sup>2</sup>,Jongho Park<sup>2</sup>, Beomjoon Kim<sup>2</sup>, Yoshio Mita<sup>2</sup>, and Gilgueng Hwang<sup>1,2</sup><sup>1</sup>CNRS, Université Paris-Saclay, FRANCE and <sup>2</sup>University of Tokyo, JAPAN

**b - Emerging Technologies and New Opportunities for MEMS/NEMS****Internet of Things (IoT) with MEMS/NEMS****T18-b A MICROFABRICATED GASTROBOT FOR SUSTAINABLE ON-WATER PROPULSION**

Anwar Elhadad, Yang Gao, and Seokheun Choi

*State University of New York, Binghamton, USA*

**W18-b LONG-RANGE ULTRASOUND WAKE-UP RECEIVER USING PZT-SCALN HYBRID PMUT LINK WITH EXPONENTIAL HORN**

Shyam Trivedi<sup>1</sup>, Duan J. Goh<sup>1</sup>, Weiguo Chen<sup>1</sup>, Wei D. Toh<sup>1</sup>, Jun Zhang<sup>1</sup>, Sagnik Ghosh<sup>1</sup>, Domenico Giusti<sup>2</sup>, Alberto Leotti<sup>2</sup>, Huan C. Chan<sup>2</sup>, Goutham Koppiseti<sup>2</sup>, Yao Zhang<sup>1</sup>, Yuan Gao<sup>1</sup>, Joshua E.-Y. Lee<sup>1</sup>, and Yul Koh<sup>1</sup>

<sup>1</sup>*Agency for Science, Technology and Research (A\*STAR), SINGAPORE*  
<sup>2</sup>*STMicroelectronics, ITALY*

**b - Emerging Technologies and New Opportunities for MEMS/NEMS****Machine Learning (ML) & Artificial Intelligence (AI) Enhanced MEMS/NEMS Design, Manufacturing, and Applications****M19-b CHARACTERIZATION OF PIEZOELECTRIC ACTUATOR WITH PHYSICS-INFORMED NEURAL NETWORKS**

Binh H. Nguyen, Guilherme B. Torri, and Veronique Rochus

*IMEC, BELGIUM*

**T19-b AN INSTANT PHONIC BRAILLE RECOGNITION SYSTEM BASED ON HIGH-DENSITY FLEXIBLE TACTILE SENSOR ARRAY**

Fang Wang<sup>1,2</sup>, Heng Yang<sup>1,2</sup>, Ke Sun<sup>1</sup>, Yi Sun<sup>1</sup>, Xikun Zheng<sup>3</sup>, Jingqing Hu<sup>3</sup>, and Xinxin Li<sup>1,2,3</sup>

<sup>1</sup>*Chinese Academy of Sciences, CHINA*, <sup>2</sup>*University of Chinese Academy of Sciences, CHINA*, and <sup>3</sup>*Xin-Huangpu Joint Innovation Institute of Chinese Medicine, CHINA*

**W19-b HIGH-SPEED YIELD ESTIMATION OF RF-MEMS USING VECTOR FITTING BASED NERO-TRANSFER MODELS**

Bo Wen<sup>1</sup>, Rukang You<sup>2</sup>, Yuancheng Zhou<sup>2</sup>, Qi Wang<sup>1</sup>, and Wei Wang<sup>1,3,4</sup>

<sup>1</sup>*Peking University, CHINA*, <sup>2</sup>*Chinese Academy of Sciences, CHINA*, <sup>3</sup>*National Key Laboratory of Micro/Nano Fabrication Technology, CHINA*, and <sup>4</sup>*Beijing Advanced Innovation Center for Integrated Circuits, CHINA*

**b - Emerging Technologies and New Opportunities for MEMS/NEMS****MEMS/NEMS for Hardware Security****M20-b CMOS-MEMS TUNED-MASS-DAMPER BASED PHYSICAL UNCLONABLE FUNCTION (PUF)**

I-Fei Chung, Ting-Yi Chen, Pin-Chun Huang, Ting-Jiu Liou, and Wei-Chang Li

*National Taiwan University, TAIWAN*

**MEMS/NEMS for Hardware Security****T20-b CONTRIBUTION OF MEMS TO PHYSICAL UNCLONABLE FUNCTIONS (PUFS): RANDOM CONFIGURATION OF PDMS NANO-STRUCTURE FOR OPTICAL PUF**

Myung-Kun Chung, Min-Uk Kim, Jong-Woo Han, Jae-Soon Yang, Beom-Jun Kim, Min-Seung Jo, Se-Yoon Jung, Sung-Ho Kim, and Jun-Bo Yoon

*Korea Advanced Institute of Science and Technology (KAIST), KOREA*

**b - Emerging Technologies and New Opportunities for MEMS/NEMS****New Computing Devices and Systems with MEMS/NEMS****W20-b HIGHLY RELIABLE NANOELECTROTHERMAL NON-VOLATILE MEMORY WITH CMOS-LEVEL VOLTAGE AND LOW ON-STATE RESISTANCE**

Yong-Bok Lee<sup>1</sup>, Pan-Kyu Choi<sup>1</sup>, Min-Ho Kang<sup>2</sup>, Su-Hyun Kim<sup>1</sup>, Seung-Jun Lee<sup>1</sup>, Tae-Soo Kim<sup>1</sup>, So-Young Lee<sup>1</sup>, and Jun-Bo Yoon<sup>1</sup>

<sup>1</sup>*Korea Advanced Institute of Science and Technology (KAIST), KOREA* and <sup>2</sup>*National NanoFab Center (NNFC), KOREA*

**M21-b EXPLORING SURFACE ACOUSTIC WAVE DEVICES FOR SOUND-BASED RESERVOIR COMPUTING**

Claude Meffan, Taiki Ijima, Amit Banerjee, Jun Hirotsani, and Toshiyuki Tsuchiya

*Kyoto University, JAPAN*

**b - Emerging Technologies and New Opportunities for MEMS/NEMS****Nonlinear Dynamics in MEMS/NEMS****T21-b BIFURCATION GENERATED TRUE RANDOM NUMBERS IN NONLINEAR MICROMECHANICAL RESONATORS**

Ting-Yi Chen and Wei-Chang Li

*National Taiwan University, TAIWAN*

**W21-b HIGH-ORDER HARMONICS FREQUENCY COMB GENERATION OF A SINGLE DRIVEN NONLINEAR NEMS MODE**

Seyyed Mojtaba Hassani Gangaraj, Yue Zheng, Jialin Wang, Mingyo Park, and Azadeh Ansari

*Georgia Institute of Technology, USA*

**M22-b MACHINE LEARNING BASED NONLINEAR RESONATOR SYSTEM IDENTIFICATION**

Pavitra Jain<sup>1</sup>, Garvit Gupta<sup>1</sup>, Hyun-Keun Kwon<sup>2</sup>, Gabrielle D. Vukasin<sup>2</sup>, and Saurabh A. Chandorkar<sup>1</sup>

<sup>1</sup>*Indian Institute of Science, Bangalore, INDIA* and

<sup>2</sup>*Stanford University, USA*

**T22-b TUNING AMONG MULTIPLE PHONONIC FREQUENCY COMBS BY A SINGLE-TONE EXCITATION DUE TO PERIOD-DOUBLING BIFURCATION**

Jiahao Wu, Penghui Song, Yan Qiao, Wenming Zhang, and Lei Shao

*Shanghai Jiao Tong University, CHINA*



## Nonlinear Dynamics in MEMS/NEMS

**W22-b DESIGN OF A NOVEL SELF-POWERED SENSOR STRUCTURE BASED ON INTERNAL RESONANCE AND MODE LOCALIZATION WITH ADJUSTABLE COUPLING**

Zhujie Zhao<sup>1</sup>, Xuesong Shang<sup>2</sup>, Wei Zhang<sup>1</sup>, Maogang Li<sup>1</sup>,  
Lijia Zhang<sup>1</sup>, Jiajia Xiang<sup>1</sup>, Xiaohe Liu<sup>3</sup>, Jie Song<sup>4</sup>,  
Yuanlin Xia<sup>1</sup>, Cao Xia<sup>1</sup>, and Zhuqing Wang<sup>1</sup>

<sup>1</sup>Sichuan University, CHINA, <sup>2</sup>Tianjin Guoke Medical Engineering and  
Technology Development Co., Ltd, CHINA, <sup>3</sup>Shenyang Ligong  
University, CHINA, and <sup>4</sup>Jiangsu University, CHINA

**M23-b NONLINEAR MODE COUPLING COEFFICIENT EXTRACTION IN ATOMICALLY THIN MoS<sub>2</sub> NANO-ELECTROMECHANICAL RESONATORS**

S M Enamul Hoque Yousuf<sup>1</sup>, Tahmid Kaiser<sup>1</sup>, Steven W. Shaw<sup>2,3</sup>,  
and Philip X.-L. Feng<sup>1</sup>

<sup>1</sup>University of Florida, USA, <sup>2</sup>Florida Institute of Technology, USA,  
and <sup>3</sup>Michigan State University, USA

**T23-b NONLINEAR DAMPING AND QUALITY FACTOR IN 2D MOLYBDENUM DISULFIDE NEMS RESONATORS AT VARYING ELECTRICAL DRIVE**

Pengcheng Zhang<sup>1</sup>, Jiahao Sun<sup>1</sup>, Yijian Zhang<sup>1</sup>, Maosong Xie<sup>1</sup>,  
Minliang Shen<sup>1</sup>, Yueyang Jia<sup>1</sup>, Zuheng Liu<sup>1</sup>, Xin Zhou<sup>2</sup>,  
Dingbang Xiao<sup>2</sup>, Ying Chen<sup>3</sup>, Hao Jia<sup>3</sup>, and Rui Yang<sup>1</sup>

<sup>1</sup>Shanghai Jiao Tong University, CHINA, <sup>2</sup>National University of Defense  
Technology, CHINA, and <sup>3</sup>Chinese Academy of Sciences, CHINA

**W23-b Q-BOOSTING OF COMPOSITE CMOS-MEMS RESONATORS BY AC CURRENT LOW-TEMPERATURE ANNEALING**

Anurag A. Zope, Kalyani S. Bhosale, and Sheng-Shian Li  
National Tsing Hua University, TAIWAN

## b - Emerging Technologies and New Opportunities for MEMS/NEMS

## Quantum Devices and Systems with MEMS/NEMS

**M24-b LEVERAGING BULK ACOUSTIC RESONATORS TOWARDS OPTOMECHANICAL MICROWAVE-TO-OPTICAL FREQUENCY CONVERSION**

Liam G. Connolly and Jason J. Gorman

National Institute of Standards and Technology, USA

**T24-b A HIGHLY RELIABLE CRYOGENIC MICROELECTROMECHANICAL SWITCH WITH SLOT-SPRING STRUCTURE FOR QUANTUM COMPUTING APPLICATIONS**

So-Young Lee<sup>1</sup>, Yong-Bok Lee<sup>1</sup>, Tae-Soo Kim<sup>1</sup>, Seung-Jun Lee<sup>1</sup>,  
Sung-Ho Kim<sup>1</sup>, Jisung Lee<sup>2</sup>, Seung-Young Park<sup>2</sup>, and Jun-Bo Yoon<sup>1</sup>

<sup>1</sup>Korea Advanced Institute of Science and Technology (KAIST), KOREA  
and <sup>2</sup>Korea Basic Science Institute (KBSI), KOREA

**W24-b MICROFABRICATED BUBBLE-IN-BUBBLE ALKALI VAPOR CELL FOR 3-D ATOMIC SENSORS**

Wenqi Li and Jintang Shang  
Southeast University, CHINA

**Quantum Devices and Systems with MEMS/NEMS**

- M25-b** **MINIATURIZED DIAMOND QUANTUM MAGNETOMETER WITH INTEGRATED LASER SOURCE AND ALL ELECTRICAL I/OS**  
Fei Xie<sup>1,2</sup>, Zhichao Chen<sup>1,2</sup>, Xiao Peng<sup>1,2</sup>, Qihui Liu<sup>1,2</sup>, Lingyun Li<sup>1,2</sup>, Nan Wang<sup>1,2</sup>, Yuqiang Hu<sup>3,4</sup>, Yichen Liu<sup>1,2</sup>, Lihao Wang<sup>1,2</sup>, Hao Chen<sup>1,2,3</sup>, Jiangong Cheng<sup>1,2</sup>, and Zhenyu Wu<sup>1,2,3,4</sup>  
<sup>1</sup>Chinese Academy of Sciences, CHINA, <sup>2</sup>University of Chinese Academy of Sciences, CHINA, <sup>3</sup>Shanghai University, CHINA, and <sup>4</sup>Shanghai Industrial  $\mu$ Technology Research Institute, CHINA

**c - Industry MEMS and Advancing MEMS for Products and Sustainability****Measurement Methods for Product Specs**

- T25-c** **PROCESS CONTROL MONITORING DEVICES FOR CMOS-MEMS MONOLITHIC PMUT TECHNOLOGY**  
Eloi Marigó, Siva Kumaaran, Mohd Safwan, and Goon Weng Wong  
*Silterra Malaysia Sdn. Bhd., MALAYSIA*
- W25-c** **VISUALIZATION OF VIBRATION IN MEMS RESONATORS USING STROBOSCOPIC DIFFERENTIAL INTERFERENCE CONTRAST MICROSCOPY WITH ENHANCED TEMPORAL RESOLUTION**  
Qian Liu, Mirai Iimori, Chao Li, and Ya Zhang  
*Tokyo University of Agriculture and Technology, JAPAN*

**c - Industry MEMS and Advancing MEMS for Products and Sustainability****MEMS/NEMS - CMOS Integration**

- M26-c** **INTEGRATION OF INFRARED SENSOR AND PRESSURE/HUMIDITY/TEMPERATURE CMOS-MEMS ENVIRONMENTAL SENSING HUB BY LOCAL VACUUM PACKAGING**  
Yuan Yuan Huang<sup>1</sup>, Yu-Cheng Lin<sup>2</sup>, MeiFeng Lai<sup>1</sup>, and Weileun Fang<sup>1</sup>  
<sup>1</sup>National Tsing Hua University, TAIWAN and <sup>2</sup>National Cheng Kung University, TAIWAN
- T26-c** **ELECTRONIC NOSE BASED ON THE INTEGRATION OF MEMS MULTI-SENSOR AND CMOS CIRCUIT**  
Xiawei Yue<sup>1,2</sup>, Jiachuang Wang<sup>1,2</sup>, Fangyu Zhao<sup>1,2</sup>, Pingping Zhang<sup>3</sup>, Heng Yang<sup>1,2</sup>, Tiger H. Tao<sup>1,2,4,5,6,7</sup>, and Nan Qin<sup>1</sup>  
<sup>1</sup>Chinese Academy of Sciences, CHINA, <sup>2</sup>University of Chinese Academy of Sciences, CHINA, <sup>3</sup>Suzhou Huiwen Nanotechnology Co. Ltd., CHINA, <sup>4</sup>ShanghaiTech University, CHINA, <sup>5</sup>Shanghai Research Center for Brain Science and Brain-Inspired Intelligence, CHINA, <sup>6</sup>Neuroxess Co., Ltd., CHINA, and <sup>7</sup>Shanghai Institute of Microsystem and Information Technology, CHINA

**c - Industry MEMS and Advancing MEMS for Products and Sustainability****Methods of Product Comparison**

- W26-c** **THE LIFETIME PREDICTION FOR METAL MEMS CANTILEVER SWITCH**  
Yabei Gu, Xu Zhu, Nicholas Yost, Max de Feijter, Chris Nassar, and Chris Keimel  
*Menlo Microsystems, Inc., USA*



**c - Industry MEMS and Advancing MEMS for Products and Sustainability****New MEMS System Design and Integration Approaches****M27-c INTEGRATED PAPERTRONICS FOR A SUSTAINABLE FUTURE**

Zahra Rafiee, Anwar Elhadad, and Seokheun Choi  
*State University of New York, Binghamton, USA*

**d - MEMS/NEMS Materials, Fabrication and Packaging****Advancement in Conventional Materials for MEMS & NEMS****T27-d PRESSURE SENSOR BASED ON AN ORGANIC ELECTROCHEMICAL TRANSISTOR WITH MODULATION OF ELECTRICAL-DOUBLE-LAYER**

Kota Inoue<sup>1</sup>, Kazumoto Miwa<sup>2</sup>, Sunao Shimizu<sup>3</sup>, Kazuhide Ueno<sup>1</sup>,  
Junichiro Ohe<sup>4</sup>, Shimpei Ono<sup>2</sup>, and Hiroki Ota<sup>1</sup>  
<sup>1</sup>*Yokohama National University, JAPAN*, <sup>2</sup>*Central Research Institute of  
Electric Power Industry, JAPAN*, <sup>3</sup>*Toyama Prefectural University, JAPAN*,  
and <sup>4</sup>*Toho University, JAPAN*

**W27-d IMPACT OF EXCESS CARBON AT THE 3C-SiC/SiO<sub>2</sub> INTERFACE USING LPCVD-BASED ALTERNATING SUPPLY DEPOSITION**

Philipp Moll, Georg Pfusterschmied, and Ulrich Schmid  
*TU Wien, AUSTRIA*

**M28-d DC HOT SWITCHING LIFETIME STUDY FOR CONTACT MEMS SWITCH BY WEIBULL DISTRIBUTION ANALYSIS**

Yulong Zhang<sup>1</sup>, Jianwen Sun<sup>1</sup>, Huiliang Liu<sup>2</sup>,  
Jiangtao Wei<sup>1</sup>, and Zewen Liu<sup>1</sup>  
<sup>1</sup>*Tsinghua University, CHINA* and  
<sup>2</sup>*China Academy of Space Technology, CHINA*

**d - MEMS/NEMS Materials, Fabrication and Packaging****Digital Micromanufacturing****T28-d LASER-BASED FABRICATION PROCESS FOR PIEZORESISTIVE CANTILEVER USING FLASH LASER ANNEALING**

Rihachiro Nakashima<sup>1</sup>, Tetsuo Kan<sup>2</sup>, and Hidetoshi Takahashi<sup>1</sup>  
<sup>1</sup>*Keio University, JAPAN* and  
<sup>2</sup>*University of Electro-Communications, JAPAN*

**W28-d DIGITAL LIGHT PROCESSING METHOD TO FABRICATE CONDUCTIVE POLYMER ON VARIOUS SUBSTRATES FOR MICROELECTRODE AND PHYSICAL SENSING APPLICATION**

Muhammad Faizul Zaki, Chen-Fang Sun, Pin-Chuan Chen,  
Adhimoorthy Saravanan, and Bohr-Ran Huang  
*National Taiwan University of Science and Technology, TAIWAN*

**d - MEMS/NEMS Materials, Fabrication and Packaging****New & Emerging Materials for MEMS/NEMS****M29-d A NOVEL MINIATURIZED BI-STABLE SELF-SENSING SOFT ACTUATOR BASED ON CNT-DISPERSED IONOGEL**

Li-Yu Lo, Pei-Ting Lin, Chia-Yu Cho, Hsiang-Yun Wang,  
and Yao-Joe Yang  
*National Taiwan University, TAIWAN*

**New & Emerging Materials for MEMS/NEMS**

- T29-d** **INVESTIGATING MECHANICAL PROPERTIES OF SILICON CARBIDE COATED CARBON NANOTUBE COMPOSITE AT ELEVATED TEMPERATURES**  
Jiarui Mo<sup>1</sup>, Gerald J.K. Schaffar<sup>2</sup>, Leiming Du<sup>1</sup>, Verena Maier-Kiener<sup>2</sup>, Daniel Kiener<sup>2</sup>, Sten Vollebregt<sup>1</sup>, and Guoqi Zhang<sup>1</sup>  
<sup>1</sup>*Delft University of Technology, NETHERLANDS and*  
<sup>2</sup>*Montanuniversität Leoben, AUSTRIA*
- W29-d** **FLEXOELECTRIC PYRAMID ULTRASONIC RECEIVERS FOR POWERING MINIATURE IMPLANTS**  
Sophia Selvarajan<sup>1</sup>, Sayemul Islam<sup>1</sup>, Seung H. Song<sup>2</sup>, and Albert Kim<sup>1</sup>  
<sup>1</sup>*University of South Florida, USA and*  
<sup>2</sup>*Sookmyung Women's University, KOREA*
- M30-d** **ENHANCED QUALITY FACTOR IN 2D NEMS RESONATORS BY OPTIMIZING AIR DAMPING AND THERMOELASTIC DAMPING**  
Pengcheng Zhang<sup>1</sup>, Yueyang Jia<sup>1</sup>, Maosong Xie<sup>1</sup>, Zuheng Liu<sup>1</sup>, Yijian Zhang<sup>1</sup>, Minliang Shen<sup>1</sup>, Jiahao Sun<sup>1</sup>, Ying Chen<sup>2</sup>, Hao Jia<sup>2</sup>, and Rui Yang<sup>1</sup>  
<sup>1</sup>*Shanghai Jiao Tong University, CHINA and*  
<sup>2</sup>*Chinese Academy of Sciences, CHINA*
- T30-d** **GALLIUM NITRIDE (GaN) MEMS LAMB WAVE RESONATORS OPERATING AT HIGH TEMPERATURE UP TO 800°C**  
Wen Sui, Mark Sheplak, and Philip X.-L. Feng  
*University of Florida, USA*
- W30-d** **SELF-HEALING AND HIGHLY STRETCHABLE ELECTRONIC SKIN FOR SOFT ROBOTS**  
Kuan-Yu Tu, Yu-Chia Lin, Lung-Hao Hu, and Ching-Te Kuo  
*National Sun Yat-sen University, TAIWAN*

**d - MEMS/NEMS Materials, Fabrication and Packaging****Generic MEMS & NEMS Manufacturing Techniques**

- M31-d** **GLASS AS A FUNCTIONAL MATERIAL FOR MICRO ELECTROMECHANICAL SYSTEMS**  
Maik Bertke, Svenja Schudak, and Roman Ostholt  
*LPKF Laser & Electronics SE, GERMANY*
- T31-d** **A SUPER STRETCHABLE, STRAIN-INSENSITIVE VERTICAL SERPENTINE CONDUCTOR BASED ON MEMS TECHNOLOGY**  
Rui Jiao<sup>1</sup>, Ruoqin Wang<sup>1</sup>, Qian Xu<sup>1</sup>, Yixin Wang<sup>1</sup>, Yik Kin Cheung<sup>1</sup>, and Hongyu Yu<sup>1,2</sup>  
<sup>1</sup>*Hong Kong University of Science and Technology, HONG KONG and*  
<sup>2</sup>*HKUST Shenzhen-Hong Kong Collaborative Innovation Research Institute, CHINA*
- W31-d** **NO-DISTORTION DEFORMATION OF KIRIGAMI STRUCTURES USING ACTIVE GRIPPING**  
Nagi Nakamura and Eiji Iwase  
*Waseda University, JAPAN*

**Generic MEMS & NEMS Manufacturing Techniques****M32-d ENGINEERING 3D HIERARCHICAL STRUCTURES WITH BIO-MIMETIC SOLID FRACTION GRADIENT**

Qingyang Sun and Tingyi "Leo" Liu  
*University of Massachusetts, USA*

**T32-d MONTE CARLO SIMULATION OF THE WET ETCHING BASED ON THE COMPLICATED ATOMIC STRUCTURE OF SAPPHIRE**

Guorong Wu, Xinghua Miao, Juan Chen, Zhufeng Miao,  
and Xuanrong Gu  
*Taizhou University, CHINA*

**W32-d A DIGITAL PCR CHIP WITH 3D STRUCTURE AND COMPOSITE MATERIALS**

Shiyuan Gao<sup>1,2,3</sup>, Tiegang Xu<sup>1,2</sup>, Lei Wu<sup>1,2</sup>, Xiaoyue Zhu<sup>4</sup>,  
Zhan Ma<sup>5</sup>, and Xinxin Li<sup>1,2,3</sup>

<sup>1</sup>Chinese Academy of Sciences, CHINA, <sup>2</sup>University of Chinese Academy of Sciences, CHINA, <sup>3</sup>ShanghaiTech University, CHINA, <sup>4</sup>Fujian Agriculture and Forestry University, CHINA, and <sup>5</sup>Shanghai Jiaotong University School of Medicine, CHINA

**d - MEMS/NEMS Materials, Fabrication and Packaging****New Fabrication Processes for Making MEMS/NEMS****M33-d MICRO-TRANSFER PRINTING OF PHOTORESIST USING ADHESION-SWITCHABLE STAMP FOR PATTERNING UNCONVENTIONAL SURFACE**

Qinhua Guo<sup>1</sup>, Jingyang Zhang<sup>1</sup>, Xin Shu<sup>1</sup>, Jiajun Zhang<sup>1</sup>,  
Qingming Chen<sup>3</sup>, Shengdong Zhang<sup>2</sup>, and Yunda Wang<sup>1</sup>  
<sup>1</sup>Hong Kong University of Science and Technology, CHINA,  
<sup>2</sup>Peking University, CHINA, and <sup>3</sup>Sun Yat-sen University, CHINA

**T33-d ALL-INKJET-PRINTED, COLOR-SELECTIVE PHOTODETECTOR ARRAY BASED ON ORGANIC MACROCYCLES-CARBON NANOTUBE HETEROSTRUCTURES**

Daeyeon Koh<sup>1</sup>, Soonjae Pyo<sup>2</sup>, and Jongbaeg Kim<sup>1</sup>  
<sup>1</sup>Yonsei University, KOREA and <sup>2</sup>Seoul National University of Science and Technology, KOREA

**W33-d POLYMETHYL METHACRYLATE (PMMA) PYROLYSIS ASSISTED TRANSFER OF 2D MATERIALS FOR LARGE-SCALE MOLYBDENUM DISULFIDE NEMS RESONATOR ARRAYS**

Zuheng Liu<sup>1</sup>, Jianyong Wei<sup>1</sup>, Pengcheng Zhang<sup>1</sup>, Yueyang Jia<sup>1</sup>,  
Ying Chen<sup>2</sup>, Hao Jia<sup>2</sup>, Zenghui Wang<sup>3</sup>, and Rui Yang<sup>1</sup>

<sup>1</sup>Shanghai Jiao Tong University, CHINA, <sup>2</sup>Chinese Academy of Sciences, CHINA, and <sup>3</sup>University of Electronic Science and Technology of China, CHINA

**M34-d ALL-PRINTING FABRICATION FOR STRETCHABLE DEVICES BASED ON R2R PROCESSES**

Kyohei Nagatake<sup>1</sup>, Hiroki Kawakami<sup>1</sup>, Sijie Ni<sup>1</sup>, Fumika Nakamura<sup>1</sup>,  
Tamami Takano<sup>1</sup>, Ibuki Ohara<sup>1</sup>, Ryosuke Matsuda<sup>1</sup>, Tatsuhiro Horii<sup>2</sup>,  
Toshinori Fujie<sup>2</sup>, and Hiroki Ota<sup>1</sup>

<sup>1</sup>Yokohama National University, JAPAN and  
<sup>2</sup>Tokyo Institute of Technology, JAPAN

**New Fabrication Processes for Making MEMS/NEMS**

- T34-d TUNABLE ULTRA-SMALL MONOLITHICALLY-ROLLED-UP CAPACITORS BY PIEZOELECTRIC ACTUATION**  
Kristen Nguyen, Zhendong Yang, Allen Wang,  
Scott A. Wicker, and Xiuling Li  
*University of Texas, Austin, USA*
- W34-d NANOSPIRES INSULATION PENETRATOR FOR RELIABLE ON-TOUCH ELECTRICAL CONNECTION**  
Ryugo Shimamura, Kei Misumi, Shun Yasunaga, Akio Higo,  
Ryosho Nakane, and Yoshio Mita  
*University of Tokyo, JAPAN*
- M35-d S-RUM INDUCTORS: 30-FOLD ENHANCEMENT OF INDUCTANCE BY CONTROLLED ELECTROPLATING POST ROLLING**  
Zhendong Yang<sup>1</sup>, Apratim Khandelwal<sup>2</sup>, Allen Wang<sup>1</sup>, Kristen Nguyen<sup>1</sup>,  
Scott Wicker<sup>1</sup>, Yang Victoria Shao<sup>2</sup>, and Xiuling Li<sup>1,2</sup>  
<sup>1</sup>*University of Texas, Austin, USA* and <sup>2</sup>*University of Illinois,  
Urbana-Champaign, USA*
- T35-d CONFORMAL DESIGN AND FABRICATION OF WEARABLE PIEZOELECTRIC SENSOR ARRAY FOR SPATIOTEMPORAL DISTRIBUTION OF ARTERIAL PULSE WAVES**  
Liyun Zhen, Yueqi Zhai, Xiantao Zhu, Mengfei Xu, Yizhi Li,  
Jingquan Liu, and Bin Yang  
*Shanghai Jiao Tong University, CHINA*
- W35-d THROUGH-SILICON ISOLATION BASED ON DRY FILLING AND REFLOW OF MICRON GLASS POWDERS**  
Wenduan Zhou<sup>1,2</sup>, Biyun Ling<sup>1</sup>, Dong Chen<sup>3</sup>, Qiao Xu<sup>3</sup>, Yuhu Xia<sup>1,2</sup>,  
Minli Cai<sup>1,2</sup>, and Yaming Wu<sup>1</sup>  
<sup>1</sup>*Chinese Academy of Sciences, CHINA*, <sup>2</sup>*University of Chinese Academy  
of Sciences, CHINA*, and <sup>3</sup>*Shanghai Satellite Internet Research Institute  
Co., Ltd., CHINA*

**d - MEMS/NEMS Materials, Fabrication and Packaging****Packaging & Assembly**

- M36-d FLEXIBLE MEMS-IC MICROSYSTEM BY A WAFER-LEVEL F-ESIFO INTEGRATION PROCESS**  
Lang Chen<sup>1</sup>, Han Xu<sup>1</sup>, Chi Zhang<sup>1,2,3</sup>, and Wei Wang<sup>1,2,3</sup>  
<sup>1</sup>*Peking University, CHINA*, <sup>2</sup>*National Key Laboratory of Advanced Micro  
and Nano Manufacture Technology, CHINA*, and <sup>3</sup>*Beijing Advanced  
Innovation Center for Integrated Circuits, CHINA*

**e – MEMS Actuators and PowerMEMS****Actuator Components & Systems**

- T36-e A NON-VOLATILE SURFACE TENSION-DRIVEN ELECTROCHEMICAL LIQUID METAL ACTUATOR**  
Xiaohang Chen<sup>1</sup>, Zihan Wang<sup>1,2</sup>, Wei Yue<sup>1</sup>,  
Peisheng He<sup>1</sup>, and Liwei Lin<sup>1</sup>  
<sup>1</sup>*University of California, Berkeley, USA* and  
<sup>2</sup>*Tsinghua University, CHINA*

**Actuator Components & Systems**

- W36-e** **DESIRED STIFFNESS VERIFICATION ON PROGRAMMABLE MEMS METAMATERIAL**  
Chenyang Lou<sup>1</sup>, Jonathan Hopkins<sup>2</sup>, and Michael Cullinan<sup>2</sup>  
<sup>1</sup>University of Texas, Austin, USA and <sup>2</sup>University of California, Los Angeles, USA
- M37-e** **BANDWIDTH ENHANCEMENT OF PIEZOELECTRIC MEMS MICROSPEAKER VIA CENTRAL DIAPHRAGM ACTUATION AND FILTER INTEGRATION**  
Chia-Hao Lin, Ting-Chou Wei, Chin Tseng, Zih-Song Hu, Mei-Feng Lai, and Weileun Fang  
National Tsing Hua University, TAIWAN
- T37-e** **DUAL-AXIS PIEZOELECTRIC MEMS MICROMIRROR WITH ADJUSTABLE ASPECT RATIO OF LISSAJOUS PATTERNS THROUGH STRUCTURE DESIGN AND ELECTRODE ARRANGEMENT**  
Po-Chun Lin, Chih-Chen Hsu, Hui-Ming Yang, Hung-Yu Lin, Si-Han Chen, and Weileun Fang  
National Tsing Hua University, TAIWAN
- W37-e** **USING REVERSE TRAPEZOID CANTILEVERS AND SEALED BACK-CHAMBER TO ENHANCE THE PERFORMANCE OF MEMS PIEZOELECTRIC MICROSPEAKER AT ULTRA-HIGH FREQUENCIES**  
Chin Tseng, Ting-Chou Wei, Chia-Hao Lin, Zih-Song Hu, and Weileun Fang  
National Tsing Hua University, TAIWAN
- M38-e** **AN ELECTROTHERMAL MICROCAGE BASED ON AL-SiO<sub>2</sub> BIMORPH ACTUATORS**  
Hengzhang Yang, Yao Lu, Yingtao Ding, Anrun Ren, Xiaoyi Wang, and Huikai Xie  
Beijing Institute of Technology, CHINA
- T38-e** **A PHOTSENSITIVE POLYIMIDE-SiO<sub>2</sub> BIMORPH BASED ELECTROTHERMAL MICROMIRROR WITH HIGH IMPACT RESISTANCE**  
Hengzhang Yang, Anrun Ren, Yingtao Ding, Yao Lu, Teng Pan, Xiaoyi Wang, and Huikai Xie  
Beijing Institute of Technology, CHINA
- W38-e** **LIGHTWEIGHT INERTIAL SWITCH WITH SPIRAL SEPARATION MECHANISM FOR EXTENDING CONTACT TIME**  
Mingyu Zhang<sup>1</sup>, Tan Yin<sup>1</sup>, Zhiyuan Hu<sup>1</sup>, Mengcheng Wang<sup>1</sup>, Haokai Huang<sup>1</sup>, Yanxin Zhang<sup>1</sup>, Yongcun Hao<sup>2</sup>, Honglong Chang<sup>2</sup>, Yan Wang<sup>1</sup>, Yunna Sun<sup>1</sup>, Zhuoqing Yang<sup>1</sup>, and Guifu Ding<sup>1</sup>  
<sup>1</sup>Shanghai Jiao Tong University, CHINA and  
<sup>2</sup>Northwestern Polytechnical University, CHINA

## e – MEMS Actuators and PowerMEMS

## Energy Harvesting Materials, Structures, and Transducers

- M39-e** AN INTERVENTIONAL MICROFABRICATION PROCESS FOR INTEGRATION OF COMMERCIAL PIEZOELECTRIC FILMS AND MICRO STRUCTURES FOR ULTRA-LOW FREQUENCY ENERGY HARVESTING  
Haizhao Feng<sup>1</sup>, Ling Bu<sup>2</sup>, Sixing Xu<sup>3</sup>, and Xiaohong Wang<sup>1</sup>  
<sup>1</sup>Tsinghua University, CHINA, <sup>2</sup>China University of Geosciences, CHINA, and <sup>3</sup>Hunan University, CHINA
- T39-e** PAPER-BASED MOIST-ELECTRIC GENERATORS FOR SCALABLE, DISPOSABLE, AND GREEN POWER GENERATION  
Yang Gao and Seokheun Choi  
State University of New York, Binghamton, USA
- W39-e** ENHANCING POWER DENSITY THROUGH ELECTRODE CONFIGURATION FOR PIEZOMEMS ENERGY HARVESTER  
Ranjith Janardhana<sup>1</sup>, Sean Smith<sup>2</sup>, Naomi Montross<sup>2</sup>, Joe Evans<sup>2</sup>, and Nathan Jackson<sup>1</sup>  
<sup>1</sup>University of New Mexico, USA and <sup>2</sup>Radiant Technologies, USA
- M40-e** LOW-TEMPERATURE INTEGRATION OF BULK PZT-5H FOR ENHANCING THE PERFORMANCE OF MEMS-BASED PIEZOELECTRIC ULTRASONIC ENERGY HARVESTERS  
Xu Tian, Theocharis Nikiforos Iordanidis, Göran Stemme, and Niclas Roxhed  
KTH Royal Institute of Technology, SWEDEN
- T40-e** A HIGH-PERFORMANCE PIEZOELECTRIC VIBRATION ENERGY HARVESTER WITH ULTRA-LOW ACCELERATION  
Fayang Wang, Pengfan Wu, Endian Cui, Zhenfeng Ji, Jizhen Li, and Xiaojing Mu  
Chongqing University, CHINA

## e – MEMS Actuators and PowerMEMS

## Manufacturing for Actuators &amp; Power MEMS

- W40-e** A 2-AXIS SI/AL BIMORPH-BASED ELECTROTHERMAL MICROMIRROR INTEGRATED WITH PIEZORESISTORS FOR HIGH RESOLUTION POSITION SENSING  
Yue Tang, Xiaoyi Wang, Lixin Xu, and Huikai Xie  
Beijing Institute of Technology, CHINA
- M41-e** FEMTOSECOND LASER DIRECT WRITING FOR CROSS-LINKED LIQUID CRYSTAL POLYMER MICROACTUATOR CONSTRUCTION  
Yong Wang<sup>1,2</sup>, Yingzhi Wang<sup>2</sup>, Jingui Qian<sup>3</sup>, and Jin Xie<sup>2</sup>  
<sup>1</sup>Hangzhou City University, CHINA, <sup>2</sup>Zhejiang University, CHINA, and <sup>3</sup>Hefei University of Technology, CHINA





## e – MEMS Actuators and PowerMEMS

## Materials for Actuators &amp; Power MEMS

- T41-e**    **EPITAXIAL SM-DOPED PMN-PT FILM WITH HIGH PIEZOELECTRIC CONSTANT FOR MEMS APPLICATION**  
Kai Fukushi<sup>1</sup>, Shinya Yoshida<sup>1,2</sup>, Xuanmeng Qi<sup>1</sup>, and Shuji Tanaka<sup>1</sup>  
<sup>1</sup>Tohoku University, JAPAN and <sup>2</sup>Shibaura Institute of Technology, JAPAN
- W41-e**    **LEGO-LIKE RECONFIGURABLE SOFT HAPTIC ARRAY VIA SELF-HEALING SENSOR/ACTUATOR MODULES**  
Peisheng He<sup>1</sup>, Wenyong Qiu<sup>1,2</sup>, Yande Peng<sup>1</sup>, Jong Ha Park<sup>1</sup>, Qilong Cheng<sup>1</sup>, David Bogy<sup>1</sup>, and Liwei Lin<sup>1</sup>  
<sup>1</sup>University of California, Berkeley, USA and <sup>2</sup>Tsinghua University, CHINA
- M42-e**    **CRAWLING SOFT ACTUATOR BASED ON LASER INDUCED GRAPHENE**  
Qihang Huang and Yichuan Wu  
University of Electronic Science and Technology of China, CHINA

## e – MEMS Actuators and PowerMEMS

## Power MEMS Components &amp; Systems

- T42-e**    **HIGH-VOLTAGE-ISOLATED MEMS QUAD-SOLENOID TRANSFORMERS WITH S-SHAPE SiO<sub>2</sub> ISOLATION BARRIERS FOR COMPACT GALVANICALLY-ISOLATED GATE DRIVER APPLICATIONS**  
Changnan Chen<sup>1,2</sup>, Pichao Pan<sup>1,2</sup>, Jiebin Gu<sup>1</sup>, and Xinxin Li<sup>1,2</sup>  
<sup>1</sup>Chinese Academy of Sciences, CHINA and  
<sup>2</sup>University of Chinese Academy of Sciences, CHINA
- W42-e**    **PIONEERING 10 KHZ+ APPLICATIONS: THE PROMISE OF ASYMMETRICALLY DESIGNED HYBRID MICRO SUPERCAPACITORS**  
Zhangshan hao Li<sup>1</sup>, Ziyun Yan<sup>1</sup>, Minghao Xu<sup>1</sup>, Haizhao Feng<sup>1</sup>, Sixing Xu<sup>2</sup>, and Xiaohong Wang<sup>1</sup>  
<sup>1</sup>Tsinghua University, CHINA and <sup>2</sup>Hunan University, CHINA

## e – MEMS Actuators and PowerMEMS

## Self-Powered Devices and Microsystems

- M43-e**    **SELF-POWERED PYROELECTRIC WARMTH SENSOR FOR ROBOTIC INTEGRATION AND MATERIALS RECOGNITION**  
Yobin Choi, Chaehyun Ryu, Hang Gyeom Kim, Il Ryu Jang, Jeonhyeong Park, Hyeoncheol Lim, and Hoe Joon Kim  
Daegu Gyeongbuk Institute of Science & Technology (DGIST), KOREA
- T43-e**    **3D-PRINTABLE SELF-POWERED PIEZOELECTRIC SMART STENT FOR WIRELESS ENDOLEAKS SENSING**  
Sayemul Islam<sup>1</sup>, Jun Ying Tan<sup>2</sup>, Trisha Das Mou<sup>1</sup>, Subhrodeep Ray<sup>3</sup>, Haijun Liu<sup>3</sup>, Jungkwun “JK” Kim<sup>2</sup>, and Albert Kim<sup>1</sup>  
<sup>1</sup>University of South Florida, USA, <sup>2</sup>University of North Texas, USA, and  
<sup>3</sup>Temple University, USA



## Self-Powered Devices and Microsystems

**W43-e SELF-POWERED REAL-TIME WIRELESS COMMUNICATION SYSTEM USING WEARABLE FABRIC BASED TRIBOELECTRIC NANOGENERATOR AND INDUCTOR**

Jonghyeon Yun and Daewon Kim  
*Kyung Hee University, KOREA*

## f - MEMS Physical and Chemical Sensors

## Fluidic Sensors

**M44-f ULTRA-SENSITIVE RESONANT LOW-MEDIUM VACUUM PRESSURE MICRO-SENSOR**

Nouha Alcheikh<sup>1</sup>, Sofiane Ben Mbarek<sup>2</sup>, and Mohammad I. Younis<sup>3,4</sup>  
<sup>1</sup>*Khalifa University of Science and Technology, UAE*, <sup>2</sup>*Queen's University Belfast, UK*, <sup>3</sup>*King Abdullah University of Science and Technology, SAUDI ARABIA*, and <sup>4</sup>*Binghamton University, USA*

**T44-f GAS INDEPENDENT THERMAL FLOW METER BASED ON REAL-TIME VELOCITY-INDEPENDENT  $k$  AND  $p_{cp}$  MEASUREMENT**

Shirin Azadi Keri<sup>1</sup>, Remco J. Wiegerink<sup>1</sup>, Remco G.P. Sanders<sup>1</sup>, and Joost C. Lötters<sup>1,2</sup>  
<sup>1</sup>*University of Twente, NETHERLANDS* and  
<sup>2</sup>*Bronkhorst High-Tech B.V., NETHERLANDS*

**W44-f INLINE AND REAL-TIME MICROFLUIDIC RELATIVE PERMITTIVITY SENSOR USING HIGHLY DOPED SILICON SIDEWALL ELECTRODES**

Maarten J.S. Bonnema<sup>1</sup>, Henk-Willem Veltkamp<sup>1</sup>, Dennis Alveringh<sup>1</sup>, Remco J. Wiegerink<sup>1</sup>, and Joost C. Lötters<sup>1,2</sup>  
<sup>1</sup>*University of Twente, NETHERLANDS* and  
<sup>2</sup>*Bronkhorst High-Tech B.V., NETHERLANDS*

**M45-f A WIDE-RANGE RESONANT PRESSURE SENSOR WITH ENHANCED SENSITIVITY BASED ON AN INDIRECT COUPLING SCHEME**

Praveen Kumar<sup>1</sup>, Sahana D.<sup>1,2</sup>, Chandrashekar L.N.<sup>1</sup>, Antony Jeyaseelan<sup>1</sup>, M.M. Nayak<sup>1</sup>, Rudra Pratap<sup>1,2</sup>, and Gayathri Pillai<sup>1</sup>  
<sup>1</sup>*Indian Institute of Science, Bengaluru, INDIA* and  
<sup>2</sup>*Plaksha University, INDIA*

**T45-f PILLAR-TYPE LASER-INDUCED GRAPHENE AIRFLOW SENSOR ASSEMBLED VIA KIRIGAMI / ORIGAMI TECHNIQUE**

Kei Ohara, Rihachiro Nakashima, and Hidetoshi Takahashi  
*Keio University, JAPAN*

**W45-f MINIATURIZED FLOW SENSOR BASED ON THERMAL FEEDBACK AND DIGITIZED POWER DISTRIBUTION**

Minghao Huang<sup>1</sup>, Izhar<sup>2</sup>, Xiangyu Song<sup>1</sup>, Linze Hong<sup>1</sup>, Ruining Xu<sup>1</sup>, and Wei Xu<sup>1,3</sup>  
<sup>1</sup>*Shenzhen University, CHINA*, <sup>2</sup>*University of Pennsylvania, USA*, and <sup>3</sup>*State Key Laboratory of Radio Frequency Heterogeneous Integration, CHINA*



## f - MEMS Physical and Chemical Sensors

## Force &amp; Displacement Sensors

- M46-f** **A BIOCOMPATIBLE GLASS-ENCAPSULATED TRIAXIAL FORCE SENSOR FOR IMPLANTABLE TACTILE SENSING APPLICATIONS**  
Yixiao Ding<sup>1</sup>, Lin Du<sup>2,3</sup>, Han Hao<sup>1</sup>, Thomas C. E. Mier<sup>1</sup>,  
Jan Van der Spiegel<sup>1</sup>, Timothy H. Lucas<sup>2,3</sup>,  
Firooz Aflatouni<sup>1</sup>, Andrew G. Richardson<sup>1</sup>,  
and Mark G. Allen<sup>1</sup>  
<sup>1</sup>University of Pennsylvania, USA, <sup>2</sup>Ohio State University, USA, and  
<sup>3</sup>NeuroTech Institute, USA
- T46-f** **A VISUAL-TACTILE COUPLING MECHANISM SENSOR FOR REAL-TIME FORCE CALIBRATION**  
Xiaotong Hu, Chunpeng Jiang, Bin Yang, and Jingquan Liu  
Shanghai Jiao Tong University, CHINA
- W46-f** **ORIGAMI-INSPIRED TACTILE SENSORS BASED ON ELECTRICAL CONTACT RESISTANCE (ECR) FOR WEARABLE APPLICATIONS**  
Rajat Subhra Karmakar<sup>1</sup>, Jhih-Fong Huang<sup>2</sup>, Jui-I Chao<sup>2</sup>,  
Ying-Chih Liao<sup>1</sup>, and Yen-Wen Lu<sup>1</sup>  
<sup>1</sup>National Taiwan University, TAIWAN and  
<sup>2</sup>National Yang Ming Chiao Tung University, TAIWAN
- M47-f** **A DIAPHRAGM TRIAXIAL FORCE SENSOR USING SOI TECHNOLOGY WITH HIGH SENSITIVITY AND LARGE FORCE RANGE**  
Cong Lin, Xincheng Zhu, Yi Liu, Jiahao Miao, Zhanxuan Zhou,  
Xueliang Wang, and Xiaomei Yu  
Peking University, CHINA
- T47-f** **3D PRINTED LOW CROSSTALK 6-AXIS FORCE SENSOR PROBE FOR INSECTS' JUMPING FORCE MEASUREMENT**  
Yukitake Nakahara and Hidetoshi Takahashi  
Keio University, JAPAN
- W47-f** **A DUAL SPIRAL-COILS TACTILE SENSOR WITH NOVEL DRIVING MODES FOR INDUCTIVE FORCE AND CAPACITIVE PROXIMITY SENSING**  
Fuchi Shih, Shihwei Lin, Rongshun Chen, and Weileun Fang  
National Tsing Hua University, TAIWAN
- M48-f** **PORTABLY PACKAGED ON-CHIP MICROSPHERICAL GLASS SHELL OPTICAL RESONATOR AS A PRESSURE SENSOR**  
Jiayuan Zhang and Srinivas Tadigadapa  
Northeastern University, USA

## f - MEMS Physical and Chemical Sensors

## Gas &amp; Chemical Sensors

- T48-f** **NANO-NET MoS<sub>2</sub>-BASED NO<sub>2</sub> SENSOR AT ROOM TEMPERATURE USING FACILE FABRICATION WITH ELECTROSPUN FIBER MASK**  
Gyujun Choi<sup>1</sup>, Yongkeun Oh<sup>1</sup>, Jaesam Sim<sup>2</sup>, and Jongbaeg Kim<sup>1</sup>  
<sup>1</sup>Yonsei University, KOREA and <sup>2</sup>Korea Institute of Industrial  
Technology, KOREA



## Gas &amp; Chemical Sensors

- W48-f** **DESIGN AND IMPLEMENTATION OF MULTI-LAYER OPENED-IDAS ELECTRODES FOR THE RESPONSE ENHANCEMENT OF CMOS-MEMS GAS SENSORS AT ROOM TEMPERATURE**  
Thu Do Thi, Chin Tseng, Fuchi Shih, Yuanyuan Huang, Yu-Lun Chueh, and Weileun Fang  
*National Tsing Hua University, TAIWAN*
- M49-f** **AVALANCHE PHOTOIONIZATION DETECTOR**  
Xiaheng Huang, Weishu Wu, and Xudong Fan  
*University of Michigan, USA*
- T49-f** **HIGH-SENSITIVE HYDROGEN DETECTION IN OXYGEN-FREE ENVIRONMENT WITH MEMS DIFFERENTIAL THERMOPILES**  
Zechun Li<sup>1,2</sup>, Ming Li<sup>1</sup>, Hao Jia<sup>1,2</sup>, Haozhi Zhang<sup>1,2</sup>, Pengcheng Xu<sup>1,2</sup>, and Xinxin Li<sup>1,2</sup>  
<sup>1</sup>Chinese Academy of Sciences, CHINA and  
<sup>2</sup>University of Chinese Academy of Sciences, CHINA
- W49-f** **IMPROVEMENT IN CHEMIREISTIVE RESPONSE OF SnO<sub>2</sub> THIN FILM BY RuO<sub>2</sub>-NANOSHEETS-FUNCTIONALIZATION AND ITS APPLICATION TO HIGHLY SENSITIVE ETHANOL SENSOR**  
Wonkeun Park<sup>1</sup>, Yunsung Kang<sup>2</sup>, Xiaoyan Jin<sup>1</sup>, Dongseok Lee<sup>1</sup>, Seong-Ju Hwang<sup>1</sup>, and Jongbaeg Kim<sup>1</sup>  
<sup>1</sup>Yonsei University, KOREA and <sup>2</sup>Kyungpook National University, KOREA
- M50-f** **A MICROFABRICATED COLUMN COMPRISED OF HIGH-ASPECT-RATIO SILICON PILLAR ARRAYS FOR MICRO-GAS CHROMATOGRAPHY**  
Dong Wook Seong, Sung Kuk Bae, and Jung Hwan Seo  
*Hongik University, KOREA*
- T50-f** **GAS SENSORS BASED ON 1 & 2-DOF PIEZOELECTRIC BAW MEMS RESONATORS WITH COATED ZIF-8**  
Linlin Wang<sup>1</sup>, Chen Wang<sup>1</sup>, Max Tietze<sup>1</sup>, Margot Verstreken<sup>1</sup>, Bernardo P. Madeira<sup>1</sup>, Yuan Wang<sup>2</sup>, Nicolas Chanut<sup>1</sup>, Chenxi Wang<sup>1</sup>, Aojie Quan<sup>1</sup>, Rob Ameloot<sup>1</sup>, and Michael Kraft<sup>1</sup>  
<sup>1</sup>KU Leuven, BELGIUM and <sup>2</sup>University of Macau, CHINA
- W50-f** **AN INVESTIGATION ON OBSERVED POSITIVE FREQUENCY SHIFTS DURING GAS UPTAKE FOR COUPLED RESONATORS**  
Chenxi Wang, Yangyang Guan, Chen Wang, Aojie Quan, Giel Arnauts, Rob Ameloot, and Michael Kraft  
*KU Leuven, BELGIUM*
- M51-f** **A HIGH HEAT TRANSFER EFFICIENCY MEMS THERMAL CONDUCTIVITY GAS SENSOR WITH BRIDGE STRUCTURE FOR HYDROGEN DETECTION**  
Dongcheng Xie<sup>1</sup>, Yan Zhang<sup>1</sup>, Di He<sup>2</sup>, Yujie Yang<sup>2</sup>, Ruichen Liu<sup>2</sup>, Chong Xing<sup>2</sup>, Dongliang Chen<sup>2</sup>, Liang Geng<sup>2</sup>, Qiuju Wu<sup>2</sup>, Dongting Yao<sup>2</sup>, and Lei Xu<sup>1</sup>  
<sup>1</sup>Micro Nano Sensing (Hefei) Technology Co., Ltd., CHINA and  
<sup>2</sup>University of Science and Technology of China, CHINA



## Gas &amp; Chemical Sensors

**T51-f A HIGHLY INTEGRATED AND LOW-POWER SNO<sub>2</sub> GAS SENSOR CELL FOR THE DETECTION OF GAS MIXTURE**

Chong Xing<sup>1</sup>, Dongcheng Xie<sup>2</sup>, Yan Zhang<sup>2</sup>, Di He<sup>1</sup>,  
Yujie Yang<sup>1</sup>, Liang Geng<sup>1</sup>, Qiuju Wu<sup>1</sup>, Dongting Yao<sup>1</sup>,  
Dongliang Chen<sup>1</sup>, and Lei Xu<sup>2</sup>

<sup>1</sup>University of Science and Technology of China, CHINA and

<sup>2</sup>Micro Nano Sensing (Hefei) Technology Co., Ltd., CHINA

**W51-f SENSITIVE LEAD DETECTION THROUGH INTEGRATION OF ELECTROCHEMICAL DEPOSITION AND GRAPHENE ION-SENSITIVE FIELD-EFFECT TRANSISTOR**

Yingming Xu, Peng Zhou, Terrence Simon, and Tianhong Cui

University of Minnesota, USA

**M52-f DEVELOPMENT OF GLASS-SUBSTRATE-BASED MEMS MICRO-HOTPLATE WITH LOW-POWER CONSUMPTION AND TGV STRUCTURE THROUGH ANODIC BONDING AND GLASS THERMAL REFLOW**

Honglin Qian<sup>1</sup>, Haotian Dai<sup>1</sup>, Fanhong Chen<sup>2</sup>, Shuai Liu<sup>2</sup>,  
Xiaohui Du<sup>2</sup>, Bing Li<sup>1</sup>, Minjie Zhu<sup>2</sup>, and Gaopeng Xue<sup>1</sup>

<sup>1</sup>Harbin Institute of Technology, CHINA and

<sup>2</sup>Instrumentation Technology and Economy Institute, CHINA

## f - MEMS Physical and Chemical Sensors

## Inertial Sensors

**T52-f CLOSED-LOOP OPERATION OF A HIGH-Q SILICON MEMS QUATREFOIL SUSPENSION GYROSCOPE**

Madan Parajuli<sup>1</sup>, Guillermo Sobreviela-Falces<sup>1</sup>, Douglas Young<sup>1</sup>,  
Niall MacCarthy<sup>1</sup>, Callisto Pili<sup>1</sup>, Colin Baker<sup>1</sup>, and Ashwin Seshia<sup>1,2</sup>

<sup>1</sup>Silicon Microgravity Ltd., UK and <sup>2</sup>University of Cambridge, UK

**W52-f MODE LOCALIZATION AND FREQUENCY MODULATION SENSING USING SUPERPOSED IN-PHASE AND ANTI-PHASE OSCILLATIONS**

Takashiro Tsukamoto<sup>1</sup>, Roman Forke<sup>2</sup>, Sebastian Weidlich<sup>3</sup>,  
Daniel Bülz<sup>2</sup>, Alexey Shaporin<sup>2</sup>, Karla Hiller<sup>3</sup>, and Shuji Tanaka<sup>1</sup>

<sup>1</sup>Tohoku University, JAPAN, <sup>2</sup>Fraunhofer Institute for Electronic Nano Systems, GERMANY, and <sup>3</sup>Chemnitz University of Technology, GERMANY

**M53-f A NOVEL RESONANT MEMS ACCELEROMETER OPERATING IN AIR WITH THERMALLY ACTUATED PIEZORESISTIVE RESONATORS**

Chen Wang<sup>1</sup>, Aojie Quan<sup>1</sup>, Linlin Wang<sup>1</sup>, Rui Amendoeira Esteves<sup>1</sup>,  
Yuan Wang<sup>2</sup>, Bernardo P. Madeira<sup>1</sup>, Yangyang Guan<sup>1</sup>, Xinyu Wu<sup>1</sup>,  
Nadezda Kuznetsova<sup>1</sup>, Milad Shojaeian<sup>1</sup>, Pan Zhang<sup>2,3</sup>,  
Pui-In Mak<sup>2</sup>, and Michael Kraft<sup>1</sup>

<sup>1</sup>KU Leuven, BELGIUM, <sup>2</sup>University of Macau, CHINA, and

<sup>3</sup>Peking University, CHINA



### Inertial Sensors

#### T53-f ENHANCING SENSITIVITY OF MODE-LOCALIZED ACCELEROMETERS USING ASYMMETRICAL COUPLED RESONATORS

Zheng Wang<sup>1</sup>, XingYin Xiong<sup>2</sup>, KunFeng Wang<sup>2,3</sup>, WuHao Yang<sup>2</sup>, XiaoRui Bie<sup>2</sup>, ZhiTian Li<sup>2</sup>, and XuDong Zou<sup>1,2</sup>

<sup>1</sup>QiLu Aerospace Information Research Institute, CHINA,

<sup>2</sup>Chinese Academy of Sciences, CHINA, and

<sup>3</sup>University of Southern California, USA

#### W53-f A FRONT-SIDE FABRICATED MONOLITHIC 5000G-/100000G-MEASURED RANGE COMPOSITE SHOCK ACCELEROMETERS WITH SMALL CHIP-SIZE, HIGH RESONANT FREQUENCY AND ULTRA-HIGH ANTI-OVERLOAD CAPACITY

Mengyao Zheng<sup>1,2</sup>, Haifei Bao<sup>1</sup>, Jiachou Wang<sup>1,2</sup>, and Xinxin Li<sup>1,2</sup>

<sup>1</sup>Chinese Academy of Sciences, CHINA and

<sup>2</sup>University of Chinese Academy of Sciences, CHINA

### f - MEMS Physical and Chemical Sensors

#### Materials for Physical Sensors

#### M54-f IMPACT OF GRAIN SIZE ON THE Q-FACTOR OF POLY-CRYSTALLINE DIAMOND MEMS RESONATORS

Dominik Huber<sup>1</sup>, Daniel Platz<sup>1</sup>, Andre Gesing<sup>1</sup>, Paul Fulmek<sup>1</sup>, Doris Steinmüller-Nethl<sup>2</sup>, Georg Pfusterschmied<sup>1</sup>, and Ulrich Schmid<sup>1</sup>

<sup>1</sup>TU Wien, AUSTRIA and <sup>2</sup>CarbonCompetence GmbH, AUSTRIA

#### T54-f ENHANCED ELECTRICAL CONDUCTIVITY IN LASER-INDUCED GRAPHENE-SILICON CARBIDE LAMINATED NANOSHEETS FOR FLEXIBLE STRAIN SENSORS AND PULSE WAVE VELOCITY ASSESSMENT

Yixin Liu, Yanru Chen, Zhibiao Wang, and Min Zhang

Tsinghua University, CHINA

#### W54-f DYNAMIC RANGE TUNING IN 2D MOLYBDENUM DISULFIDE NEMS RESONATORS TOWARDS AN ENHANCED MASS RESOLUTION

Pengcheng Zhang, Minliang Shen, Yijian Zhang, Shuai Yuan,

Yueyang Jia, Jiahao Sun, Zuheng Liu, and Rui Yang

Shanghai Jiao Tong University, CHINA

### f - MEMS Physical and Chemical Sensors

#### Metrology and Measurement Techniques for MEMS/NEMS Sensors

#### M55-f 800x NON-DISTORTION MAGNIFIED VISUALIZATION OF DEEP SUB-NANOMETER MEMS VIBRATIONS USING A CAMERA

Shuke Zang, Jiahao Wu, Wenming Zhang, and Lei Shao

Shanghai Jiao Tong University, CHINA

### f - MEMS Physical and Chemical Sensors

#### Nanoscale Physical Sensors

#### T55-f TUNABLE DUAL MODE CARBON NANOTUBE STRAIN GAUGE

Morten Vollmann, Cosmin Roman, and Christofer Hierold

ETH Zürich, SWITZERLAND







## f - MEMS Physical and Chemical Sensors

## Sonic &amp; Ultrasonic MEMS Transducers

- W55-f** **ULTRA-WIDE RANGE FREQUENCY TUNING OF PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCERS VIA DC BIAS VOLTAGE**  
Yufeng Gao, Lei Zhao, Chong Yang, and Yipeng Lu  
*Peking University, CHINA*
- T56-f** **A CURVE-STRUCTURED FLEXIBLE PMUT WITH ENHANCED ACOUSTIC SENSITIVITY**  
Yiyin Su<sup>1</sup>, Yiwei Zhang<sup>1</sup>, Xiaohui Yang<sup>1</sup>, Yipeng Lu<sup>2</sup>, Liwei Lin<sup>3</sup>, and Xishan Guo<sup>1</sup>  
<sup>1</sup>*Zhejiang University, CHINA*, <sup>2</sup>*Peking University, CHINA*, and <sup>3</sup>*University of California, Berkeley, USA*
- W56-f** **FABRICATION AND CHARACTERIZATION OF LARGE-AREA FLEXIBLE CAPACITIVE MICROMACHINED ULTRASOUND TRANSDUCERS**  
Chloe Halbach<sup>1,2</sup>, Jeremy Segers<sup>1</sup>, Veronique Rochus<sup>1</sup>, Epimitheas Georgitzikis<sup>1</sup>, Paul Heremans<sup>1,2</sup>, and David Cheyns<sup>1</sup>  
<sup>1</sup>*IMEC, BELGIUM* and <sup>2</sup>*KU Leuven, BELGIUM*
- M57-f** **ON THE PERFORMANCE ENHANCEMENT OF PIEZOELECTRIC MEMS MICROPHONE USING S-SHAPE SLIT DESIGN**  
Zih-Song Hu and Weileun Fang  
*National Tsing Hua University, TAIWAN*
- T57-f** **A BIPOLAR-BIASED DIFFERENTIAL CMOS-MEMS CMUT**  
Po-Chun Chen, Yu-Cheng Lin, Hung-Yu Chen, Sheng-Shian Li, and Ming-Huang Li  
*National Tsing Hua University, TAIWAN*
- W57-f** **DEMONSTRATION OF MHZ PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCERS (PMUTS) ARRAY AND THE POTENTIAL APPLICATION IN BIOMEDICAL THERAPIES**  
Dengke Wang<sup>1</sup>, Yucheng Ji<sup>1</sup>, Shaokun Wang<sup>1</sup>, Haochen Lyu<sup>3</sup>, and Songsong Zhang<sup>1,2</sup>  
<sup>1</sup>*Shanghai University, CHINA*, <sup>2</sup>*Shanghai Melon Tech. Company Ltd., CHINA*, and <sup>3</sup>*Rutgers, State University of New Jersey, USA*
- M58-f** **EQUIDIMENSIONAL SUSPENDED PIEZOELECTRIC MICROMACHINED ULTRASOUND TRANSDUCER ARRAY WITH VARIOUS MASS LOADS FOR HIGH ULTRASOUND SENSITIVITY AND WIDE BANDWIDTH**  
Xingli Xu, Yongquan Ma, Chenyang Yu, Liang Zhang, Wei Wei, Mingchao Sun, Boyun Zhang, Menglun Zhang, Pengfei Niu, and Wei Pang  
*Tianjin University, CHINA*



### Sonic & Ultrasonic MEMS Transducers

- T58-f AN ANALYTICAL METHOD FOR THE ENHANCEMENT OF ELECTROMECHANICAL COUPLING OF PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCERS COMBINED WITH PRE-STRESS**  
Guangzheng Deng<sup>1,2</sup>, Haochen Lyu<sup>2,3</sup>, Haolin Yang<sup>2</sup>, and Songsong Zhang<sup>1,2</sup>  
<sup>1</sup>Shanghai University, CHINA, <sup>2</sup>Shanghai Melon Tech. Company Ltd., CHINA, and <sup>3</sup>Rutgers, State University of New Jersey, USA
- M59-f CONTINUOUS VOLUMETRIC INDOOR TEMPERATURE MONITORING VIA PMUTS**  
Megan Teng<sup>1</sup>, Wei Yue<sup>1</sup>, Pei-Chi Tsao<sup>1</sup>, Yande Peng<sup>1</sup>, Mingzheng Duan<sup>1</sup>, Hanxiao Liu<sup>1</sup>, Seiji Umezawa<sup>2</sup>, Yasuhiro Aida<sup>2</sup>, Shinsuke Ikeuchi<sup>2</sup>, and Liwei Lin<sup>1</sup>  
<sup>1</sup>University of California, Berkeley, USA and <sup>2</sup>Murata Manufacturing Co., Ltd., JAPAN
- T59-f PMUT PACKAGE DESIGN OPTIMIZATION VIA MACHINE LEARNING**  
Megan Teng, Wei Yue, Yande Peng, Pei-Chi Tsao, Huicong Deng, Fan Xia, and Liwei Lin  
University of California, Berkeley, USA
- W59-f SUB-1mm<sup>2</sup> HIGH DETECTION CAPABILITY PMUTS-ON-CMOS ARRAY FOR ULTRASOUND IMAGES**  
Eyglis Ledesma, Francesc Torres, Arantxa Uranga, and Núria Barniol  
Universitat Autònoma de Barcelona, SPAIN
- M60-f BROADBAND AND HIGH-PRESSURE OUTPUT PMUT ARRAY BASED ON LEAD-FREE KNN THIN FILM**  
Lei Zhao, Chong Yang, Xinyue Zhang, Zhiwei You, and Yipeng Lu  
Peking University, CHINA

### f - MEMS Physical and Chemical Sensors

#### Other Physical Sensors

- T60-f A PIEZOELECTRIC MEMS RESONANT TEMPERATURE SENSOR WITH 10- $\mu$ K RESOLUTION AND 0.06-PJK<sup>2</sup> RESOLUTION FOM**  
Ye Yuan, Hexu Luo, Yi Gong, Boyun Zhang, Haolin Li, Wei Pang, Quanning Li, Mingchao Sun, and Menglun Zhang  
Tianjin University, CHINA
- W60-f A MINIATURE SPOT POSITION DETECTOR BASED ON A RESONANT CALORIMETER FOR THE MICRO-SIZED SPOT**  
Aojie Quan<sup>1</sup>, Chen Wang<sup>1</sup>, Hemin Zhang<sup>2</sup>, Yangyang Guan<sup>1</sup>, Chengxin Li<sup>1</sup>, Chenxi Wang<sup>1</sup>, and Michael Kraft<sup>1</sup>  
<sup>1</sup>KU Leuven, BELGIUM and <sup>2</sup>Northwestern Polytechnical University, China, CHINA
- M61-f MINIATURIZED RUTHENIUM OXIDE CRYOGENIC TEMPERATURE SENSOR BASED ON MEMS TECHNOLOGY**  
Kanglai Zhu, Minmin You, Yongpeng Ran, Yudong Shen, Bin Yang, and Jingquan Liu  
Shanghai Jiao Tong University, CHINA

**g - MEMS/NEMS for Optical, RF and Electromagnetics****DC & Low Frequency Magnetic & Electrochemical Components & Systems****T61-g EXTREMELY LOW FREQUENCY FLEXIBLE-MAGNET BASED MECHANICAL ANTENNA**

Qingang Li<sup>1</sup>, Weijie Mo<sup>1</sup>, Chen Wang<sup>2</sup>, Zhi Cui<sup>2</sup>,  
Yong Cui<sup>2</sup>, and Xining Zang<sup>1</sup>

<sup>1</sup>Tsinghua University, CHINA and <sup>2</sup>Beihang University, CHINA

**g - MEMS/NEMS for Optical, RF and Electromagnetics****Electrical Field and Magnetic Field Sensors and Transducers****W61-g ELECTROMAGNETIC METAMATERIAL ABSORBERS FOR SOIL PROPERTY EVALUATION**

Soma Sato<sup>1</sup>, Ken Sakabe<sup>2</sup>, Hiroaki Onoe<sup>2</sup>, and Tetsuo Kan<sup>1</sup>

<sup>1</sup>University of Electro-Communications, JAPAN and

<sup>2</sup>Keio University, JAPAN

**M62-g DESIGN OF A MAGNETIC SENSOR WITH CONTROLLABLE TWO-AXIS SYNCHRONOUS MOTION**

Ching-Yu Tai, Shih-Jui Chen, and Yu-Lin Yang

National Central University, TAIWAN

**g - MEMS/NEMS for Optical, RF and Electromagnetics****Free Space Optical Components & Systems (Displays, Lenses, Detectors)****T62-g PIEZOELECTRIC MEMS MIRROR WITH CANTILEVER-TYPE ACTUATOR FOR COMPACT, LOW-VOLTAGE DRIVE, AND WIDE-ANGLE DEFLECTION**

Yosuke Abe, Goichi Akanuma, Mizuki Shinkawa, Tsuyoshi Hashiguchi,  
Masaaki Sato, Shuichi Suzuki, Atsushi Sakai, and Yuki Yoshi Ishimoto  
*Ricoh Company, Ltd., JAPAN*

**W62-g A MEMS FAST STEERING MIRROR WITH 10 MM APERTURE FOR FREE-SPACE OPTICAL COMMUNICATION**

Yichen Liu<sup>1,2</sup>, Yongquan Su<sup>1,3</sup>, Zhichao Weng<sup>3</sup>, Yi Yang<sup>3</sup>,  
Yang Wang<sup>1,2</sup>, Lihao Wang<sup>1</sup>, and Zhenyu Wu<sup>1,2,3</sup>

<sup>1</sup>Chinese Academy of Sciences, CHINA, <sup>2</sup>University of Chinese Academy of Sciences, CHINA, and <sup>3</sup>Shanghai University, CHINA

**M63-g TWO-DIMENSIONAL PIEZOELECTRICALLY ACTUATED MICROMIRROR WITH FAST FOCUSING FUNCTION**

Takashi Sasaki, Adrien Piot, Clément Fleury, Sara Guerreiro,  
Rodrigo T. Rocha, and Anton Lagosh

*Silicon Austria Labs, AUSTRIA*

**T63-g PIEZOELECTRICALLY ACTUATED MICROMIRROR USING HEAVY FRAME SUPPORTED WITH SOFT SUSPENSION SPRINGS**

Takashi Sasaki, Jaka Pribošek, Pooja Thakkar, and Anton Lagosh

*Silicon Austria Labs, AUSTRIA*



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

- W63-g** **DESIGNING AND FABRICATING GAN-BASED MICROCANTILEVER WITH MICRO-LED ELEMENT**  
Hungshun Hu, Yuancing Hsieh, and Chingfu Tsou  
*Feng Chia University, TAIWAN*
- M64-g** **ARTIFICIAL COMPOUND EYES VISUAL IMAGING SYSTEM USING ORGANIC PHOTODETECTOR AND BIONIC MICRO-LENS ARRAY**  
Jiachuang Wang<sup>1,2</sup>, Xiawei Yue<sup>1,2</sup>, Shuai Wei<sup>1,2</sup>, Fangyu Zhao<sup>1,2</sup>, Nan Qin<sup>1,2</sup>, and Tiger H. Tao<sup>1,2,3,4,5</sup>  
<sup>1</sup>Chinese Academy of Sciences, CHINA, <sup>2</sup>University of Chinese Academy of Sciences, CHINA, <sup>3</sup>Neuroxess Co., Ltd., CHINA, <sup>4</sup>Guangdong Institute of Intelligence Science and Technology, CHINA, and <sup>5</sup>Tianqiao and Chrissy Chen Institute for Translational Research, CHINA
- T64-g** **HIGH TRANSMITTANCE AND HIGH DIFFRACTION EFFICIENCY WITH SIN METASURFACE HOLOGRAMS**  
Masakazu Yamaguchi<sup>1</sup>, Hiroki Saito<sup>1</sup>, Satoshi Ikezawa<sup>2</sup>, and Kentaro Iwami<sup>1</sup>  
<sup>1</sup>Tokyo University of Agriculture and Technology, JAPAN and <sup>2</sup>Waseda University, JAPAN
- W64-g** **RESEARCH AND OPTIMIZATION OF LARGE APERTURE ELECTROMAGNETIC MEMS MICROMIRROR FOR AUTOMOTIVE LIDAR**  
Fei Zhao, Xiaoshi Dong, Guosheng Zeng, Jinghui Xu, and Jiahao Wu  
*Huawei Technologies Company, Ltd., CHINA*

## g - MEMS/NEMS for Optical, RF and Electromagnetics

## Infrared (IR) Sensors and Imaging Systems

- M65-g** **IDENTIFICATION AND QUANTITATIVE DETECTION OF PESTICIDE RESIDUES USING OVERCOUPLED METAMATERIAL ABSORBER**  
Ziwei Chen, Xueyuan Wu, Dongxiao Li, Hong Zhou, Tao Liu, and Xiaojing Mu  
*Chongqing University, CHINA*
- T65-g** **ENHANCED PHOTODETECTION CAPABILITIES OF SMALLER SIZE 2D AU/PTS/P-SI NANO HOLE ARRAY-BASED MIR SCHOTTKY DETECTOR**  
Ashenafi A. Elyas and Tetsui Kan  
*University of Electro-Communications, JAPAN*
- W65-g** **HIGH-RESPONSIVITY VACUUMLESS MICROBOLOMETER ARRAYS MICROFABRICATED ON THERMALLY ISOLATED SUSPENDED MEMBRANES**  
Md. Rabiul Hasan, Amirali Nikeghbal, Adwait Deshpande, Mohit U. Karkhanis, Erfan Pourshaban, Aishwaryadev Banerjee, Seungbeom Noh, Hanseup Kim, and Carlos H. Mastrangelo  
*University of Utah, USA*

**Infrared (IR) Sensors and Imaging Systems**

- M66-g SPECTROSCOPY FOR CONTINUOUS LIGHT WITH A SUBMICRON GRATING MEMS CANTILEVER PLASMONIC PHOTODETECTOR**  
Yuki Kaneda<sup>1</sup>, Masaaki Oshita<sup>1</sup>, Abubakr Eslam<sup>1,3</sup>,  
Shiro Saito<sup>2</sup>, and Tetsuo Kan<sup>1</sup>  
<sup>1</sup>University of Electro-Communications, JAPAN, <sup>2</sup>IMRA JAPAN Co., LTD.,  
JAPAN, and <sup>3</sup>Aswan University, EGYPT
- T66-g A BIOCHEMICAL SENSOR BASED ON A SURFACE LATTICE RESONANCE METASURFACE IN THE NEAR-INFRARED BAND**  
Liye Li, Lijun Ma, and Wengang Wu  
Peking University, CHINA

**g - MEMS/NEMS for Optical, RF and Electromagnetics****MEMS for Timing & Frequency Control**

- W66-g FULLY DIFFERENTIAL GYRATOR USING A DYNAMICALLY BIASED 20 MHZ LAMÉ MODE RESONATOR**  
Jintark Kim<sup>1</sup>, Rakibul Islam<sup>1</sup>, James M.L. Miller<sup>1</sup>,  
Jianing Zhao<sup>1</sup>, Gabrielle Vukasin<sup>2</sup>, Ryan Kwon<sup>2</sup>,  
Saurabh Saxena<sup>1</sup>, Pavan K. Hanumolu<sup>1</sup>,  
Thomas W. Kenny<sup>2</sup>, and Gaurav Bahl<sup>1</sup>  
<sup>1</sup>University of Illinois, Urbana-Champaign, USA and  
<sup>2</sup>Stanford University, USA
- M67-g AN EFFECTIVE FREQUENCY TUNING MECHANISM FOR PIEZOELECTRIC MEMS OSCILLATORS**  
Zhong-Wei Lin, Chin-Yu Chang, and Sheng-Shian Li  
National Tsing Hua University, TAIWAN
- T67-g 4H-SiC BEAM RESONATORS WITH TAILORED LOCAL ZERO TCF**  
Yaoyao Long, Zhenming Liu, Xinyu Jiang, and Farrokh Ayazi  
Georgia Institute of Technology, USA
- W67-g RESOSWITCH SQUEGGING CONTROL BY COMPACT MODEL-ASSISTED IMPACT ELECTRODE DESIGN**  
Kevin H. Zheng, Qiutong Jin, and Clark T.-C. Nguyen  
University of California, Berkeley, USA

**g - MEMS/NEMS for Optical, RF and Electromagnetics****Photonic Components & Systems**

- M68-g ACTUATOR/REFLECTOR DECOUPLING FOR REDUCED EXCITATION OF SECONDARY MECHANICAL RESONANCE MODES IN MEMS-TUNABLE VCSELS**  
Vivek A. Menon<sup>1</sup>, Yi Xiao<sup>2</sup>, Mohammed S. Khan<sup>2</sup>, Keiji Isamoto<sup>2</sup>,  
Nobuhiko Nishiyama<sup>3</sup>, and Hiroshi Toshiyoshi<sup>1</sup>  
<sup>1</sup>University of Tokyo, JAPAN, <sup>2</sup>Santec OIS Corporation, JAPAN, and  
<sup>3</sup>Tokyo Institute of Technology, JAPAN

## g - MEMS/NEMS for Optical, RF and Electromagnetics

## RF MEMS Components &amp; Systems

- T68-g** **ACOUSTOELECTRIC EFFECT IN SEZAWA MODE SAW DEVICES ON ALGAN/GAN/SIC HETEROSTRUCTURE AT 9.7 GHz**  
Imtiaz Ahmed<sup>1</sup>, Jr-Tai Chen<sup>2</sup>, and Dana Weinstein<sup>1</sup>  
<sup>1</sup>Purdue University, USA and <sup>2</sup>SweGaN AB, SWEDEN
- W68-g** **MILLIMETER WAVE THIN-FILM BULK ACOUSTIC RESONATOR IN SPUTTERED SCANDIUM ALUMINUM NITRIDE USING PLATINUM ELECTRODES**  
Sinwoo Cho<sup>1</sup>, Omar Barrera<sup>1</sup>, Pietro Simeoni<sup>2</sup>, Ellie Y. Wang<sup>1</sup>, Jack Kramer<sup>1</sup>, Vakhtang Chulukhadze<sup>1</sup>, Joshua Campbell<sup>1</sup>, Matteo Rinaldi<sup>2</sup>, and Ruochen Lu<sup>1</sup>  
<sup>1</sup>University of Texas, Austin, USA and <sup>2</sup>Northeastern University, USA
- M69-g** **ROOM TEMPERATURE NANOPHONONICS FROM 1 GHz – 110 GHz WITH COMPOSITE PIEZOELECTRIC TRANSDUCER HBARS**  
Vikrant J. Gokhale, Jason A. Roussos, Matthew T. Hardy, D. Scott Katzer, and Brian P. Downey  
US Naval Research Laboratory, USA
- T69-g** **COMPACT BENDS AND LOW-LOSS JUNCTIONS FOR SO LAMB MODES IN FULLY ETCHED SCANDIUM ALUMINUM NITRIDE ACOUSTIC WAVEGUIDES**  
Jack Guida, Ryan Tetro, Matteo Rinaldi, and Siddhartha Ghosh  
Northeastern University, USA
- W69-g** **L-BAND LINBO<sub>3</sub>/SIO<sub>2</sub>/SAPPHIRE LONGITUDINAL LEAKY SAW (LLSAW) RESONATORS WITH HIGH FIGURE OF MERIT**  
Zhi-Qiang Lee, Tzu-Hsuan Hsu, Chia-Hsien Tsai, Cheng-Chien Lin, Ya-Ching Yu, Shao-Siang Tung, and Ming-Huang Li  
National Tsing Hua University, TAIWAN
- M70-g** **PASSIVE IN-BAND RF POWER SENSING IN THIN-FILM LITHIUM NIOBATE ON SILICON PLATFORM**  
Hakhamanesh Mansoorzare, and Reza Abdolvand  
University of Central Florida, USA
- T70-g** **X-CUT LITHIUM NIOBATE SO MODE RESONATORS FOR 5G APPLICATIONS**  
Ryan Tetro, Luca Colombo, Walter Gubinelli, Gabriel Giribaldi, and Matteo Rinaldi  
Northeastern University, USA
- W70-g** **RELIABILTIY ASSESSMENT OF AN ULTRATHIN DIELECTRIC TRANSDUCED MICROMECHANICAL RESONATOR**  
Satish K. Verma, Pawan Kumar, and Bhaskar Mitra  
Indian Institute of Technology, Delhi, INDIA





## RF MEMS Components &amp; Systems

**M71-g THREE-DIMENSIONAL RECONFIGURABLE V-BAND ANTENNA VIA MECHANICALLY-GUIDED METHOD**

Qi Wang<sup>1</sup>, Zetian Wang<sup>1</sup>, Bo Wen<sup>1</sup>, Yufeng Jin<sup>1</sup>,  
Mengdi Han<sup>1,2</sup>, and Wei Wang<sup>1,2,3</sup>

<sup>1</sup>Peking University, CHINA, <sup>2</sup>National Key Laboratory of Advanced Micro and Nano Manufacture Technology, CHINA, and <sup>3</sup>Beijing Advanced Innovation Center for Integrated Circuits, CHINA

## g - MEMS/NEMS for Optical, RF and Electromagnetics

## THz MEMS Components &amp; Systems

**T71-g A MEMS RECONFIGURABLE AIR-SPACED METAMATERIAL ENABLED DYNAMIC TERAHERTZ BEAM STEERING**

Zhenci Sun<sup>1</sup>, Chao Liang<sup>1</sup>, Ziqi Mei<sup>1</sup>, Enze Zhou<sup>1</sup>, Rongbo Xie<sup>1</sup>,  
Rui You<sup>2</sup>, Xiaomeng Bian<sup>2</sup>, Xiaoguang Zhao<sup>1</sup>, and Jiahao Zhao<sup>1</sup>

<sup>1</sup>Tsinghua University, CHINA and <sup>2</sup>Beijing Information Science and Technology University, CHINA

**W71-g THREE-DIMENSIONAL TERAHERTZ COMPUTED TOMOGRAPHY IMAGING BASED ON THERMOMECHANICAL MICROCANTILEVER FOCAL PLANE ARRAY**

Zhanxuan Zhou<sup>1</sup>, Jiahao Miao<sup>1</sup>, Jia Xu<sup>1</sup>, Yi Liu<sup>1</sup>, Xincheng Zhu<sup>1</sup>,  
Cong Lin<sup>1</sup>, Zhenwei Zhang<sup>2</sup>, and Xiaomei Yu<sup>1</sup>

<sup>1</sup>Peking University, CHINA and <sup>2</sup>Capital Normal University, CHINA

## h – Micro- &amp; Nanofluidics

## Biological and Medical Microfluidics and Nanofluidics

**M72-h AN INTEGRATED MICROFLUIDIC DEVICE FOR SAMPLE PRETREATMENT AND CAPTURING OF CIRCULATING TUMOR CELLS BY USING MAGNETIC PEARL-BEAD-LIKE CHAIN-STRUCTURES**

Sasi Kiran Boilla, Yi Cheng Tsai, and Gwo-Bin Lee  
National Tsing Hua University, TAIWAN

**T72-h MULTIFUNCTIONAL THERMAL BIOSENSOR BASED ON SILICON THERMOCOUPLE JUNCTION AND SUSPENDED MICROFLUIDIC CHANNEL**

Tianxiang Liang, Zhen Peng, Chunyang Li, Cao Xia,  
Yuanlin Xia, and Zhuqing Wang  
Sichuan University, CHINA

**W72-h ENHANCED IMPEDANCE FLOW CYTOMETRY VIA ACOUSTIC-DRIVEN MICROPARTICLE FOCUSING IN MICROCHANNELS**

Peng Zhou<sup>1</sup>, Yingming Xu<sup>1</sup>, Terrence Simon<sup>1</sup>,  
Martin E. Fernandez-Zapico<sup>2</sup>, Wen Wee Ma<sup>3</sup>,  
and Tianhong Cui<sup>1</sup>

<sup>1</sup>University of Minnesota, USA, <sup>2</sup>Mayo Clinic, USA, and  
<sup>3</sup>Cleveland Clinic, USA



## h – Micro- &amp; Nanofluidics

## Generic Microfluidics &amp; Nanofluidics

- M73-h** **SPATIOTEMPORALLY CONTROL OF PARTICLE INTERVALS BY ON-CHIP VORTEX GENERATIONS**  
Makoto Saito<sup>1</sup>, Fumihito Arai<sup>2</sup>, Yoko Yamanishi<sup>1</sup>, and Shinya Sakuma<sup>1</sup>  
<sup>1</sup>*Kyushu University, JAPAN* and <sup>2</sup>*University of Tokyo, JAPAN*

## h – Micro- &amp; Nanofluidics

## Integrated/Embedded Microfluidics and Nanofluidic Systems &amp; Platforms

- T73-h** **A VERSATILE CONTROL SYSTEM FOR DIGITAL MICROFLUIDIC CHIPS OF VARYING TYPES, SHAPES, SIZES, AND THICKNESSES**  
Qining Leo Wang<sup>1</sup>, Jia Li<sup>1</sup>, Hyun-Sung “Eric” Cho<sup>1</sup>, Lin Xu<sup>2</sup>, Amanda Wang<sup>1</sup>, Shounak Kuiry<sup>1</sup>, Zifan He<sup>1</sup>, Jessica Ho<sup>1</sup>, and Chang-Jin “CJ” Kim<sup>1</sup>  
<sup>1</sup>*University of California, Los Angeles, USA* and <sup>2</sup>*Nankai University, CHINA*
- W73-h** **TUNABLE PARTICLE SEPARATION THROUGH ACOUSTIC DETERMINISTIC LATERAL DISPLACEMENT MICROPILLAR ARRAYS**  
Hiroki Fukunaga<sup>1</sup>, Naotomo Tottori<sup>1</sup>, Shinya Sakuma<sup>1</sup>, Takeshi Hayakawa<sup>2</sup>, and Yoko Yamanishi<sup>1</sup>  
<sup>1</sup>*Kyushu University, JAPAN* and <sup>2</sup>*Chuo University, JAPAN*
- M74-h** **A NOVEL MICROFLUIDIC STRATEGY FOR DNA DATA RANDOM ACCESS VIA DROPLET DIGITAL PCR**  
Dayin Wang<sup>1,2,3</sup>, Yanan Du<sup>3</sup>, Ning Wang<sup>1,2,3</sup>, Yifan Liu<sup>3</sup>, Yuan Luo<sup>1,2</sup>, and Jianlong Zhao<sup>1,2,3</sup>  
<sup>1</sup>*Chinese Academy of Sciences, CHINA*, <sup>2</sup>*University of Chinese Academy of Sciences, CHINA*, and <sup>3</sup>*ShanghaiTech University, CHINA*
- T74-h** **DEMONSTRATING ELECTRICAL CONNECTION ON RECONSTITUTED ASIC CHIPS ON 8-INCH SILICON WAFER**  
Wei Wei, Lei Zhang, Bert Tobback, Jakob Visker, Tim Stakenborg, Gauri Karve, and Deniz S. Tezcan  
*IMEC, BELGIUM*
- W74-h** **HIGH-PRESSURE LIQUID ENVIRONMENT BASED THIN-PDMS-FILM DIGITAL PCR**  
Shiyuan Gao<sup>1,2,3</sup>, Tiegang Xu<sup>1,2</sup>, Lei Wu<sup>1,2</sup>, Xiaoyue Zhu<sup>4</sup>, Lihong Jiang<sup>5</sup>, Quan Wang<sup>6</sup>, and Xinxin Li<sup>1,2,3</sup>  
<sup>1</sup>*Chinese Academy of Sciences, CHINA*, <sup>2</sup>*University of Chinese Academy of Sciences, CHINA*, <sup>3</sup>*ShanghaiTech University, CHINA*, <sup>4</sup>*Fujian Agriculture and Forestry University, CHINA*, <sup>5</sup> *Jiading Hospital of Traditional Chinese Medicine, CHINA*, and <sup>6</sup>*Jiangsu University, CHINA*



## h – Micro- &amp; Nanofluidics

## Manufacturing for Micro- and Nanofluidics

- M75-h FABRICATION OF MULTI-LUMEN MICROFLUIDIC TUBING FOR EX SITU DIRECT LASER WRITING**  
Bailey M. Felix<sup>1</sup>, Olivia M. Young<sup>1</sup>, Jordi T. Andreou<sup>1</sup>, Sunandita Sarker<sup>1</sup>, Mark D. Fuge<sup>1</sup>, Axel Krieger<sup>2</sup>, Clifford R. Weiss<sup>3</sup>, Christopher R. Bailey<sup>3</sup>, and Ryan D. Sochol<sup>1</sup>  
<sup>1</sup>University of Maryland, USA, <sup>2</sup>Johns Hopkins University, USA, and <sup>3</sup>Johns Hopkins University School of Medicine, USA

- T75-h DEVELOPING A VACUUM-ACTUATED PERISTALTIC MICROPUMP (VPM) WITH INCLINED WALL DESIGN TO ACHIEVE LOW HEMOLYSIS BLOOD PLASMA EXTRACTION**  
Tuan N.A. Vo<sup>1,2,3</sup>, Pin-Chuan Chen<sup>1</sup>, Pai-Shan Chen<sup>4</sup>, Yung-Chen Jair<sup>4</sup>, Yi-Hsin Wu<sup>4</sup>, and Trung-Nghia Tran<sup>1,3</sup>  
<sup>1</sup>National Taiwan University of Science and Technology, TAIWAN, <sup>2</sup>Ho Chi Minh City University of Technology (HCMUT), VIETNAM, <sup>3</sup>Vietnam National University Ho Chi Minh City (VNU-HCM), VIETNAM, and <sup>4</sup>National Taiwan University, TAIWAN

- W75-h PORTABLE SINGLE THERMOCOUPLE BIOSENSOR BASED ON DUAL SUSPENSION MICROFLUIDIC STRUCTURE**  
Hao Zhang, Jingkai Huang, Yuanlin Xia, Cao Xia, and Zhuqing Wang  
Sichuan University, CHINA

- M76-h A ONE-STEP SOFT LITHOGRAPHY TECHNIQUE FOR MAKING MICROFLUIDIC PDMS CHIPS WITH MACRO-SCALE STRUCTURES**  
Shiyuan Gao<sup>1,2,3</sup>, Tiegang Xu<sup>1</sup>, Lei Wu<sup>1</sup>, Xiaoyue Zhu<sup>4</sup>, Chunyong Li<sup>5</sup>, and Xinxin Li<sup>1</sup>  
<sup>1</sup>Chinese Academy of Sciences, CHINA, <sup>2</sup>University of Chinese Academy of Sciences, CHINA, <sup>3</sup>ShanghaiTech University, CHINA, <sup>4</sup>Fujian Agriculture and Forestry University, CHINA, and <sup>5</sup>Fengning Manchu Autonomous County Hospital, CHINA

- T76-h A 3D-MICROPRINTED COAXIAL NOZZLE FOR FABRICATING LONG, FLEXIBLE MICROFLUIDIC TUBING**  
Olivia M. Young<sup>1</sup>, Bailey M. Felix<sup>1</sup>, Mark D. Fuge<sup>1</sup>, Axel Krieger<sup>2</sup>, and Ryan D. Sochol<sup>1</sup>  
<sup>1</sup>University of Maryland, USA and <sup>2</sup>Johns Hopkins University, USA

## h – Micro- &amp; Nanofluidics

## Materials for Micro &amp; Microfluidics

- W76-h FULLY POLYMER-BASED ROBOT-INTEGRATED MICROFLUIDIC CHIP FOR MECHANICAL CHARACTERIZATION OF SINGLE PARTICLES**  
Nariaki Kiyama, Makoto Saito, Yoko Yamanishi, and Shinya Sakuma  
Kyushu University, JAPAN



## h – Micro- &amp; Nanofluidics

## Modeling of Micro &amp; Nanofluidics

**M77-h REGULATED SECONDARY FLOW FOR THE ISOLATION OF PARTICLES USING INERTIAL MICROFLUIDICS**

Elliott C. Leinauer, Jussuf T. Kaifi, Shramik Sengupta,  
Matthew R. Maschmann, and Syed K. Islam  
*University of Missouri, USA*

**T77-h THE SMALLEST-FOOTPRINT MULTI-CELLS MICROFLUIDICS SEPARATION CHANNEL MODELING VIA INTEGRATION OF LIFT AND DIELECTROPHORETIC (DEP) FORCES**

Mohammad H. Alhibshi and Nebras M. Sobahi  
*King Abdulaziz University, SAUDI ARABIA*

**W77-h DEFORMING SINGLE SOFT MICROPARTICLES IN LIQUID USING MEMBRANE RESONATORS**

Hao Jia, Haoran Zhang, and Xinxin Li  
*Chinese Academy of Sciences, CHINA*

## h – Micro- &amp; Nanofluidics

## Other Micro- and Nanofluidics

**M78-h FLEXIBLE LOOP HEAT PIPE DRIVEN BY MICROPILLARS FOR WEARABLE DEVICES**

Ryobu Nomura<sup>1</sup>, Masaaki Hashimoto<sup>2</sup>, Taiga Kawakami<sup>1</sup>,  
Abdulkareem Alasli<sup>1</sup>, Hosei Nagano<sup>1</sup>, and Ai Ueno<sup>1</sup>  
<sup>1</sup>*Nagoya University, JAPAN and* <sup>2</sup>*Keio University, JAPAN*



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## i - Open Posters

- T79-i** **FIBER-OPTIC SPR SENSOR MODIFIED BY MOS<sub>2</sub>-GRAPHENE HETEROSTRUCTURE**  
Jiaming Ma, Ridong Wang, Dachao Li, and Kexin Xu  
*Tianjin University, CHINA*
- W79-i** **INTEGRATION OF MICROSENSOR-EMBEDDED PIPETTE AND COMPUTER VISION FOR SINGLE-CELL HANDLING AUTOMATION SYSTEM**  
Satoshi Amaya<sup>1</sup>, Daito Ando<sup>1</sup>, Hirotaka Sugiura<sup>1</sup>, Bilal Turan<sup>1</sup>, Yuko Ukai<sup>2</sup>, Yoshikatsu Sato<sup>2</sup>, and Fumihito Arai<sup>1</sup>  
<sup>1</sup>*University of Tokyo, JAPAN* and <sup>2</sup>*Nagoya University, JAPAN*
- M79-i** **PARTICLE-LESS INKJET-PRINTED, WEARABLE TACTILE SENSOR ON COTTON FABRIC WITH THERMAL STABILITY**  
Bowoong Heo<sup>1</sup>, Kyubin Bae<sup>1</sup>, Yunsung Kang<sup>2</sup>, Soonjae Pyo<sup>3</sup>, and Jongbaeg Kim<sup>1</sup>  
<sup>1</sup>*Yonsei University, KOREA*, <sup>2</sup>*Kyungpook National University, KOREA*, and <sup>3</sup>*Seoul National University of Science and Technology, KOREA*
- T80-i** **BIO-INSPIRED PIEZOELECTRIC METAMATERIALS FOR ENHANCED BIOMEDICAL SENSING IN KNEE IMPLANTS**  
Zhe Xu, Peder Solberg, Douglas W. Van Citters, and John X.J. Zhang  
*Dartmouth College, USA*
- W80-i** **MEMS PRESSURE SENSOR UTILIZING MULTIPLE-BALLOON TACTILE SENSOR FOR TUMOR DETECTION IN MINIMALLY INVASIVE SURGERY**  
Naoki Tano and Takeshi Hatsuzawa  
*Tokyo Institute of Technology, JAPAN*
- M80-i** **I-GLAD: A NOVEL FABRICATION TECHNIQUE FOR ANTIFUNGAL SURFACES**  
Chuang Qu, Jesse L. Rozsa, Mark P. Running, Shamus McNamara, and Kevin M. Walsh  
*University of Louisville, USA*
- T81-i** **A METAL-FREE TRANSPARENT BULK ACOUSTIC WAVE RESONATOR FOR PHOTONIC WIRING OF PHONON MODULATED QUANTUM SPINS IN SILICON CARBIDE**  
Jingjie Cheng, Zhaoliang Peng, Jiahao Wu, Yan Qiao, Wenming Zhang, and Lei Shao  
*Shanghai Jiao Tong University, CHINA*
- W81-i** **RELIABILITY ANALYSIS HIGH-TEMPERATURE STORAGE EFFECTS ON MEMS PMUT RESONATOR DEVICES WITH VARIED CAVITY SIZES**  
Goon Weng Wong, Siva Kumaaran, and Eloi Marigo Ferrer  
*Silterra Malaysia Sdn. Bhd., MALAYSIA*
- M81-i** **SMALLER FOOTPRINT OF ALKALI-METAL VAPOR CELLS WITH MICROFABRICATED ON-CHIP DISPENSING COMPONENT**  
Ryo Murakami, Shun Kiyose, and Yoshikazu Hirai  
*Kyoto University, JAPAN*



## i - Open Posters

- T82-i**    **EXTRACTION OF THE DEPENDENCE OF THE PIEZOELECTRIC AND MECHANICAL PARAMETERS ON THE VOLTAGE OF THE PZT PVD THROUGH STATIC AND DYNAMIC MEASUREMENTS ON WAFER LEVEL**  
Luigi Barretta<sup>1</sup>, Rossana Scaldaferri<sup>1</sup>, Alessandro S. Savoia<sup>2</sup>, Carla L. Prelini<sup>1</sup>, Carla M. Lazzari<sup>1</sup>, Yul Koh<sup>3</sup>, Sagnik Ghosh<sup>3</sup>, Daniel S-H. Chen<sup>3</sup>, Andrea Di Matteo<sup>1</sup>, and Domenico Giusti<sup>1</sup>  
<sup>1</sup>STMicroelectronics, ITALY, <sup>2</sup>Roma Tre University, ITALY, and <sup>3</sup>Agency for Science, Technology and Research (A\*STAR), SINGAPORE
- W82-i**    **RESONANT 1D PIEZOELECTRIC MEMS SCANNER WITH LARGE SIZE MIRROR AND MEANDER-SHAPED ACTUATORS FOR DEFLECTION ANGLE OVER 180°**  
Masayuki Fujishima, Nobunari Tsukamoto, Masaaki Sato, Junichi Konishi, Shuichi Suzuki, and Atsushi Sakai  
*Ricoh Company, Ltd., JAPAN*
- M82-i**    **DIRECT, DRY INTEGRATION OF 2D-MATERIALS INTO DEVICES VIA FORCE ENGINEERING**  
Peter Satterthwaite, Weikun Zhu, Patricia Jastrzebska-Perfect, Melbourne Tang, Sarah Spector, Hongze Gao, Hikari Kitadai, Ang-Yu Lu, Qishuo Tan, Jing Kong, Xi Ling, Farnaz Niroui  
*Massachusetts Institute of Technology, USA*
- T83-i**    **FEASIBILITY OF A PIEZOELECTRIC MICROMACHINED ULTRASONIC TRANSDUCER (PMUT) WITH STACKED DUAL HETEROGENEOUS PIEZOELECTRIC THIN FILMS FOR HIGH PERFORMANCE TRANSCEIVER**  
Xuanmeng Qi<sup>1</sup>, Shinya Yoshida<sup>2</sup>, and Shuji Tanaka<sup>1</sup>  
<sup>1</sup>Tohoku University, JAPAN and <sup>2</sup>Shibaura Institute of Technology, JAPAN



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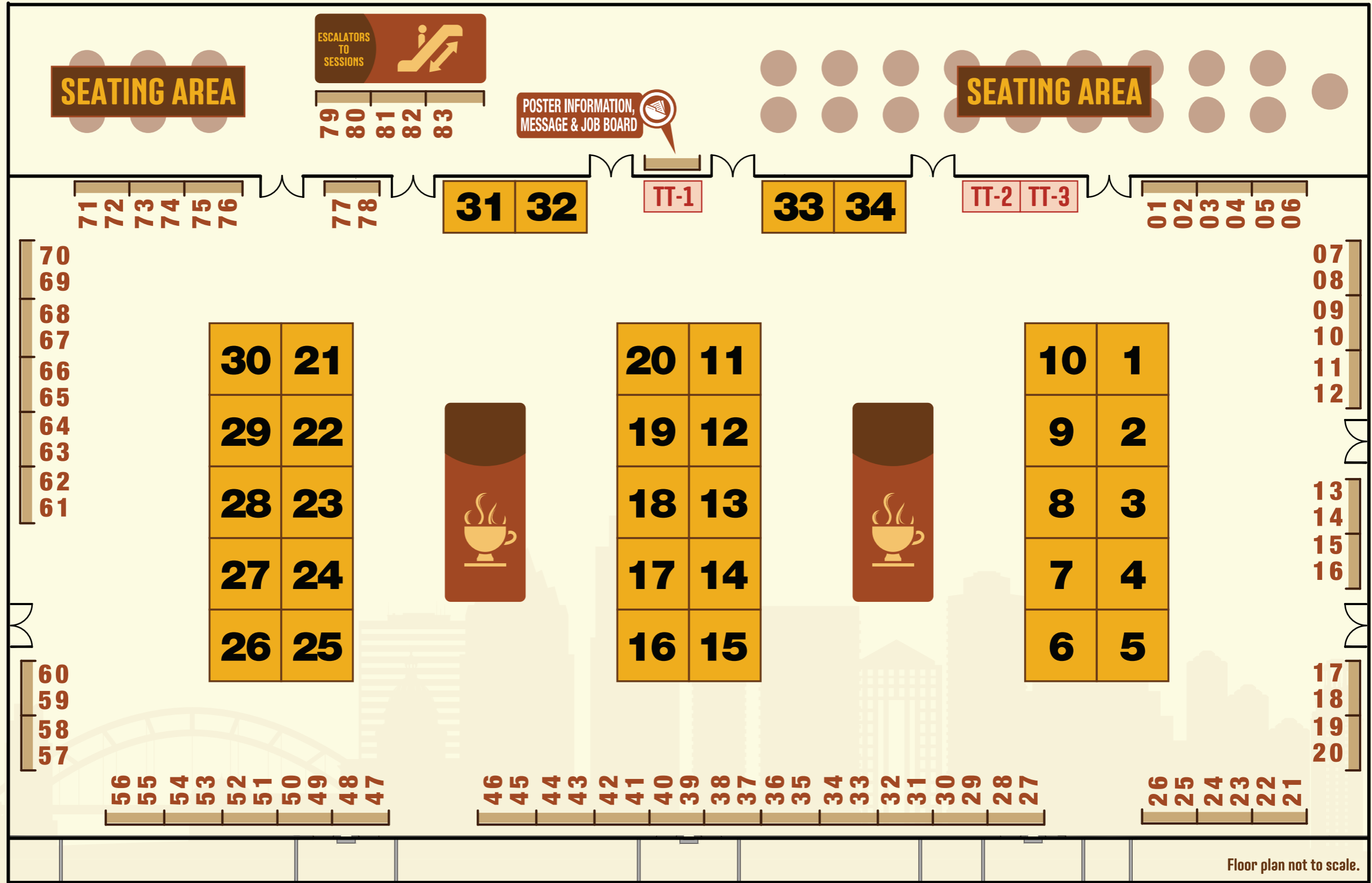
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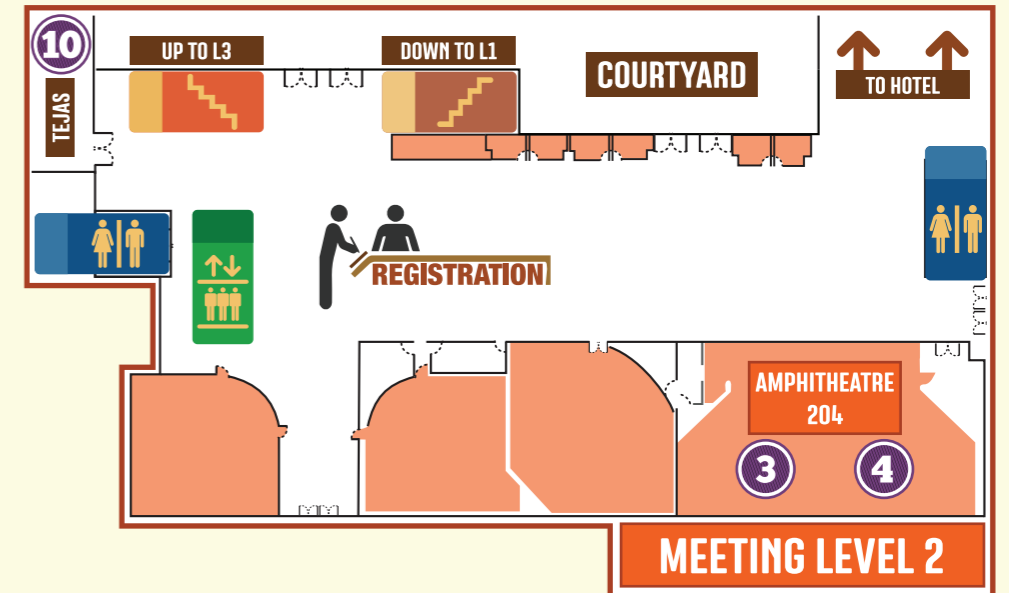
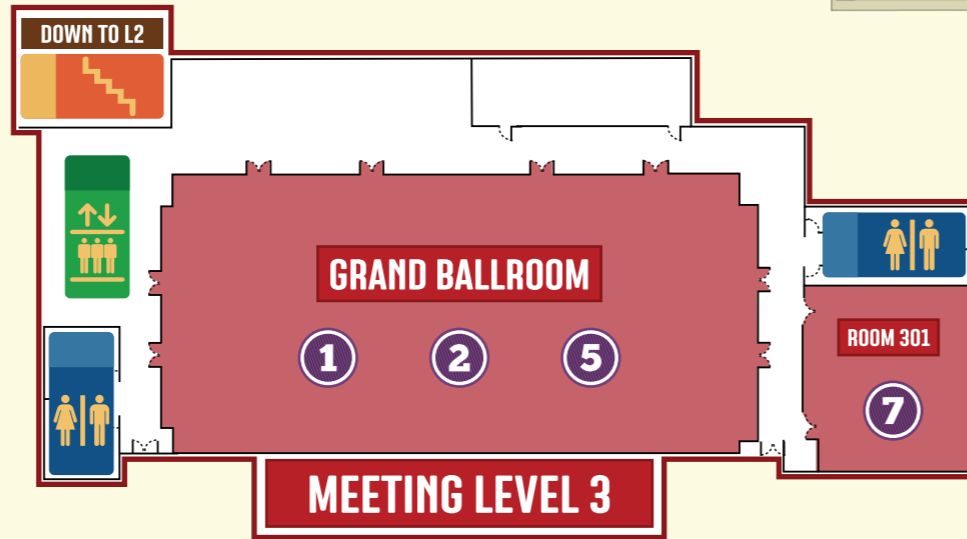
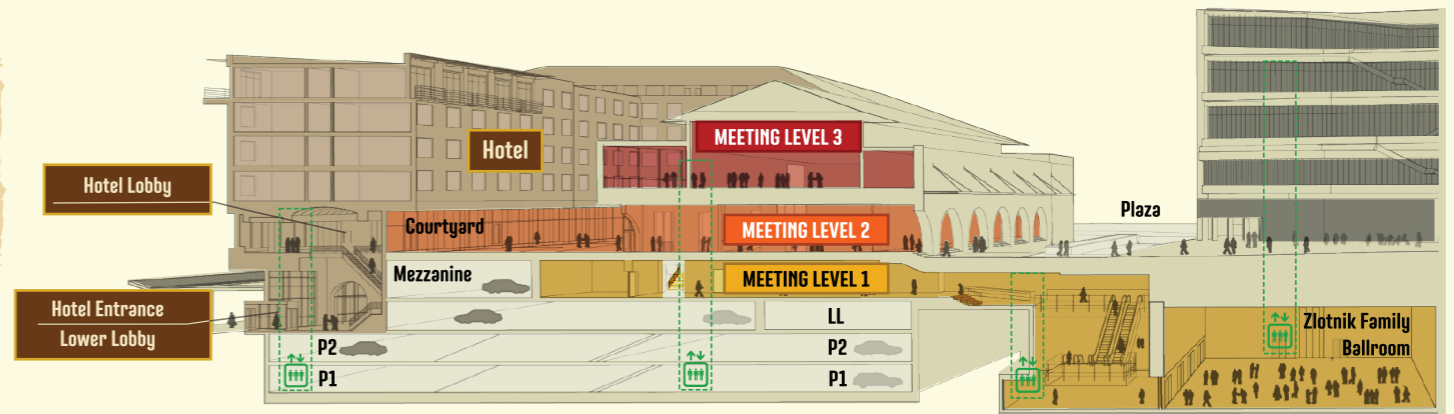
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## POSTER TOPIC CATEGORIES

(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

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Award Presentations	5	Young Professionals and Industry Mixer	11
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