IEEE FLEPS 2025

IEEE International Conference on Flexible, Printable Sensors and Systems

Singapore // June 22-25, 2025

IEEE INTERNATIONAL CONFERENCE ON FLEXIBLE, PRINTABLE SENSORS AND SYSTEMS

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MESSAGE FROM THE CONFERENCE CHAIRS

It is with great pleasure that we prepare to welcome you to the **7th IEEE International Conference on Flexible and Printable Sensors and Systems (IEEE FLEPS 2025)** in the vibrant city of **Singapore** from **June 22-25, 2025**.

Building on the considerable success of our previous conferences, including the well-received FLEPS 2024 in Tampere, we are proud to continue the tradition of IEEE FLEPS as a premier global forum for cutting-edge flexible electronics research. Our aim is to bring together researchers, engineers, and practitioners from around the world to share their latest research findings, ideas, and applications in the advancing field of flexible and printable sensors and systems.

Flexible and printable electronics represent a crucial area of technological development and is at the cusps of exponential relevance in new applications and adoption. The ability of these technologies to integrate seamlessly with machines and the human body is fundamental for acquiring physical data that will inform future artificial intelligence platforms. This positions them as enabling and indispensable technologies for the ongoing digital transformation across various industry sectors.

IEEE FLEPS 2025 in Singapore will offer an excellent forum for discussing the latest developments and helping to shape future roadmaps in electronics based on new materials and manufacturing technologies. We are committed to exploring a comprehensive range of innovations, ensuring a thorough exploration of advancements across a broad spectrum of electronics and materials technologies. **The conference provides a valuable opportunity for the academic community to meet and network with industry leaders, and for industry professionals to receive updates on the latest advancements and challenges in this field.**

We have prepared a comprehensive program that includes:

- **Insightful Tutorial Sessions:** These sessions will offer in-depth explorations of specialized topics, providing valuable learning opportunities. The MYOSA mini IOT Workshop Kit Workshop offers opportunities to explore IoT hardware in various sensing and data collection applications.
- **Distinguished Plenary Speakers:** Each day will feature talks by world-renowned experts from academia and industry, offering comprehensive overviews of significant advances, challenges, and opportunities in our field.
- **A Strong Technical Program:** The conference will feature numerous presentations over three full days, covering a wide array of topics. This will include invited talks by leading experts from both academia and industry. Presentations based on contributed papers are selected through a rigorous peer-review process.
- **New Focused Sessions & Workshops:** We have introduced sessions and workshops designed to delve into innovative applications and integrate cutting-edge materials and technologies, offering insights into future directions. This year, we have a special panel on building "**Standards for flexible electronics**" to bring research closer to industry. A WiSE (Women in Science and Engineering) panel aims to discuss how we can enhance support for inclusiveness.
- **Publication and Award Opportunities:** As in previous years, we offer pathways for authors to submit extended versions of their conference papers to relevant IEEE journals, including the IEEE Journal on Flexible Electronics (J-FLEX). The conference will also feature awards for the best student papers.

Our host city, **Singapore**, is renowned for its innovation and dynamic atmosphere, providing an ideal setting for a conference focused exchanging of ideas and advances in flexible electronics. Attendees will find state-of-the-art facilities conducive to fruitful discussions and networking, along with opportunities to explore the city's unique blend of culture and modernity. Social events, including a welcome reception and a gala dinner, are planned to provide ample opportunities for informal interactions. Our gala dinner is set in the iconic CHIJMES Hall—a beautifully restored 19th-century convent – that offers a unique blend of heritage and modernity. Enjoy a curated menu featuring local and international cuisine while surrounded by the charm of this National Monument in the heart of Singapore.

Our sincere thanks go to the IEEE Sensors Council for their continued sponsorship and invaluable support. We also extend our heartfelt gratitude to our sponsors for their generous contributions, which are vital to the success of this conference. We are also grateful to our patrons and exhibitors, and our host venue, the National University of Singapore. The Singapore Hybrid-Integrated Next-Generation μ-Electronics (SHINE) Centre, hosted at the NUS College of Design and Engineering, has also strongly supported the conference program through their extensive industry networks. The National University of Singapore (NUS) and Singapore Hybrid-Integrated Next-Generation μ-Electronics (SHINE) are also the patrons of the Gala Dinner. A tremendous effort has been made by the Technical Program Committee, track co-chairs, speakers, and presenters for an exciting conference.

We thank you for joining us to make IEEE FLEPS 2025 a successful and impactful event. We believe that you will find the conference professionally stimulating and rewarding.

We eagerly look forward to welcoming you to Singapore for IEEE FLEPS 2025!

Nanshu Lu and Benjamin Tee
IEEE FLEPS 2025 General Co-Chairs

Wei Gao and Changsheng Wu
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Track 3: Physical Sensors and Smart Systems
Kuniharu Takei, *Hokkaido University, Japan*
Yasser Khan, *USC, USA*

Track 4: Bio- and Chemical Sensors
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Anna Maria Pappa, *Khalifa University of Science and Technology, UAE*

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Xiaomin Xu, *Tsinghua University, China*

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Yingying Zhang, *Tsinghua University, China*

Track 7: Hybrid Integration and Advanced Packaging
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Philipp Gutruf, *The University of Arizona, USA*

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Shiming Zhang, *HKU, Hong Kong*

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Next-generation Technologies for Sensing, Electrophysiology and Drug Delivery in the Gastrointestinal Tract
Valerio Francesco Annese, *Italian Institute of Technology – IIT, Milan, Italy*
Francesca Leonardi, *Imec OnePlanet, Wageningen, Netherlands*

Neuromorphic Devices and Systems
Hocheon Yoo, *Hanyang University, South Korea*
Junhwan Choi, *Dankook University, South Korea*

Multifunctional Bioelectronics for Sensing, Stimulation, and Biological Integration
Faheem Ershad, *University of Houston, USA*

Plant Electronics
Wenlong Li, *IMRE ASTAR, Singapore*

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PLENARY SPEAKERS

Memristive Devices for Neuromorphic Computing
Joshua Yang, *University of Southern California, USA*

Neuromorphic computing, inspired by biological intelligence, promises a transformative shift in computational efficiency and adaptability. Memristive devices, which leverage coupled ionic-electronic interactions, physically mimic synapses and neurons, enabling true emulation rather than mere simulation of biological processes. This talk will explore the latest advancements in memristive devices and their role in neuromorphic computing. I will first discuss their application as high-efficiency machine learning accelerators, offering significant energy and throughput advantages. Then, I will examine how these devices enable bio-plausible artificial intelligence systems, moving toward computing architectures that more closely resemble natural intelligence.

Nanoscale Silver for Flexible and Transparent Electronics: from Development to Commercialization
Ajay Virkar, *DuPont, USA*

In this presentation, we introduce DuPont's Activegrid™—a highly flexible, stretchable, and formable silver nanowire-based transparent conductor (TC) that matches or surpasses the optoelectronic performance of conventional brittle sputtered TCs, such as indium tin oxide (ITO).Activegrid inks can be deposited from solution using a variety of high-speed, low-takt-time manufacturing methods, and they require significantly lower processing temperatures—down to just 25°C—compared to other transparent conductors.The technology has already been commercialized in several of the world's first mass-produced flexible consumer electronic devices, where it primarily serves as the TC in capacitive touch sensors. Beyond consumer electronics, Activegrid has been prototyped, qualified, and integrated into a wide range of emerging applications, including smart windows, EMI shielding, photovoltaics, next-generation displays, and biomedical devices. A new generation of Activegrid is now being commercialized specifically for automotive applications, with a focus on transparent heating for LiDAR and camera sensors—delivering substantial performance, design, and processing advantages over incumbent technologies. We will also highlight recent developments in highly concentrated silver nanowire inks and dispersions, which exhibit exceptional electrical and rheological properties. These advanced materials open new opportunities for the design and manufacturing of next-generation flexible and printed electronics.

Decoding the Essence of Materials Chemistry in Bio-interfaced Electronics
Xiaodong Chen, *Nanyang Technological University, Singapore*

In the digital and big data era, electronic devices are crucial for addressing societal challenges and enhancing life quality. However, the rigid nature of traditional electronics limits their applicability. Flexible electronic devices emerge as a solution, offering seamless integration with various environments and human experiences. Despite considerable progress in research, the market adoption of flexible sensors remains limited. This talk delves deep into the fundamental materials chemistry questions within flexible electronics, aiming for a clearer and deeper understanding of its core principles. Additionally, I will explore the principles of conformal sense digitalization, its applications, and the challenges ahead in unlocking its full potential.

INVITED SPEAKERS

Two-Dimensional Semiconductors for Advanced Electronics
Lain-Jong (Lance) Li, *NUS, Singapore*

With the scaling of dimensions, the control of transistor gates weakens due to increased source-drain tunneling. Therefore, reducing the thickness of the transistor body is necessary to ensure effective electrostatic control. The utilization of new materials such as "ultra-thin" 2D semiconducting materials has garnered attention. In this presentation, I aim to provide an analysis and rationale regarding the potential for scaling device dimensions, potentially down to the 1nm technology node, utilizing 2D transition metal dichalcogenides (TMD) semiconductors. From a circuit perspective, I will share our insights on benchmarking 2D-based circuits against state-of-the-art Si FinFETs, using SRAM circuits as a case study to highlight the advantages of employing 2D materials over Si FinFET (or GAA) in technology nodes ranging from N16 down to N1. Furthermore, we will discuss the most critical defect issues in the material growth of 2D semiconductors, how to develop high-quality 2D semiconductors that meet future electronics needs, and several key issues in transistor fabrication, including metal contacts, high-k dielectric layers, and the progress of related research.

Optimization of Sintering Conditions for Screen-Printed Copper Circuits on Polyimide Substrates for Flexible Electronics Applications
Martin Bolduc, *University of Quebec, Canada*

This study investigates the sintering behavior of screen-printed copper ink on Kapton® HN polyimide film under varying temperature and time conditions to achieve optimal electrical performance. Sintering was conducted at temperatures ranging from 240°C to 300°C. The sheet resistance of the sintered samples was measured using a fourpoint probe system, while surface morphology and microstructural characteristics were analyzed using laser confocal microscopy, scanning electron microscopy (SEM), X-ray diffraction (XRD), and X-ray photoelectron spectroscopy (XPS). The results demonstrated that excessive oxidation at high temperatures increased sheet resistance, whereas insufficient densification at lower temperatures hindered conductivity. Optimized sintering conditions were determined to be 250°C for 120 seconds, with a measured sheet resistance of 5.2 mΩ/□, maximizing the balance between oxidation and ink densification. This work offers valuable insights into the sintering optimization of printed copper inks, facilitating advancements in flexible sensors, wearable sensing devices, and hybrid printed electronics.

Advances in Flexible, Foldable, and Stretchable QLEDs
Dae-Hyeong Kim, *Seoul National University, Korea*

Recent advancements in soft electronics have garnered significant attention owing to their potential applications in personalized, mobile, and wearable electronic devices. However, conventional electronic/optoelectronic devices often face challenges due to mechanical mismatches with soft human tissues, resulting in issues such as device fracture under deformation and user discomfort. To address these challenges, ultra-flexible and stretchable electronic/optoelectronic devices with low system modulus and intrinsic softness have been developed. Here, our unique strategies for synthesizing nanoscale materials (e.g., quantum dots, silver nanowires), seamlessly integrating them into patterned arrays, and designing unconventional devices and systems to achieve flexible, foldable, and stretchable quantum dot light-emitting devices are presented. These deformable light-emitting devices can be integrated with stretchable biosensors to form standalone wearable systems, which can create various mobile consumer electronics applications. Recent progresses in soft robotic vision systems and their wearable-display-centric integration potentials can be also briefly discussed. These advancements in electronics/optoelectronics, which combine recent breakthroughs in nanoscale material technologies and unconventional soft electronics, open up many new opportunities.

Electrochemical Biosensing Interface Engineering for Continuous Biomarker Monitoring Systems
Jayoung Kim, *Yonsei University, Korea*

Wearable biosensors represent a promising opportunity to monitor human physiology through dynamic measurements of (bio)chemical markers in bio-fluids such as sweat, tears, saliva, and interstitial fluid in continuous and non-invasive way. Such new platforms can thus offer real-time (bio)chemical information toward a more comprehensive view of a wearer's health, performance, or stress at the molecular level in daily life. Continuous biomonitoring addresses the limitations of traditional invasive blood testing and provides the opportunity for early diagnostic and therapeutic interventions. My talk will focus on developing wearable electrochemical biosensors towards non-invasive health monitoring opportunities and evaluating the potential impact of such wearable point-of-care devices on our daily life and clinical settings. It will cover various types of salivary, sweat and tear fluid based wearable biosensors utilizing mouthguard, tattoo patch, and contact lens form-factors. Significant effort have been made on developing enzymatic electrochemical sensors for continuous metabolite monitoring towards healthcare in daily-life or managing diabetes like chronic disease. Recently, we demonstrated personalization strategy for accurate estimation of blood glucose utilizing non-invasive biofluids. Lastly, the talk will also cover the latest efforts on developing small molecule monitoring wearable sensors, focusing on nanoscale molecularly imprinted polymer via quantum electrochemical detection.

The Potential of Ultra-light Weight Organic Photovoltaics for Wearable and Soft Robot Applications
Kenjiro Fukuda, *Osaka University, Japan*

Extreme thinness can reduce the weight of electronics, significantly decreasing discomfort when worn. Furthermore, it also enhances their mechanical robustness against bending, as the applied strain is determined by the material's softness and device thickness. In a simplified model, film thickness is inversely proportional to strain, meaning that a thinner film experiences less strain for the same bending radius. Additionally, an important benefit when considering photovoltaic devices is that we can expect maximized power output per unit area, which is advantageous for applications where weight is a critical parameter.We focus on improving both the power conversion efficiency (PCE) and the environmental stability of ultra-thin organic solar cells. In this talk, I would like to share recent progress in ultra-thin and lightweight solar cells, as well as their potential applications in wearable devices and soft robotics.

INVITED SPEAKERS

The Avenue to "Green" in Organic Bioelectronics
Mihai Irimia-Vladu, *Johannes Kepler University in Linz, Austria*

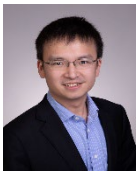
Through its appealing avenues of processing the component devices at room temperature and from low-cost precursor materials, organic electronics has a tremendous potential for the development of products able to achieve the goals of production sustainability as well as environmental and human friendliness for electronics. In an effort to stave off the e-waste growth, the presenter and his research group went further down the path opened by organic electronics research and investigated a large number of biomaterials as substrates, dielectrics, semiconductors and smoothening layers for the fabrication of organic field effect transistors, integrated circuits and organic solar cells. The presentation will focus on the highlights of our recent research, especially with respect to materials investigated, devices fabricated and the immense potential for follow up research: (1) flexible natural and biodegradable substrates; (2) natural dielectrics; (3) bio-origin, H-bonded semiconductors in the families of indigos, anthraquinones and acridones; (4) bio-degradation protocols for organic semiconductors. These highlights will be placed in the context of the mountain that one has to climb in order to reach the coveted "green" connotation for electronics, sensors and integrated circuits: (1) biocompatibility issue; (2) biodegradability issue; (3) compostability issue; (4) cost of production / energy expanded in production issue; (5) materials choice issue (carbon foot print); (6) toxicity and the environmental impact of the synthetic avenue for component materials. The potential of follow-up research in the green electronics field is immense, with large area electronics fabrication, biomedical implants, bio-sensing and smart labeling, representing only the tip of the iceberg of many more immediate possibilities of high interest for our group. Natural and nature-inspired materials have the unrivalled capability to create "safe-first" electronic markets for human and environment, with minimal or even neutral carbon footprint.

A Three-dimensionally Architected Electronic Skin Mimicking Human Mechanosensation
Yihui Zhang, *Tsinghua University, China*

Human skin sensing of mechanical stimuli originates from transduction of mechanoreceptors that converts external forces into electrical signals. While imitating the spatial distribution of those mechanoreceptors can enable developments of electronic skins capable of decoupled sensing of normal/shear forces and strains, it remains elusive. In this talk, I will introduce a three-dimensionally architected electronic skin (denoted as '3DAE-Skin') with force and strain sensing components arranged in a 3D layout that mimics that of Merkel cells and Ruffini endings in human skin. This 3DAE-Skin shows excellent decoupled sensing performances of normal force, shear force and strain. Integration of the 3DAE-Skin with data acquisition/processing modules aided by deep learning algorithms allows development of a tactile system capable of normal/shear force sensing with spatial resolution comparable to human skin, as well as simultaneous modulus and curvature measurements through a simple touch of an object. Demonstrations include rapid modulus measurements of fruits, bread and cake with various shapes and degrees of freshness.

Mechanics and Devices for Mechanical Haptics
Hanqing Jiang, *Westlake University, China*

Unlike visual or auditory stimuli, touch commands immediate attention and elicits instinctive reactions, making it essential for environmental interactions, personal safety, and emotional connections. Recent advancements in bioelectronics have transformed traditional haptic devices into wearable systems, unlocking new possibilities for tactile interactions. However, existing wearable haptics are often constrained by unimodal feedback, continuous energy demands, and attachment challenges. This talk will cover recent progress in mechanical haptics developed in my group, focusing on both wearable and structured approaches to enhancing tactile interactions. We will introduce curved origami-based stiffness manipulation, enabling in situ stiffness switching across positive, zero, and negative ranges, with applications in robotics and a novel first-person haptic device that synchronizes with virtual environments for realistic material perception. Additionally, we will present a wireless, real-time haptic interface that leverages a mechanically bistable mechanism inspired by the Kresling origami pattern, enabling diverse tactile sensations—including normal pressure, shear force, and vibrations—by storing and releasing mechanical energy through the skin. Finally, we will discuss a bistable soft-pneumatic textile interface for full-body haptics, offering energy-efficient, multimodal touch feedback for immersive and assistive applications. These advancements represent a paradigm shift in haptic technology, broadening its applications in human-machine interactions, rehabilitation, and immersive digital experiences.



Designing long-term stable, wireless, stretchable and hair-compatible EEG system
Huiliang Wang, *University of Texas at Austin, USA*

Electroencephalography (EEG) system played an important role in both neuroscience research, diagnostics and brain-computer interface enable therapeutic applications. However, conventional EEG monitoring system faces several hardware limitations, including fast drying of EEG gels, complex wiring and preparation procedures, and difficulty to comply with the diverse head anthropometry and hair conditions. In this talk, we will discuss about our strategies to overcome these challenges in our wearable EEG system, including hydrogel-based EEG electrodes to achieve low-impedance and long-term stability, integration of wireless circuits with hydrogel electrode to achieve wireless EEG recording, kirigami-inspired mesh design with liquid metal interconnects to achieve stretchability, and conical 3D-printed electrode with embedded hydrogel to achieve hair capability. We validate our system through five-week offline and online EEG-based brain-computer interface tasks, demonstrating its exceptional performance in continuous monitoring and dynamic applications. These results mark a promising advance toward wearable, non-invasive neural interfaces in clinical diagnostics and everyday use.

INVITED SPEAKERS

Ambient Printing of Pristine Oxide Films Enabled by Liquid Metals
Michael Dickey, *North Carolina State University, USA*

This talk will discuss efforts to take advantage of liquid metals to directly print both metallic and oxide thin films at ambient conditions. The metal is a gallium-based metal alloy that is a low-viscosity liquid at room temperature with low toxicity and negligible vapor pressure. Despite the large surface tension of the metal, it can be printed into non-spherical shapes due to the presence of an ultra-thin surface oxide skin. The ability to directly print liquid metal alloys into 3D structures enables soft, self-healing, and ultra-stretchable conductors. We recently discovered a way to separate the oxide from the liquid using fluid instabilities. The process works by dragging a meniscus of liquid metal across a surface. At the right conditions, the fluid inside the meniscus is unstable and only oxide is left behind on the surface. Doing so enables direct-write printing of very thin (~4 nm) oxides without the need for vacuum processing. Surprisingly, the oxide is conductive because the printing process deposits a bilayer film with a metallic interior. The ability to deposit oxide coatings is important for electronics, sensors, optics, and touch screens. This approach is appealing because it avoids vacuum processing that is typically used to deposit oxides.

The Landscape of Ingestible and Insertable Chemical Sensors
Kourosh Kalantar-Zadeh, *University of Sydney, Australia*

Advancements in biomedical engineering have led to the development of a variety of ingestible sensors and moving towards insertable sensors. These are miniaturized, wireless devices capable of real-time biochemical monitoring within the body. These sensors hold significant promise for non-invasive, longitudinal health monitoring, particularly in gastrointestinal health in whole population and gynecological health in women. Ingestible sensors travel through the gut, measuring gases, electrolytes, and metabolites to provide insights into digestion, microbiome activity, and disorder states such as problems with the gut motility and irritable bowel syndrome. By enabling dynamic monitoring of gut physiology, these sensors have the potential to strongly impact diagnostics and treatment personalisation for gastrointestinal disorders. Insertable sensors, particularly those designed for vaginal use, under development in Kalantar-Zadeh's laboratory, enable the continuous monitoring of hormones, metabolites, pro-inflammatory proteins, and electrolytes. Such technologies offer transformative applications in gynaecological and menstrual health, and the early detection of conditions such as bacterial vaginosis, endometriosis, and preterm birth risk. This talk will explore the current landscape of ingestible and insertable sensors, focusing on their design, capabilities, and emerging clinical applications. Key challenges, including biocompatibility, data transmission, and regulatory considerations, will be discussed, along with future directions for integrating these sensors into personalised medicine. By bridging advances in materials science, sensor technology, and digital health, ingestible and insertable sensors are poised to redefine non-invasive monitoring, enabling a deeper understanding of human health.

3D gas and chemical mapping in the gut with AI-enabled ingestible and wearable electronics
Yasser Khan, *USC, USA*

Gas and chemical sensing in the gastrointestinal (GI) tract plays a critical role in diagnosing and continuously monitoring conditions such as irritable bowel syndrome, inflammatory bowel disease, and food intolerances. Traditional diagnostic techniques for measuring and pinpointing the location of gases and chemicals typically involve invasive, hospital-based procedures. While ingestible electronics offer a more user-friendly alternative, accurately determining their precise location remains a significant challenge. In this study, we introduce a wearable platform utilizing magnetic-field-based three-dimensional (3D) localization, achieving millimeter-level accuracy with resolutions better than 2.2 mm using a lookup-table-based algorithm and under 4.2 mm using a neural-network-based algorithm. Our ingestible pill incorporates optoelectronic gas sensors capable of detecting oxygen (O_2) concentrations ranging from 0% to 20%, and ammonia (NH_3) within the 0–100 ppm range. Notably, NH_3 detection provides an indirect indicator for the presence of Helicobacter pylori, a bacterium associated with peptic ulcers, gastritis, and gastric cancer. Furthermore, we demonstrate the electrochemical sensing of pH through a custom-designed ingestible device encapsulated within a self-orienting, 3D-printed shell measuring 6.2 mm in diameter and 17 mm in length. This innovative design ensures the sensor remains consistently oriented toward the GI tract wall, enhancing measurement reliability. Ultimately, our platform aims to empower individuals to conveniently monitor and manage their digestive health from the comfort and privacy of their homes.

Gas Sensors Based on Edible and Organic Materials for Fish Spoilage Detection
Pierluigi Mondelli, *Italian Institute of Technology in Milan, Italy*

According to the United Nations Environment Programme report on the Food Waste Index,1 approximately 18% of the world's food production is wasted throughout the food chain. Furthermore, food waste is responsible for around 10% of global greenhouse gas emissions, posing a universal challenge to both escalating global hunger and climate change. In this context, technologies that continuously assess the condition of food are necessary to prevent spoilage and subsequent waste. For these reasons, we first focused on identifying the most relevant target gases produced in the packaging headspace of salmon meat samples during spoilage. Gas Chromatography-Mass Spectrometry experiments confirmed that sub-ppm to a few ppm concentration ranges of ammonia and trimethylamine are the primary gaseous products during spoilage. The known gas concentrations were correlated with Total Volatile Basic Nitrogen (TVB-N), a standard indicator of food freshness.2 Furthermore, we developed gas sensors based on Organic Field Effect Transistors (OFET) to detect low concentrations (sub-ppm level) of those target gases produced during food deterioration, which can serve as early indicators of food degradation. Finally, the use of an edible semiconductor3 in gas sensors enables safe introduction into food packaging without risks in case of ingestion.

Photonic Neuromorphic Hardware with 2D Material Synapses and Neurons
Sanghoon Chae, *Nanyang Technological University (NTU), Singapore*

Neuromorphic photonic hardware enables ultrafast, energy-efficient AI, but integrating brain-like feedback without sacrificing simplicity and scalability remains challenging. We present a self-powered optical spiking neural network (SPOSNN) unit by combining 2D-material-based synaptic and neuronal devices with silicon photonics. The system uses microring resonator (MRR) modulators as optical synapses and waveguide-integrated photodetectors as self-powered neurons. This optical-electrical-optical (OEO) feedback operates without external power or control circuits, drastically reducing complexity and energy consumption while enabling scalable, brain-like photonic computing. Our work highlights the promise of 2D materials in photonic neuromorphic systems, paving the way for high-performance, energy-efficient AI platforms.

INVITED SPEAKERS

Low-Power Soft Artificial Nerves Based on Printed Nanowire Electronics
Yeongjun Lee, *KAIST, Korea*

Soft electronics is an emerging field with the potential to revolutionize wearable and biomedical technologies by overcoming the limitations of conventional rigid devices. In particular, printed organic nanowires are highly attractive due to their flexibility, stretchability, unidirectional charge transport, and solution processability. Here, we present our recent advances in the development of stretchable organic semiconductor nanomaterials and devices for next-generation soft bioelectronics and neuromorphics. We introduce a novel semiconductor nanowire printing technology and demonstrate strain-resilient nanowire transistors with potential for bioelectronic applications [1]. Furthermore, we describe the development of organic semiconductor nanowire-based stretchable artificial synapses and nerves that mimic the structure and function of biological counterparts, offering opportunities for neuromorphic robotics and bioelectronic systems [2,3]. In particular, we highlight the realization of stretchable efferent nerves that accurately emulate neuromuscular junctions and muscle actuation, enabling biomimetic motor system. Finally, we demonstrate the application of soft artificial nerves as low-power, stretchable neuromorphic implants that provide real-time closed-loop proprioceptive feedback, successfully restoring coordinated and smooth leg movements in mice with motor impairments. Our findings underscore the potential of printed organic nanomaterials and soft neuromorphic devices as future low-power neurorehabilitation technologies.

3D NAND Flash Memory and Memristor for Emerging Computing System
Byung Chul Jang, *Kyungpook National University, Korea*

Recent breakthroughs in AI are driving innovation in the medical field, including medical diagnosis and virtual health assistants. Energy-based computing has recently garnered significant interest due to its potential in training generative neural networks and solving NP-hard problems. However, Conventional systems suffer from inefficiency due to von Neumann architecture and traditional annealing methods. We present MoS2 channel for 3D NAND Flash-based in-memory computing and memristor-based true random number generators (TRNG). MoS2 serves as an alternative to polycrystalline silicon channels in 3D NAND Flash, overcoming short-channel effects and current limitations. Our MoS2 devices show reliable 6-bit precision operaiton. Our memristor with imidazole copolymer generates random noise via metal nanocluster filaments. Compliance current modulation through InGaZnO transistors controls entropy. This noise efficiently solves optimization problems and generates realistic chest X-ray images, outperforming software random numbers in energy efficiency. This work advances energy-based computing with broad implications for materials science and engineering.

3D-Printed Microneedle-Based Electrochemical Sensors for Real-Time Plant Health Monitoring
Marc Parrilla, *University of Antwerp, Belgium*

Real-time plant health monitoring is emerging as a crucial approach to understanding physiological processes such as plant stress signaling. Wearable sensors offer a promising strategy for monitoring crop health and detecting environmental changes. However, the development of affordable, field-deployable sensing devices remains a challenge. In my work, I employ cost-effective 3D printing to manufacture microneedle array patches as a minimally invasive platform for in situ plant health assessment. These microneedle-based sensors enable real-time detection of key plant health biomarkers—including H_2O_2, glucose, and pH—while also allowing electrochemical profiling of plant physiology. Additionally, by modifying the electrode functionalization, these platforms can be adapted for the detection and monitoring of multiple biomarkers.

Plant wearables for monitoring physiological indicators
Chun-Chun Qu, *China Agricultural University (CAU), China*

The excellent stretchability and biocompatibility of flexible sensors have inspired an emerging field of plant wearables, which enable intimate contact with the plants to continuously monitor the growth status and localized microclimate in real-time. Plant flexible wearables provide a promising platform for the development of plant phenotype. Here, we describe several plant wearables that can harmlessly and continuously monitor the plant electrical signal and leaf temperature/humidity, which are key parameters for analyzing physiological status and microclimate of plants, respectively. Credited to the biocompatibility materials chosen and particular design, these sensors are flexible, flyweight and breathable, enabling on-site and non-destructive testing. These plant wearables can be used as a non-invasive, high-throughput, low-cost toolbox and have excellent potential for phenotypic analysis.

Plant-Wearable Sensors for Future Precision Farming
Xiangjiang Liu, *Zhejiang University, China*

Wearable electronics bridge the gap between conventional silicon- based devices and the living biological organisms and unlock functionalities previously unattainable. In agriculture, wearable sensors for plants and animals have become a hot research area, as an essential tools for monitor physiological data from individual plants. Here, we present the first flexible electronic sensor designed to harmlessly coexist with plants, enabling continuous tracking of sap flow, a key physiological indicator of plant health, water consumption and nutrient transport. Due to a special design and the materials chosen, the realized plant-wearable sensor is thin, soft, lightweight, permeable, and shows excellent biocompatibility, therefore enabling the sap flow detection in a continuous and non-destructive manner. Furthermore, the real-time investigation on stem flow insides watermelon reveals a previously unknown day/night shift pattern of water allocation between fruit and its adjacent branch. We believe our has vast potential in future precision farming, such as water-saving irrigation strategies in arid regions, breeding for drought-resistant crops, ultimately enhance agricultural efficiency.

INVITED SPEAKERS

Origami-inspired Highly Stretchable and Breathable 3D Wearable Sensors for In-situ and Online Monitoring of Plant Growth and Microclimate
Cheng Zhang, *Nanjing Agricultural University, China*

The emerging wearable plant sensors demonstrate the capability of in-situ measurement of physiological and micro-environmental information of plants. However, the stretchability and breathability of current wearable plant sensors are restricted mainly due to their 2D planar structures, which interfere with plant growth and development. Here, origami-inspired 3D wearable sensors have been developed for plant growth and microclimate monitoring. Unlike 2D counterparts, the 3D sensors demonstrate theoretically infinitely high stretchability and breathability derived from the structure rather than the material. They are adjusted to 100% and 111.55 mg·cm-2·h-1 in the optimized design. In addition to stretchability and breathability, the structural parameters are also used to control the strain distribution of the 3D sensors to enhance sensitivity and minimize interference. After integrating with corresponding sensing materials, electrodes, data acquisition and transmission circuits, and a mobile App, a miniaturized sensing system is produced with the capability of in-situ and online monitoring of plant elongation and microclimate. Moreover, it generates negligible hindrance to plant growth. This study would significantly promote the development of wearable plant sensors and their applications in the fields of plant phenomics, plant-environment interface, and smart agriculture.

Ion-selective electrode for simultaneous measurement of multiple elements in a portable nutrient solution
Kyu Hwan Lee, *Korea Institute of Materials Science (KIMS), Korea*

In smart farming, nutrient solutions are mainly managed by EC and pH, limiting precision and recycling. Crops change nutrient uptake based on root zone and environment. Understanding this behavior enables development of healthier, more productive, and disease-resistant crops. Conventional glass ion sensors are expensive and large; screen-printed types are hard to use in the root zone. This study developed a compact multi-ion sensor using PCB technology, effective in root-zone monitoring. A portable potentiometer was also created to operate with the sensor. An advanced all-in-one electroanalytical device (AED) was developed, integrating amperometric, voltammetric, potentiometric, conductometric, and impedance techniques. The AED (48×37 mm) supports eight PCB sensors and uses USB and Bluetooth. A user-friendly GUI enables real-time control and data display. Electrical and field tests confirmed its accuracy. The small, versatile platform can also evolve into a wearable biosensor with proper biomarkers, aiding smart agriculture.

Development of Stretchable Conductive Polymer Materials and Their Application in Bioelectronic Devices
Hyunseok Shim, *Pusan National University, Korea*

The development of stretchable conductive polymer materials has gained significant attention due to their potential applications in next-generation bioelectronic devices. Such materials offer unique advantages, including mechanical flexibility, biocompatibility, and tunable electrical properties, making them ideal for wearable and implantable healthcare technologies. In this talk, we present our latest advancements in designing and engineering stretchable conductive polymers that not only exhibit enhanced conductivity and mechanical robustness but also feature effectively tuned work function. We explore innovative fabrication strategies, including nanocomposite integration, to achieve superior stretchability without compromising electrical performance. Additionally, we demonstrate the application of these materials in bioelectronic devices such as flexible sensors, electrophysiological monitoring systems, and soft power management systems. Our findings highlight the potential of these materials to bridge the gap between conventional electronics and biological systems, paving the way for new opportunities in personalized healthcare and implantable bioelectronics.

Unconventional directions for organic soft electronics
Kyoseung Sim, *Ulsan National Institute of Science and Technology (UNIST), Korea*

The advancement of organic soft electronics has predominantly centered on improving sensing performance, leaving unconventional directions relatively unexplored. In this talk, we introduce three distinct approaches that significantly expand the functional landscape of organic soft electronics, including an all-soft implantable bioelectronic patch, biomimetic artificial finger pad electronics, and fully recyclable organic devices. Our implantable system, composed entirely of soft components, interfaces directly and conformally with the beating heart, enabling in vivo spatiotemporal mapping, localized stimulation, and mechanical energy harvesting. This represents a fundamentally new paradigm in biointegration, departing from conventional designs that often overlook the mechanical and physiological dynamics of internal organs. In parallel, our artificial finger pad electronics replicate the fine morphological patterns of human fingerprints to facilitate object recognition, user identification, and enhanced tactile interaction. Finally, our fully recyclable devices demonstrate complete material recovery with no loss in device functionality, addressing the growing demand for sustainability in next-generation electronics. Collectively, these unconventional strategies open new opportunities in organ-interfacing electronics, biomimetic systems, and sustainable wearable technologies.

INDUSTRY SPEAKERS

SHINE's Role in Advancing Singapore's Semiconductor Landscape
Yeow Kheng Lim, *National University of Singapore, Singapore*

By working across NUS, NTU, A*STAR-IME, DSO National Labs, and SIMTech, the Singapore Hybrid-Integrated Next-Generation μ-Electronics (SHINE) Centre, hosted at the NUS College of Design and Engineering, seeds a National Heterogeneous Integration pilot line locally that is capable of unique "Mix-&-Match" hybrid electronic technologies. At the intersection of materials science, electronics, and photonics, the Centre brings together researchers across disciplines to develop advanced microelectronics, including flexible electronics, with an emphasis on real-world impact. As a platform for academic-industry collaboration, SHINE enables partners across the semiconductor value chain to co-develop and translate emerging technologies into practical applications. By advancing heterogeneous integration capabilities and hybrid-integrated technologies, SHINE plays a pivotal role in propelling Singapore's semiconductor industry forward, driving innovation, and solidifying the country's position as a key player in the global microelectronics landscape.

Unleashing Power of Advanced Packaging with Smart Manufacturing
Chris Sim, *Micron Technology*

This keynote explores how the semiconductor industry is advancing toward the next frontier of innovation through cutting-edge smart manufacturing capabilities that are reshaping advanced packaging. As packaging complexity increases, the industry is embracing a new paradigm that combines system-level codesign, predictive modeling, advanced process controls, and digital twin technologies. Attendees will gain insight into how these capabilities are transforming manufacturing into a more intelligent, adaptive, and efficient ecosystem. We will examine how predictive simulations and digital twins are enabling virtual qualification, enhancing quality and consistency, and driving predictive maintenance. The session will also highlight how smart manufacturing is becoming a cornerstone of Industry 4.0, unlocking new levels of agility and performance in semiconductor production.

Robust, Easy to Integrate Z-Axis Interconnect for Flexible Hybrid Electronics
Madhu Stemmermann, *SunRay Scientific Inc*

Flexible Hybrid Electronics are comprised of soft and rigid electronic components. Robust and reliable electrical interconnections are necessary to ensure the proper functionality of the devices with rigid semiconductors, communications, and sensor components on flexible circuits. ZTACH® ACE, magnetically aligned Anisotropic Conductive Epoxy (ACE) takes advantage of magnetically induced self-assembly of ferro-magnetic particles that self-align into Z-axis "wires" in an epoxy polymer matrix optimized for Flexible Hybrid Electronic (FHE) applications. ZTACH® ACE provides a high-reliability electrical and mechanical interconnection without requiring precise patterning, high heat, or pressure. This magnetically aligned conductive epoxy cures at low temperatures (80C-160C) and supports fine-pitch (100 microns) reliably while maintaining low contact resistance and strong mechanical bond strength. Additionally, ZTACH® ACE acts as its own underfill and edge encapsulant, eliminating the need for a separate underfill step. Importantly, ZTACH® ACE integrates seamlessly into traditional Surface Mount Technology (SMT) lines, enabling efficient, high-volume production. SunRay will present several case studies of this novel adhesive technology using various demonstration vehicles, showcasing results of rigorous electrical and mechanical testing. Example applications to be discussed include flipped bare die attachment on flexible circuits, replacing wire-bonding, and dam and fill assembly on rigid boards. ZTACH® ACE bonding enables lower profile component attachment on flexible substrates for smart labels, allowing the addition of security features or integrated sensing, while decreasing costs and meeting performance requirements. Further case studies include the use of ZTACH® ACE in typical wearable electronic applications on host substrates like textiles and TPU, without the addition of underfill and/or encapsulation. This magnetically aligned adhesive is compatible with existing SMT lines, making adoption for manufacturing a low cost, easily adaptable technology. An Ultra Violet (UV) curable version under development is garnering interest in roll-to-roll flexible assemblies. The goal of this talk will be to demonstrate the possibilities of transitioning rigid products to FHE systems using a novel magnetically aligned ACE with existing SMT infrastructure. Easier, lower cost manufacturing of robust, flexible, wearable FHEs can be integrated into a wider range of cost effective, reliable end use applications.

Automotive FPC display interfaces – Modelling and Validation
Kalivaraprasad Reddy, *Continental Automotive Singapore*

Continental Automotive develops pioneering technologies and services for sustainable and connected mobility of people and their goods. It offers safe, efficient, intelligent, and affordable solutions for vehicles, machines, traffic, and transportation. Our pioneering technologies for visual, tactile, and auditory interaction with the vehicle determine the mobility of the future. In this presentation, we will give an overview about automotive display interfaces design and challenges associated with those interfaces. These interfaces use FPC/FFC cables along with FPC display boards. Flexible PCBs can be folded or shaped to fit into compact or irregular spaces, making them ideal for modern vehicles. To have the flexibility, they need to have thin cores and special ground structures that can create significant SI (Signal Integrity) and EMC (Electro Magnetic Compatibility) issues. Simulations helps here to model these flex PCB's up front and resolve the issues regarding the SI and EMC early and helps in achieving superior quality and cost-efficient design.

INDUSTRY SPEAKERS

The Latest Technology Breakthroughs for Flexible Printed OLED TV Display Technology
James (Jueng-Gil) Lee, *TCL Corporate Research*

The flexible printed OLED TV display technology will be able to create new application market, such as rollable/foldable TV, in the future. It's TV Mobiles. The flexible printed OLED TV Mobiles, combined with touch/camera technology, ubiquitous connectivity through 5G/6G technology, and with the integration of Iot/healthcare sensors on the flexible printed OLED TV Mobiles panel, and with the help of AI, Big Data and iCloud, will change our daily life into a smart way of thinking, living, and working. TCL believes that this kind of TV Mobiles will be a "Disruptive Game Changer" in the display industry in near the future. Since the TCL (TCL CSOT, Guangdong Juhua Printed Display Technology Co. Ltd. & TCL Corporate Research) has successfully demonstrated the 31" FHD flexible printed OLED TV, there are a lot of technology breakthroughs for improving the panel performance and cost reduction. The co-planar top gate Oxide TFT device architecture, printing OLED top emission device architecture with new OLED materials, MURA free ink jet printing technology with unique bank design, advanced encapsulation technology with new inorganic material for panel performance improvement are developed. Especially innovative mechanical release technology without using laser lift off technology is developed for cost reduction and production yield up in flexible printed OLED TV MP line. Based on these technology breakthroughs, 31" 4K flexible printed OLED TV with high resolution(142ppi) are fabricated. The performance of 31" flexible printed OLED TV is, 4K high resolution (3840x2160, 142ppi), luminance: FW 150nits, excellent C/R; > 1M:1, color gamut: DCI-P3: >99%, wide viewing angle (△u'v' < 0.02): ≥ +/- 45°, A/R: 47.75%, and curvature radius: 20mm. In this paper, the panel performance of 31" 4K high resolution flexible printed OLED TV and the latest technology breakthroughs are discussed in details.

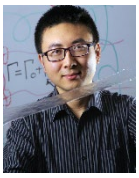
Advancing Manufacturing in Flexible Hybrid Electronics through Innovation and Design
Sudheer Kumar, *Indian Institute of Technology Kanpur, India*

Flexible Hybrid Electronics represents the forefront of technology, combining the flexibility of printed electronics with the performance of traditional semiconductor components to create lightweight, bendable, and adaptable electronic systems with enhanced functionality. As the flexible hybrid electronics market needs shift to additive printing, reduced paste metal content, and lower processing temperatures, it is required to develop direct write technologies to meet these technical targets. Ability to influence the electronic structure and material properties such particle morphology, aspect ratio, conductivity, adhesion and residual organic content is critical for robust functioning of the end-product. The talk will delve into the developments and advancements in flexible hybrid electronics, with a specific focus on emerging applications in advanced packaging and healthcare applications.

The Challenge of current stretchable PCB and the fabrication Approach
Shimizu Ryota, *Satosen Corporation, Japan*

For this talk, Mr. Shimizu will discuss the stretchable Printed Circuit Board (PCB) that incorporates the use of liquid metal to enhance flexibility, a fabrication approach with potential for high-volume production, and social implementation. At Satosen, Mr. Shimizu and his team fabricated PCBs with liquid metal channels in an elastomer, achieving high durability and reliable electrical conductivity. The study showcases the fabrication process, electrical performance under strain, and mechanical robustness. The results show the potential of the above-mentioned approach for use in wearable electronics and flexible sensors. Key findings include long-term performance. This work represents a step forward in the advancement of highly deformable electronic devices.

TUTORIAL SPEAKERS



Merging Humans and Machines through Soft Systems
Xuanhe Zhao, *Massachusetts Institute of Technology, USA*

Whereas human tissues and organs are mostly soft, wet, and bioactive, machines are commonly hard, dry, and abiotic. Merging humans, machines, and their intelligence is of imminent importance in addressing grand societal challenges in health, energy, security, education, and happiness in life. However, merging humans and machines is extremely challenging due to their fundamentally contradictory properties. At MIT Zhao Lab, we invent, understand, and facilitate the translation of soft materials systems to form long-term, robust, non-fibrotic, and high-efficacy interfaces between humans and machines, advancing human-machine collaboration and convergence. In this tutorial, I will discuss a series of fundamental topics in soft systems for merging humans and machines. I will conclude the tutorial with a vision for future human-machine convergence – aided by and synergized with modern technologies such as artificial intelligence, synthetic biology, and precision medicine.

Fabrication and Integration Strategies for Flexible Piezoresistive Thin Films for Sensing Applications
Aftab M. Hussain, *IIIT Hyderabad, India*

Sensor systems are an important link between the physical and the digital world. Thin film sensors are a class of sensors that provide the opportunity to integrate sensor systems onto or into biological systems. Well-designed flexible sensors can lead to several paradigm changing applications in the fields of soft robotics, healthcare, IoT, smart cities, and so on. In this tutorial, we will discuss thin film sensors using piezoresistive transduction as an example. We will go through the theoretical models used to describe and understand the physics of transduction, the fabrication strategies used to create the sensor thin films, and the readout circuits involved in creating a flexible sensor system. In addition, I plan to demonstrate the fabrication of a simple flexible piezoresistive sensor, using a commercially available piezoresistive thin film in the classroom. This demonstration will also include several strategies for the readout circuitry and will include some analysis and visualization considerations. The hope is to engage the audience and create excitement among young researchers for the field of flexible sensor systems.

PROGRAM AT-A-GLANCE

Sunday, June 22, 2025				Monday, June 23, 2025				Tuesday, June 24, 2025				Wednesday, June 25, 2025			
				08:00-17:30	Registration EA Atrium			08:00-17:30	Registration EA Atrium			08:00-15:30	Registration EA Atrium		
08:30-18:00	Registration EA Atrium			08:30-08:45	Welcome and Introduction LT 7A			8:30-8:45	SHINE Introduction LT 7A			08:30-10:00	Track 11.3 EA-06-02	Track 11.4.1 EA-06-03	
09:00-10:30		MYOSA Workshop EA-06-02		08:45-10:15	Track 11.1 EA-06-02	Track 11.2 EA-06-03		08:45-10:15	Industry Session 1 LT 7A			10:00-10:20	Coffee Break EA Atrium		
10:00-10:30	Coffee Break EA Atrium			10:15-10:35	Coffee Break EA Atrium			10:15-10:35	Coffee Break EA Atrium			10:15-10:35	IEEE Sensors Council Introduction LT 7A		
10:30-12:00	Tutorial - Xuanhe Zhao LT 7A			10:35-11:35	Plenary Lecture 1 - Joshua Yang LT 7A			10:35-11:35	Plenary Lecture 2 - Ajay Virkar LT 7A			10:35-11:35	Plenary Lecture 3 - Xiaodong Chen LT 7A		
12:00-13:30	Lunch EA Atrium			11:35-13:05	Track 2 EA-06-02	Track 3 EA-06-03	WiSe Panel LT 7A	11:35-13:05	Industry Session 2 LT 7A			11:35-13:05	Track 13 EA-06-02	Track 11.4.2 EA-06-03	
13:30-15:00	Tutorial - Aftab M. Hussain LT 7A	Laser-Induced Graphene Workshop EA-06-02		13:05-14:05	Lunch EA Atrium			13:05-14:05	Lunch EA Atrium			13:05-14:05	Lunch EA Atrium		
15:00-15:30	Coffee Break EA Atrium			14:05-15:35	Track 5 EA-06-02	Track 10 EA-06-03		14:05-15:35	Track 1 EA-06-02	Track 7 EA-06-03	DataPort LT 7A	14:05-15:35	Track 14 EA-06-02	YP Panel EA-06-03	Standards Workshop LT 7A
15:30-17:00		Laser-Induced Graphene Workshop EA-06-02		15:35-16:05	Coffee Break EA Atrium			15:35-16:05	Coffee Break EA Atrium			15:35-16:05	Coffee Break EA Atrium		
17:30-19:30	Welcome Reception	Poster Session	MYOSA Competition	16:05-17:35	Track 6 EA-06-02	Track 8 EA-06-03		16:05-17:35	Track 4 EA-06-02	Track 9 EA-06-03	BiP Competition LT 7A	16:05-16:35	Concluding Remarks LT 7A		
				19:00-21:00	Appreciation Dinner (by Invitation)			19:00-21:00	Gala Dinner			16:35-17:35	SHINE Lab Tour (by Registration)		

17:30-19:30
Poster Session
Session Chair: Changsheng Wu
EA Atrium

6002: Printed Electroluminescent Displays on Wood Veneers: A Novel Approach for Smart Surfaces
Lukas Rauter{3}, Jose Manoj{3}, Daniel Corzo{3}, Stephanie Weiss{2}, Olivia Moser{2}, Stefan Pandur{1}, Jürgen Kosel{3}
{1}F.LIST GmbH, Austria; {2}Kompetenzzentrum Holz GmbH, Austria; {3}Silicon Austria Labs GmbH, Austria

6009: Metamaterial Antenna Skin Enables Advanced Human Machine Interactions
Yufei Zhao, Yong Liang Guan, Chau Yuen
Nanyang Technological University, Singapore

6014: Scalable Fabrication of Flexible Tatile Sensors Using Additive Manufacturing and Polyvinyl Alcohol-Assisted Carbon Nanotube Transfer
Mingyu Kang, Jingu Jeong, Yoo-Bin Heo, Soonjae Pyo
Seoul National University of Science and Technology, Korea

6016: A Pressure-Driven Microfluidic Electrical Switch Array Embedded in a Flexible Matrix
Christoph Lehmann{2}, Ali Usama{2}, Peilong Hou{2}, Bastian Rapp{2}, Laura Maria Comella{1}
{1}University of Applied Sciences Karlsruhe, Germany; {2}University of Freiburg, Germany

6019: Precision Drug Delivery Positioning in Spinal Procedures Using a Minimally Invasive Device Integrated with Electrodes on Paraylene Film
Jinhwan Kim{2}, Jong-Min Jeon{2}, Jeong Il Choi{1}, Jihoon Yang{1}
{1}Chonnam National University Medical School and Hospital, Korea; {2}Korea Institute of Industrial Technology, Korea

6023: A Flexible Ultra-Low Power LDO for Battery-Less IoT Applications
Oscar Alonso{2}, Juan Luis Soler-Fernández{2}, Angel Diéguez{2}, Juan Daniel Prades{1}
{1}Technische Universität Braunschweig, Germany; {2}Universitat de Barcelona, Spain

6026: Design, Fabrication, and Characterization of a PMN-PT Based Ultrasound Transducer
Syed Turab Haider Zaidi{1}, Dong Hun Kim{2}, Muhammad Ali Shah{1}, Young Jin Lee{1}, Byung Chul Lee{2}, Shin Hur{1}
{1}Korea Institute of Machinery and Materials, Korea; {2}Korea Institute of Science and Technology, Korea

6029: Fabrication of a Flexible Temperature-Pressure Dual Sensor Array for E-Skin Applications
Ruqaiyya Baramatiwala, Anis Fatema, Aftab Hussain
International Institute of Information Technology Hyderabad, India

6030: Screen-Printed Current Collector for Flexible Supercapacitor
Sheng Yong, Shuran Yang, Stephen Beeby
University of Southampton, United Kingdom

6033: Wearable Soft Stethoscope with Noise Reduction Using Neural Network Towards Neonate Breath Monitoring
Yuji Isano{2}, Kazuhiro Iwama{1}, Shuichi Ito{1}, Hiroki Ota{2}
{1}Yokohama City University, Japan; {2}Yokohama National University, Japan

6039: Characterization of Bending Behaviour of Flexible Conductive CNT-PDMS Thin Films
Dhayanithi Niteesh, Saurabh Mishra, Chetanya Goyal, Aftab Hussain
International Institute of Information Technology Hyderabad, India

6040: Flexible Multimodal Tactile Sensor for Contactless Vital Sign Monitoring
Romol Chadda, Omar Ben Dali, Tim Engel, Jan Helge Dörsam, Alexander Altmann, Mario Kupnik
Technische Universität Darmstadt, Germany

6043: Miniaturized Proximity Coupled Fabric Patch Antenna Design for Wearable Applications
Irfan Ullah, Stephen Beeby
University of Southampton, United Kingdom

6047: Biodegradable Connector for Underwater Robotics
Niharika Gogoi{1}, Farshad Arvin{1}, Mahdi Saleh{3}, Ronald Thenius{2}, Alex Casson{3}
{1}Durham University, United Kingdom; {2}University of Graz, United Kingdom; {3}University of Manchester, United Kingdom

6051: iThermoGraph: IoT-Integrated Graphene-Based Thermocouple for Real-Time Temperature Monitoring
Aiman Mahar, Umar Farooq, Babar Ali, Alessandro Giuseppe D'Aloia, Hossein Cheraghi Bidsorkhi, Maria Sabrina Sarto
Sapienza Università di Roma, Italy

6052: Long-Term Performance of Activated Wood Carbon Printed Supercapacitors: A Sustainable Alternative to Conventional Activated Carbon
Remuel Vitto{3}, Hamed Pourkheirollah{3}, Aleksandrs Volperts{2}, Steffen Thrane Vindt{1}, Līga Grīnberga{4}, Gints Kučinskis{4}, Chirag Mevada{3}, Jari Keskinen{3}, Matti Mäntysalo{3}
{1}InnoCell ApS, Denmark; {2}Latvian State Institute of Wood Chemistry, Latvia; {3}Tampere University, Finland; {4}University of Latvia, Latvia

6060: Natural Wood Substrates for Flexible Thin-Film Temperature Sensors
Fahimeh Masoumi{1}, Annelot Nijkoops{1}, Alejandro Carrasco-Pena{1}, Aart Van Bezooijen{1}, Nitzan Cohen{1}, Hafiza Faiqa Maqsood{1}, Michael Haller{1}, Giuseppe Cantarella{2}, Niko Münzenrieder{1}
{1}Free University of Bozen - Bolzano, Italy; {2}University of Modena and Reggio Emilia, Italy

6066: Harnessing Human Footsteps: Graphene-Cement Triboelectric Energy Harvester for Sustainable Energy Harvesting
Valliammai Palaniappan{3}, Alimohammad Haji Adineh{3}, Pashka Durgaj{1}, Amani Hendricks{2}, Dinesh Maddipatla{3}, Massood Atashbar{3}
{1}Manhattan University, United States; {2}University of Miami, United States; {3}Western Michigan University, United States

6068: Conjugated Polymer Nanoparticles for Multifunctional Bioelectronics and Sensing P3HT:PCBM-NPs Embedded in PEO Hydrogel
Manuela Ciocca, Soufiane Krik, Michele Pompilio, Javad Shoae Gharehbagh, Luisa Petti, Franco Cacialli
Free University of Bozen - Bolzano, Italy

6077: Development of Graphite-Based Flexible and Biodegradable Sensor for Tunable Filtration and Human-Machine Interaction
Sai Aravind, Adarsh Nigam, Amit Kumar Goyal
Manipal Academy of Higher Education, India

6090: Natural Cellulose-Based Flexible Bioimpedance Electrodes for AgriFood Applications
Ahmed Rasheed{1}, Sundus Riaz{1}, Pietro Ibba{1}, Giulia Elli{1}, Angelo Zanella{2}, Luisa Petti{1}, Paolo Lugli{1}
{1}Free University of Bozen - Bolzano, Italy; {2}Free University of Bozen - Bolzano / Laimburg Research Centre, Italy

6132: Bendable Wideband 4×4 Dipole Array at X-band with Adaptive Beamformer for Wide Angle Wireless Sensing
Gong Chen, Jiahao Wang, Koen Mouthaan
National University of Singapore, Singapore

6134: Design and Fabrication of Flexible Thin-Wire Multi-Spot Thermocouples Using Hot-Wire Coating
Sebastian Lang, Wolfgang Hilber, Tina Mitteramskogler, Bernhard Jakoby
Institute for Microelectronics and Microsensors, Johannes Kepler University Linz, Austria

6137: Highly aligned P(VDF-TrFE) nanofibers for tactile and flow-sensing applications
Debarun Sengupta{1}, Ajay Giri Prakash Kottapalli{2}
{1}Shiv Nadar Institution of Eminence, Delhi-NCR, India; {2}University of Groningen, Netherlands

8:45-10:15
Track 11.1: Next-Generation Technologies for Sensing, Electrophysiology & Drug Delivery in the GI Tract
Session Chairs: Valerio Francesco Annese, Francesca Leonardi
EA-06-02

8:45
6099: The Landscape of Ingestible and Insertable Chemical Sensors (INVITED)
Kourosh Kalantar-Zadeh
University of Sydney, Australia

9:15
6114: 3D Gas and Chemical Mapping in the Gut with AI-Enabled Ingestible and Wearable Electronics (INVITED)
Yasser Khan
University of Southern California, United States

9:45
6100: Gas Sensors Based on Edible and Organic Materials for Fish Spoilage Detection (INVITED)
Pierluigi Mondelli
Italian Institute of Technology, Italy

8:45-10:15
Track 11.2: Neuromorphic Devices & Systems
Session Chair: Hocheon Yoo
EA-06-03

8:45
6080: Photonic Neuromorphic Hardware with 2D Material Synapses and Neurons (INVITED)
Sanghoon Chae
Nanyang Technological University, Singapore

9:15
6110: Low-Power Soft Artificial Nerves Based on Printed Nanowire Electronics (INVITED)
Yeongjun Lee
Korea Advanced Institute of Science and Technology, Korea

9:45
6116: 3D NAND Flash Memory and memristor for Emerging Computing System (INVITED)
Byung Chul Jang
Kyungpook National University, Korea

11:35 - 13:05
Track 3: Physical Sensors & Smart Systems
Session Chair: Yamin Zhang
EA-06-03

11:35
6104: Deformable QLEDs and Bio-Inspired E-Eyes (INVITED)
Dae-Hyeong Kim
Seoul National University, Korea

12:05
6013: Tactile Intelligence Enabled Pulse Oximeter for Motion Artifacts Removal
Siyuan Zhou{2}, Lei Zhao{1}, Jiayuan Fang{2}, Tingrui Pan{2}
{1}Chinese University of Hong Kong, Hong Kong, China; {2}University of Science and Technology of China, China

12:20
6036: Wearable Interdigitated Capacitive Sensor with Flexible Analog Front End for Superficial Skin Hydration Measurements
Alexandar Todorov, Huanghao Dai, Russel Torah, Michael Ardern-Jones, Stephen Beeby
University of Southampton, United Kingdom

12:35
6062: Surface Hardness Mapping with Flexible Insoles Using Machine Learning
Koundinya Varma, Anis Fatema, Aftab Hussain
International Institute of Information Technology Hyderabad, India

12:50
6069: Flexible Ultrathin Temperature Sensor Array as a Patch for Early Breast Cancer Detection
Marah Alassaf, Faezeh Arab Hassani
University of Bristol, United Kingdom

11:35-13:05
Track 2: Advanced Manufacturing
Session Chair: Nanjia Zhou
EA-06-02

11:35
6086: Optimization of Sintering Conditions for Screen-Printed Copper Circuits on Polyimide Substrates for Flexible Electronics Applications (INVITED)
Mohamad Taherian{2}, Luis Felipe Gerlein{2}, Krunal Shah{1}, Jaime Benavides-Guerrero{1}, Ali Taherian{2}, Sylvain G Cloutier{1}, Martin Bolduc{2}
{1}École de Technologie Supérieure, Canada; {2}Université du Québec à Trois-Rivières, Canada

12:05
6010: Additive Manufacturing of an Airflow Sensor Inspired by the Flat Trichobothria of Scorpions
Samuele Martinelli, Andrew Reid, James Windmill
University of Strathclyde, United Kingdom

12:20
6056: Rapid Prototyping of Organic Electrochemical Transistors Using Dispenser Printing on Flexible Substrates for Future e-Textiles
Changxin Shen, Abiodun Komolafe, Sheng Yong, Stephen Beeby, Russel Torah
University of Southampton, United Kingdom

12:35
6095: Inductive Pressure Sensors Using 3D-Printed Structures with Tunable Stiffness
Rahul Bhaumik{2}, Thomas Preindl{2}, Alexandra Ion{1}, Camilo Ayala-Garcia{2}, Nitzan Cohen{2}, Michael Haller{2}, Niko Münzenrieder{2}
{1}Carnegie Mellon University, United States; {2}Free University of Bozen - Bolzano, Italy

12:50
6124: Printed Silicon Nanoribbon-Based Temperature Sensors on Flexible Substrates
Ayoub Zumeit, Abhishek Singh Dahiya, Ravinder Dahiya
Northeastern University, United States

14:05 - 15:35
Track 10: Emerging Applications
Session Chairs: Nazek El-Atab, Shiming Zhang
EA-06-03

14:05
6105: Ambient Printing of Pristine Oxide Films Enabled by Liquid Metals (INVITED)
Michael Dickey
North Carolina State University, United States

14:35
6035: Characterization of Energy Consumption of a Dielectric Elastomer Actuator Based Flapping Wing
Dhayanithi Niteesh, Shreya Malkurthi, Aftab Hussain
International Institute of Information Technology Hyderabad, India

14:50
6073: Development of a Fiber Optic Grip Force Sensor for fMRI-Based Human Motor Control Studies
Winncy Du, Beldanin Aslani Takieh
San Jose State University, United States

15:05
6076: Assistive Living and Wireless Emergency Alert System for Mobility Impaired Users
Gitansh Verma{1}, Shrutidhara Sarma{1}, Eugen Koch{2}, Andreas Dietzel{2}
{1}Indian Institute of Technology Jodhpur, India; {2}Technische Universität Braunschweig, Germany

15:20
6123: High-Sensitivity RFID Tag Sensor with Coupled Ring Resonators for Multiposition Crack Monitoring
Xiangyu Xie{3}, Lihong Dong{1}, Haidou Wang{4}, Yuelan Di{1}, Weiling Guo{1}, Peng Wang{5}, Jun Zhang{2}
{1}Army Academy of Armored Forces, China; {2}Guangdong University of Technology, China; {3}Guiyang University, China; {4}Harbin Engineering University, China; {5}Hebei University of Technology, China

14:05-15:35
Track 5: Energy Harvesting & Storage
Session Chairs: Xiaomin Xu
EA-06-02

14:05
6093: The Potential of ultra-Light Weight Organic Photovoltaics for Wearable and Soft Robot Applications (INVITED)
Kenjiro Fukuda
University of Osaka, Japan

14:35
6045: Indigo-Functionalized Activated Carbon Electrode for Screen-Printed Eco-Friendly Supercapacitors
Chirag Mevada, Aapo Kattainen, Vijay Singh Parihar, Amit Tewari, Jari Keskinen, Matti Mäntysalo
Tampere University, Finland

14:50
6067: Sustainable PLA Innovations for Recyclable Piezoelectric Transducers and Harvesters
Amulya Raj{1}, Caroline Duc{1}, Hui Shen{1}, Timo Punkari{2}, Matti Mäntysalo{2}, Cedric Samuel{1}
{1}IMT nord Europe, France; {2}Tampere University, Finland

16:05-17:35
Track 8: Reliability, Simulation & Modelling
Session Chairs: Huanyu Cheng, Zhuangjian Liu
EA-06-03

16:05
6011: A Comparative Evaluation of Predictive Models for Optimized Droplet Classification in Inkjet Printing
Shahrin Akter, Dilruba Alam, Mohammad Haider
University of Missouri, United States

16:20
6032: Impact of Transverse Geometry and Substrate Selection on the Sensitivity of Laser-Induced Graphene Temperature Sensors
Faizan Tariq Beigh, Vishal Singh, Dhiman Mallick
Indian Institute of Technology Delhi, India

16:35
6131: Real-Time Hand Gesture Classification Using Infrared Sensor Arrays Based Wearable Bracelet and Efficient 1D Convolutional Neural Network
Agastasya Dahiya{3}, Rohan Katti{1}, Luigi Occhipinti{2}
{1}Bennett University, India; {2}University of Cambridge, United Kingdom; {3}University of Cambridge and Bennett University, India

16:50
6136: A Wearable Sweat Rate Sensor with Adaptive Sweat Ion Concentration Calibration
Mohammad Shafiqul Islam, Sangwon Cha, Wenxin Cai, Munia Ferdoushi, Yasser Khan
University of Southern California, United States

17:05
6138: Evaluation of Printed Silver/PEDOT:PSS Dry Electrodes for Pulse Wave Detection via Impedance Plethysmography Measurements
Camilo Téllez Villamizar{1}, Arvind Gurusekaran{1}, Ahmed Rasheed{1}, Ibba Pietro{2}, Christian Tronstad{3}, Giuseppe Ciccone{1}, Paolo Lugli{1}, Luisa Petti{1}
{1}Free University of Bolzano, Italy; {2}Free University of Bozen, Italy; {3}Oslo Hospital University, Norway

17:20
6135: A Compact Dual Band Antenna Sensor for Multiband Sensing Application
Subha Mandal{1}, Soham Karak{1}, Anumoy Ghosh{2}, Gobinda Sen{1}
{1}Institute of Engineering & Management, Kolkata, India; {2}NIT Mizoram, India

16:05-17:35
Track 6: Bioresorbable, Green & Low-Power Electronics
Session Chairs: Yingying Zhang, Niko Münzenrieder
EA-06-02

16:05
6089: The Avenue to "Green" in Organic Bioelectronics (INVITED)
Mihai Irimia-Vladu
Johannes Kepler University Linz, Austria

16:35
6022: Design and Performance of an Ultra-Low Power Wake-Up Timer for n-FET Based FlexIC Technologies
Oscar Alonso{3}, Juan Luis Soler-Fernández{3}, Ângelo Emanuel Neves Santos{1}, Pedro Miguel Cândido Barquinha{1}, Rodrigo Ferrão Paiva Martins{1}, Angel Diéguez{3}, Juan Daniel Prades{2}
{1}NOVA University Lisbon, Portugal; {2}Technische Universität Braunschweig, Germany; {3}Universitat de Barcelona, Spain

16:50
6025: Thermal Sensors on Cellulose Based Substrate for Green Thin-Film Electronics
Hafiza Faiqa Maqsood{1}, Ahmed Rasheed{1}, Soufiane Krik{1}, Fahimeh Masoumi{1}, Franco Cacialli{1}, Paolo Lugli{1}, Luisa Petti{1}, Niko Münzenrieder{1}, Giuseppe Cantarella{2}
{1}Free University of Bozen - Bolzano, Italy; {2}University of Modena and Reggio Emilia, Italy

17:05
6046: Application of Agave Silk Fibers in Sustainable and Flexible Electronics
Soufiane Krik{2}, Ahmed Rasheed{2}, Guglielmo Trentini{3}, Michele Pompilio{2}, Javad Shoae Gharehbagh{2}, Hafiza Faiqa Maqsood{2}, Giada Bombardelli{3}, Paolo Lugli{2}, Luisa Petti{2}, Andrea Gaiardo{1}, Niko Münzenrieder{2}, Franco Cacialli{2}, Manuela Ciocca{2}
{1}Fondazione Bruno Kessler, Italy; {2}Free University of Bozen - Bolzano, Italy; {3}Free University of Bozen - Bolzano / Fondazione Bruno Kessler, Italy

17:20
6133: Signal Integrity Analysis of Biodegradable Stretchable Interconnect for Wearable Application
Gulafsha Bhatti, Devkaran Maru, Kamlesh Patle, Kinnaree Shah, Vinay S Palaparthy, Yash Agrawal
Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinaga, India

14:05-15:35
Track 7: Hybrid Integration & Advanced Packaging
Session Chair: Huanyu Cheng
EA-06-03

14:05
6103: A three-Dimensionally Architected Electronic Skin Mimicking Human mechanosensation (INVITED)
Yihui Zhang
Tsinghua University, China

14:35
6004: Micro-Relays with Liquid Metal Dispersion
Sneha Chaudhary{1}, Renu Raman Sahu{1}, Sreelal S Pillai{2}, Haresh Kumar Singh{2}, Tapajyoti Das Gupta{1}, Sanjiv Sambandan{1}
{1}Indian Institute of Science, India; {2}Indian Space Research Organisation, India

14:50
6042: High-Linearity, Low-Hysteresis and Thermally-Stable MWCNT/Elastomer Characterization: Potential for Gait Parameter Estimation
Giuseppe Longo, Francesca Gentile, Rosalba Liguori, Luigi Di Benedetto, Gian Domenico Licciardo, Roberto Pantani, Alfredo Rubino
University of Salerno, Italy

15:05
6107: Simultaneously Encapsulation and Formation of PDMS-MWCNTs Composites for Multidirectional Microchannel Force Sensors
Yuzhen Li{2}, Yunfei Wang{2}, Yixin Liu{2}, Yuhan Liu{2}, Liuyang Han{2}, Yanru Chen{2}, Juntian Qu{2}, Puxiang Lai{1}, Xiang Qian{2}
{1}Hong Kong Polytechnic University, China; {2}Tsinghua University, China

15:20
6119: Randomly Accessible Active Pixel Sensor with Logarithmic-Exponential Response Enabling Low Dose and Wide Dynamic Range Indirect-Conversion X-Ray Imaging
Kai Wang
Sun Yat-sen University, China

14:05-15:35
Track 1: Emerging Materials
Session Chairs: Yi Wan, Wenzhuo Wu
EA-06-02

14:05
6108: Two-Dimensional Semiconductors for Advanced Electronics (INVITED)
Lain-Jong Li
National University of Singapore, Singapore

14:35
6015: Integrated Stretchable and Adhesive Ionic Gel Epidermal Electrode for Cardiovascular Monitoring
Chuqian Yu, Mengkang Deng, Siyuan Zhou, Ye Miao, Tingrui Pan
University of Science and Technology of China, China

14:50
6061: Subthreshold Characteristics of Printed Ion-Gated Crumpled Graphene Field Effect Transistors
Beiyi Wang{3}, Henry Wysong-Grass{3}, Kevin Schnittker{3}, Sharar Muhtasim{3}, Aydan Akyildiz{2}, Claudia-F. López-Cámara{1}, Hartmut Wiggers{2}, Joseph Andrews{3}
{1}Eindhoven University of Technology, Netherlands; {2}University of Duisburg-Essen, Germany; {3}University of Wisconsin-Madison, United States

15:05
6071: Time-Resolved Analysis of Near-Infrared Porphyrin-Based OLEDs for Future Flexible Applications
Michele Pompilio{4}, Eugenio Lunedei{3}, Alessandro Minotto{5}, Ibrahim Bulut{6}, Zewdneh Genene{2}, Petri Murto{1}, Ergang Wang{2}, Javad Shoae Gharehbagh{4}, Soufiane Krik{4}, Manuela Ciocca{4}, Harry Laurence Anderson{6}, Franco Cacialli{4}
{1}Aalto University, Finland; {2}Chalmers University of Technology, Sweden; {3}CNR-Istituto per lo Studio dei Materiali Nanostrutturati, Italy; {4}Free University of Bozen - Bolzano, Italy; {5}University of Milano-Bicocca, Italy; {6}University of Oxford, United Kingdom

15:20
6075: Electroplating of Flexible Antennas by Laser-Induced Graphene Priming
Alessio Mostaccio, Gaetano Marrocco
Università degli Studi di Roma Tor Vergata, Italy

16:05-17:35
Track 9: Wireless Devices & Systems
Session Chairs: Philipp Gutruf
EA-06-03

16:05
6097: Designing long-Term stable, wireless, Stretchable and hair-Compatible EEG System (INVITED)
Huiliang Wang
University of Texas at Austin, United States

16:35
6074: Defected Laser-Induced Graphene (LIG) Flexible Antennas as Physical Unclonable Function (PUF) Generators
Francesca Nanni, Gaetano Marrocco
Università degli Studi di Roma Tor Vergata, Italy

16:50
6020: Flexible Screen-Printed Antenna for 5G n260 Band
Henry Lei{2}, Jerry Lopez{1}, Devin Mackenzie{2}
{1}NoiseFigure Research, United States; {2}University of Washington, United States

17:05
6057: Lightweight Conformal Filtering Antenna Based on Stacking of Multi-Corrugated Polyimide Films
Mohammad Ameen, Koen Mouthaan
National University of Singapore, Singapore

17:20
6041: Chipless RFID Based Stretchable RF Sensor for Remote Sensing of Joint Folding Angle
Seyeon Park, Minjae Lee, Sungjoon Lim
Chung-Ang University, Korea

16:05 - 17:35
Track 4: Bio- & Chemical Sensors
Session Chairs:
EA-06-02

16:05
6109: Electrochemical Biosensing Interface Engineering for Continuous Biomarker Monitoring Systems (INVITED)
Jayoung Kim
Yonsei University, Korea

16:35
6005: Highly Selective Ethanol Gas Sensor of 1-D Belt Featured In2O3 Structures: Effects of Cr Dopant Ion
Mosima Kgomo-Masoga{2}, Murendeni Nemufulwi{2}, Mokhotjwa Dhlamini{2}, Gugu Mhlongo{1}
{1}Council for Scientific and Industrial Research, South Africa; {2}University of South Africa, South Africa

16:50
6037: Laser Induced Graphene Based Electroimpedance Sensor with Imprinted Polymers for Serum Protein Analysis
Faizan Tariq Beigh{2}, Chloe Davidson{1}, Dhiman Mallick{2}, Ravi Prakash{1}
{1}Carleton University, Canada; {2}Indian Institute of Technology Delhi, India

17:05
6055: Charge Neutrality Point Analysis of Flexible Electrolyte Gated Gr-FET Under Bending Deformation
Kamalesh Tripathy, Mitradip Bhattacharjee
Indian Institute of Science Education and Research Bhopal, India

17:20
6122: An Organic Electrochemical Transistor Fabricated on Waxy-Sublimating Substrates
Elisabetta Dimaggio{4}, Francesco Nepa{4}, Silvia Conti{3}, Lorenzo Pimpolari{4}, Francesco Pieri{4}, Francesca D'Elia{1}, Luana Persano{2}, Gianluca Fiori{4}
{1}Laboratorio NEST, Istituto Nanoscienze-CNR, Italy; {2}Laboratorio NEST, Scuola Normale Superiore, Italy; {3}Springer Nature AG Co KGaA, Germany; {4}University of Pisa, Italy

8:30-10:00
Track 11.3: Multifunctional Bioelectronics for Sensing, Stimulation, & Biological Integration
Session Chair: Faheem Ershad
EA-06-02

8:30
6081: Unconventional Directions for Organic Soft Electronics (INVITED)
Kyoseung Sim
Ulsan National Institute of Science and Technology, Korea

9:00
6088: Development of Stretchable Conductive Polymer Materials and Their Application in Bioelectronic Devices (INVITED)
Hyunseok Shim
Pusan National University, Korea

9:30
6038: Wearable and Imperceptible Platform for on Body Sensing, Toward Haptic Feedback
Marc Ramuz{3}, Séverine De Mulatier{5}, Lionel Fliegans{1}, Joseph Troughton{4}, Valentin Gaubert{3}, William Lamboglia Ferreira{2}, Roger Delattre{3}, Sylvain Blayac{3}
{1}Aix Marseille University, France; {2}Alten, France; {3}École Nationale Supérieure des Mines de Saint-Étienne, France; {4}University of Oxford, United Kingdom; {5}University of Tokyo, Japan

9:45
6098: Cortisol Detection Methods for Stress Monitoring: Current Insight and Future Prospect: A Review
Utkarsha Wankhade{1}, Yogesh Thakare{2}, Bhalchandra Hardas{2}, Rajesh Pande{2}
{1}Ramdeobaba College of Engineering and Management, India; {2}Ramdeobaba University, India

8:30-10:00
Track 11.4.1: Plant Electronics 1
Session Chair: Wenlong Li
EA-06-03

8:30
6083: 3D-Printed Microneedle-Based Electrochemical Sensors for Plant Health Monitoring (INVITED)
Marc Parrilla
University of Antwerp, Belgium

9:00
6084: Plant Wearables for Monitoring Physiological Indicators (INVITED)
Chunchun Qu, Tian Shen, Tiankai Zhao, Daiwei Hu, Xiqing Wang, Zhizhu He
China Agricultural University, China

9:30
6085: Plant-Wearable Sensors for Future Precision Farming (INVITED)
Xiangjiang Liu
Zhejiang University, China

11:35-13:05
Track 13: Sensors Journal
Session Chair: Ravinder Dahiya
EA-06-02

11:35
6094: Substrate Effects on the Transient Chemiresistive Gas Sensing Performance of Monolayer Graphene
Jie Zhang{1}, Manasi Doshi{2}, Eric Fahrenthold{2}
{1}Peking University, China; {2}University of Texas at Austin, United States

11:50
6101: Low-Power BLE Relay Node Operation in Mesh-Like Architectures for Precision Agriculture
Sukriti Gautam, Suman Kumar
Indian Institute of Technology Ropar, India

12:05
6106: Empowering Portable Optoelectronics with Computer Vision for Intraoral Cavity Detection
Sucharita Khuntia{1}, Sue-Yuan Fan{1}, Po-Hsiang Juan{1}, Ci-Ruei Liou{1}, Yi-Hsiang Hung{1}, Kanishk Singh{1}, Chukwuebuka Ogwo{2}, Li-Chia Tai{1}
{1}National Yang Ming Chiao Tung University, India; {1}National Yang Ming Chiao Tung University, Taiwan, China; {2}Temple University, United States

12:20
6117: Comparative Performance Evaluation of Fetal Movement-Detecting Wearable Sensors Using a Body-Worn Device
Abhishek Kumar Ghosh{3}, Omar-Ibne Shahid{3}, Niamh Nowlan{2}, Ravi Vaidyanathan{1}
{1}Imperial College London, Bangladesh; {2}University College Dublin, Ireland; {3}University of Dhaka, Bangladesh

12:35
6118: Wearable Flexible Temperature Sensor Suite for Thermal-Tactile Perception
Mitradip Bhattacharjee
Indian Institute of Science Education and Research Bhopal, India

12:50
6121: Real-Time Monitoring Ozone by an Intelligent Sensor Terminal with Low Cost
Qingpeng Zhang, Min Bai, Hanwen Dong, Xiangman Song
Northeastern University, China

11:35 - 13:05
Track 11.4.2: Plant Electronics 2
Session Chair: Wenlong Li
EA-06-03

11:35
6113: Origami-Inspired Highly Stretchable and Breathable 3D Wearable Sensors for in-situ and online Monitoring of Plant Growth and Microclimate
Cheng Zhang
Nanjing Agricultural University, China

12:05
6115: Ion-Selective Electrode for Simultaneous Measurement of Multiple Elements in a Portable Nutrient Solution
Kyu Hwan Lee{1}, Min-Yeong Kim{1}, Sungyong Jung{2}
{1}Korea Institute of Materials Science, Korea; {2}South Dakota State University, United States

12:35
6129: Understanding the Influence of Film Thickness on rGO-Based Flexible Capacitive Leaf Wetness Sensors for in-situ Agriculture Applications
Pooja Yogi{1}, Rohit Yadav{2}, Kusum Kumari{2}, Hitesh Borkar{2}, Anil K Roy{1}, Vinay S Palaparthy{1}
{1}Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinaga, India; {2}Malaviya National Institute of Technology Jaipur, India

12:50
6130: Flexible Electrolyte-Gated Field-Effect Transistors for Gallic Acid Detection
Giulia Elli, Shamim Torkian, Giuseppe Ciccone, Ahmed Rasheed, Paolo Lugli, Luisa Petti, Pietro Ibba
Free University of Bozen - Bolzano, Italy

14:05 - 15:35
Track 14: Sensors Letters
Session Chair: Anil Roy
EA-06-02

14:05
6078: Collective Optimization of Synthesis and Printing for Improved Performance of ZnO Nanowires Based Large-Area Printed Sensors
Fengyuan Liu{1}, Dhayalan Shakthivel{2}, Adamos Christou{2}, Ravinder Dahiya{2}
{1}Fondazione Bruno Kessler, Italy; {2}Northeastern University, United States

14:35
6125: Aluminium Doped Zinc Oxide and Silver Nanowire Composite Based Printed CO2 Gas Sensor
Nikhila Patil{2}, Neethu Thomas{1}, Neha Sharma{1}, Parasuraman Swaminathan{1}, Sumathi Parasuraman{2}
{1}Indian Institute of Technology Madras, India; {2}Indian Institute of Technology Roorkee, India

14:50
6126: 3D-Printed Conductance-Based Force Sensors Using Single Traxels
Anders Frem Wolstrup, Thomas Schlaikjer Holst, Jon Spangenberg, Tiberiu Gabriel Zsurzsan
Technical University of Denmark, Denmark

15:05
6092: Highly Stretchable, Sensitive and Robust Wearable Strain Sensor Based on CNTs/AgNWs Nanocomposite for Health and Fitness Monitoring
Jagan Singh Meena, Lucas Lum Yu Xiang, Yeow Kheng Lim
National University of Singapore, Singapore