IEEE FLEPS 2022

IEEE International Conference on Flexible, Printable Sensors and Systems

Vienna, Austria // July 10-13, 2022

FLEPS 2022 CONFERENCE PROGRAM

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MESSAGE FROM THE CONFERENCE CHAIRS

Dear colleagues and friends,

It is our pleasure to welcome you to present, exhibit, and participate in the 4th IEEE International Conference on Flexible Printable Sensors and Systems (FLEPS 2022) at the TU Wien in Vienna, Austria. After two years of COVID-induced virtual format, FLEPS is finally moving back to in-person mode. For us as organizers, this has been, admittedly, quite a challenge. Though nobody really likes virtual conferences, we have somehow grown accustomed to it, and going back to where we have been before the pandemic seems to be not so easy, at least not in 2022. Travelling is still difficult for many of us, budgets have been cut, and resources for conference participation seem lower than they used to be, be it in academia or in industry. Therefore, we have doubled our efforts this year to make FLEPS even more attractive by enhancing the program with exciting fringe meetings and events. We are thankful to IEEE Sensors Council for the supporting our efforts. As a novelty, the conference proceedings are also being published on IEEE Xplore one month *before* the conference to increase visibility for your works.

The IEEE FLEPS 2022 is sponsored by the IEEE Sensors Council, exclusively dedicated to Flexible, printable and large-area sensors and electronics technologies and their applications. Recent years show a trend to repurpose the conventional printing technologies and micro/nanofabrication methods to realise flexible, printed and large-area sensors and systems so that these systems can conform to a wide variety of surfaces and cater to the requirements of several traditional and new applications such as wearables and implantable electronics, robotics, healthcare technologies and the Internet of Things etc. This trend is likely to continue as the field of flexible, printed and disposable sensor technology is growing at an exponential rate. The printable and solution processable nanomaterials, and the additive manufacturing techniques offer new resource efficient and eco-friendly manufacturing routes for these smart sensor systems. IEEE FLEPS offers an excellent forum to discuss such latest developments in the field and shape the future roadmaps for electronics based on non-conventional materials and manufacturing technologies.

IEEE FLEPS 2022 offers a unique opportunity for the academic community to meet and network with industrial leaders in the field, and for industrialists to get an update on the most advanced technology in this field. To this end, this year the conference will have two full tracks dedicated to talks by experts from industry. This is further enriched by the exhibitors. We hope the atmosphere, breadth and depth of research topics combined with the quality of invited and contributed technical presentations will make IEEE FLEPS a 'must attend' event for you every year.

The technical program covers three full days of about 160 technical presentations, which will follow the tutorial sessions organized the day before the conference. The 6 tutorials offered, this year are: Perovskite Photovoltaic Cells For Indoor Energy Harvesting, Printed Thermoelectric Generators For Energy Harvesting, Additive Manufacturing Of Geometrically-complex Electronics And Electromagnetics, The Road Of Printed Electronics: Technology, Potential And Applications, High-performance Flexible And Printed Electronics, and Large Area Manufacturing Of Flexible Nanoelectronics Each day will have a plenary talk by speaker of world-renowned fame who will provide a great overview of the most interesting advances that uniquely position this conference in the field. Our oral sessions start with an invited talk by a leading expert on the topic and this is followed by talks based on contributed papers selected by the Technical Programme Committee after the peer review process. The contributed papers will be presented in oral and poster formats

This year FLEPS conference also has 6 new Focused topics on emerging topics aiming at the latest developments in flexible, printable, large- area sensors and systems enabling emerging applications in modern electronics. The 6 focused sessions are: Printed Biosensors For Point-of-care Diagnostics, Flexible Electronics For Energy Efficient Brain Inspired Computing, E-textile Sensor Systems, Micro- And Nano-system Tcad, E-waste And Climate Change, and Sensors Council's Young Professions. These sessions reflect some of the emerging areas in flexible and printed systems, not covered by regular tracks. We hope to continue practice in the future.

The Digest of Technical Papers for the IEEE FLEPS 2022 contains three-page versions of papers, provided to contributing and invited authors in an electronic form. The presented papers will be available in the IEEE Xplore one month before the conference. Further, there is provision to record the presentations. All recorded presentations will be posted online via IEEE Sensor Council's YouTube channel for wider dissemination of the research work presented during the conference. Further, the authors presenting at IEEE FLEPS 2022 will have an opportunity to submit the extended versions of their conference papers to the Special Journal Issue in IEEE Journal on Flexible Electronics (J-FLEX).

The Awards Committee will select 3 Best Student Papers from about 10 finalists. The finalists will be selected by awards co-chairs from list of candidates recommended by the track co-chairs based on the quality and scores received from peer review process. The finalists also get an opportunity to pitch their works to awards committee, which comprises of awards co-chairs and some members of the technical programme and organising committees. We thank all finalists and wish them good luck for future!

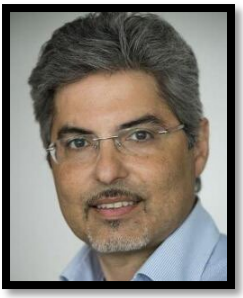
The pandemic is still not over, and our thoughts are with those who are still affected by it and experience restrictions. Although FLEPS 2022 is being organized as in-person conference, we do foresee remote participation for those who cannot make it to Vienna. Therefore, we will livestream presentations and try to enable interaction with online participants as much as reasonably possible. For those who will be present in the heart of Vienna, we have prepared everything to gain back the personal interaction we have so dearly missed during the last two years. From coffee and lunch breaks amongst posters and exhibitors, to the welcome reception on the city-center rooftop of the university, to the gala dinner in the magnificent Vienna City Hall: There will be ample possibilities for stimulating discussions, meeting old friends and making new ones, and enjoying a good time at IEEE FLEPS 2022.

We would like to express our special thanks to the Technical Program Committee and track co-chairs who contributed their time to evaluate submissions, and to the Steering Committee, who provided guidance towards the conference organization and strategic planning.

We want to thank our sponsors for their support. Our Gold Patron, CSGI. Our Exhibitors, IMPETUS and XTPL. Our Awards Patron, Cambridge University Press. Our lanyard patron – BEST group from University of Glasgow.

We thank the IEEE Sensors Council for sponsoring the IEEE FLEPS 2022 as well as our Patrons and Exhibitors. Our special thanks to Coral Miller, at Conference Catalysts, LLC for administrative support.

Finally, we thank all speakers, presenters, and attendees for making the IEEE FLEPS 2022 such a unique event. We hope that you find FLEPS 2022 professionally stimulating and enjoyable, and of course, we are looking forward to seeing you back next year for the FLEPS 2023 in Boston, USA.



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Track 9: Printed Smart Tags and Communication Devices
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Track 10: Emerging Applications
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Track 11: Printed Biosensors for Point-of-Care Diagnostics
Rainer Hainberger, *AIT Austrian Institute of Technology GmbH, Austria*
Giorgio C. Mutinati, *AIT Austrian Institute of Technology GmbH, Austria*

Track 12: Flexible Electronics for Energy Efficient Brain Inspired Computing
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Yoeri van de Burgt, *TU Eindhoven, The Netherlands*

Track 13: E-Textile Sensor Systems
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Track 14: Micro-and Nano-System TCAD
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Track 15: Printed Electronics for Automotives
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Track 16: E-Waste and Climate Change
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Track 17: Sensors Council's Young Professions
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KEYNOTE SPEAKERS

"Organic Semiconductors in Opto-Electronic Devices"
Thuc-Quyen Nguyen
University of California, Santa Barbara, USA

Abstract: Organic semiconductors (OSCs) are a class of carbon-based materials comprising of alternate single and double bonds (conjugated pi-bonds). They can be synthesized to have band gaps from the UV to the near infrared regions of the electromagnetic spectrum. OSCs are attractive due to their unique properties: light weight, mechanical flexibility, low cost, low-temperature processing, and simple fabrication methods such as roll-to-roll coating, spray coating or ink-jet printing into desired size and shape. Such materials are expected to form the basis of new technologies — called the Organic Electronics. OSCs have been implement in commercial products such as displays and lightings and have potential applications in transistors, solar cells, photodetectors, thermoelectrics, ratchets, sensors, neuromorphic computing, and bioelectronics. In this talk, I will discuss the development of OSCs for applications in solar cells, photodetectors, and electrochemical transistors. I will highlight how chemical structure and processing conditions can be used to tune the materials properties and therefore the device performance. The results from these studies provide design guidelines for new generation of materials for applications in organic electronics.

"Unconventional Materials and Platforms for Stretchable Transistor- and Resistor-Based Sensors"
Antonio Facchetti
Northwestern University, IL, USA

Abstract: Organic electronics is a technology enabling the fabrication of mechanically flexible/stretchable electronic circuits and devices using low-temperature, possibly additive, processing methodologies. In this presentation we report the development of novel materials, as well as thin-film engineering, for flexible and stretchable organic and inorganic thin film transistors and circuits. In particular we show that "ultra-soft" polymers can be synthesized by co-polymerizing naphthalenediimide (NDI) or diketopyrrolopyrrole (DPP) units with proper co-monomer building blocks and by NDI/DPP core substitution with hydrophylic/hydrophobic substituent. On material development we also report fabrication of stretchable inorganic metal oxide fiber network using spry coating. Furthermore, we discuss new "soft" transistor architectures using semiconductor film porosity as key element enhancing mechanical flexibility and tune charge transport which, combined with elastomeric pre-stretching, enables unprecedentedly stable current-output characteristic upon mechanical deformation. Finally, we demonstrate integration of these devices for sensing analytes, strain, light, temperature and physiological parameters.

KEYNOTE SPEAKERS

"Ultra Flexible Elastic Integrated Circuit System for Comprehensively Monitoring Brain Activity"

Tsuyoshi Sekitani
The Institute of Scientific and Industrial Research, Osaka University, Japan

Abstract: This paper reports the development of flexible and elastic electronic devices that are mainly composed of functional organic materials and brain-activity monitoring systems. We developed two different brain-activity monitoring systems. One is a sheet-type brain-wave sensor system (electroencephalogram: EEG) that can monitor brain waves by simply attaching the sensor to the forehead. The other is an intracranial (brain implant) brain-state sensory network (Electrocorticogram: ECoG; Local field potential: LFP) developed to understand higher-order cerebration in primates. Our laboratory has developed processes for elaborately laminating nanomaterials on ultrathin or flexible thin rubber films [1–5]. We have been conducting research and development of ultra-flexible elastic electronics using novel techniques [6–10]. We have succeeded in developing a system for monitoring biopotentials by combining four modalities: (1) a flexible/elastic and biocompatible electrode with high electrical conductivity; (2) a flexible thin-film amplifier to amplify very weak biosignals; (3) a Si-LSI platform with wireless communication; and (4) a signal-processing technique for visualizing signals in real time. The developed system is a sheet-type wireless system that is less than 5-mm thick weighs less than 20 g. Regardless of this small size, its measurement accuracy is as high as 0.1 μV; essentially, it can monitor very weak brain waves. Using this system, we developed a brain-wave sensory patch and an intercranial brain-state sensor. The patched brain-wave sensor has a measurement accuracy comparable to that of sophisticated medical equipment. In addition, brain waves can be monitored by simply attaching the sensor onto the forehead; thus, it has been used not only in medical applications but also in applications such as the development of brain-wave products, measurement of the quality of sleep, monitoring of brain waves during sport activities, and easy monitoring of cerebration at home. The brain-state sensory implant enables comprehensive monitoring of brain activities from the cerebral cortex to the deep brain and is expected to help understand high-order cerebration. The flexible, thin, and soft sheet-type multichannel electrodes can be widely distributed without damaging the cerebral cortex. The surfaces of the ECoG and LFP electrodes are completely covered with biocompatible conductive gel, which enables us to simultaneously measure comprehensive brain activity during moving for long periods, up to several months. This paper elaborates the results of the brain-monitoring system realized by imperceptible electronics. The novel system is a fusion of flexible and stretchable electrical components characterized by the softness and lightness of functional organic materials and advanced Si-LSI technology.

INVITED SPEAKERS

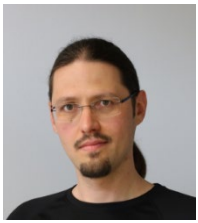
"Ultra-High Conductivity Sepia Melanin Ink Films for Environmentally Benign Electronics"
Clara Santato
Polytechnique Montreal, Canada

Abstract: Melanins (from the Greek μέλας, mélas, black) are bio-pigments ubiquitous in flora and fauna. In the melanin family, eumelanin is an insoluble brown–black type, found in vertebrates and invertebrates alike, among which Sepia (cuttlefish) is noteworthy. Sepia melanin is a type of bio-sourced eumelanin that can readily be extracted from the ink sac of cuttlefish. Eumelanin features broadband optical absorption, metal-binding affinity as well as antioxidative and radical-scavenging properties. Considering its molecular features, such as electronic conjugation, eumelanin is a prototype of material for environmentally benign, biodegradable organic electronics technologies. Unfortunately, several challenges are still open in the field of eumelanin films before their successful technological exploitation. Among them, the limited solution processability of eumelanin, in turn limiting the fabrication of low embodied energy devices, and the elusive electronic transport. In this lecture, we will discuss the successful fabrication of device quality films by printing inks based on blends of Sepia Melanin and insulating polymer binders and the observation of ultra-high conductivity and exclusive electronic transport in printed films of Sepia melanin.

"Artificial Senses Technology"
Xiaodong Chen
National Technology University of Singapore, Singapore

Abstract: Artificial senses refer to the emulation of human's basic senses and assimilate them to functional devices and systems to help us understand and perceive the world around us. This research topic of artificial senses is transdisciplinary and lies at the confluence of materials science, bioengineering, medical sciences, electrical engineering, and computer science. Some use cases, including enhanced sensory capabilities to overcome physical human limitations, improved robotic capabilities and diagnostics with smart information processing, and prosthetics and health-monitoring devices to improve quality of life, are drawing much attention. In this talk, I will present some latest progress in artificial tactile and olfaction with the viewpoint from materials development, sensor fabrication, information processing, and system integration. Artificial senses would be a new enabling technology to construct next-generation intelligent devices and systems, paving the way for advanced soft robotic applications, rehabilitation, prosthetics, and so on.

INVITED SPEAKERS



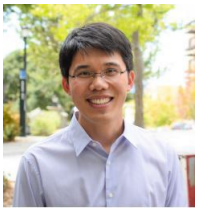
"Recent Advances of Sensor Structures Embedded in Organic Coatings on Metallic Substrates"
Thomas Voglhuber-Brunnmaier
Johannes Kepler University, Austria

Abstract: Embedded sensors provide an attractive option for implementing cost-effective monitoring capabilities for industrial applications where conventional discrete sensors are not well suited. Recently devised technologies using printed sensor structures embedded within organic coating on conductive substrates for industrial applications and harsh environments are presented. These include capacitive touch sensors, strain gauges, thermocouples, etc. Design processes as well as the distinct advantages of these sensors will be outlined. In the second part, a focus is laid on the modeling of capacitive sensors using a semi-numeric method which is particularly effective for the modeling of thin-film composites on metallic surfaces. Basic features of capacitive sensing, field distributions, and their influence on sensor performance are discussed.

"Conjugated Polymer Based Electronics for Diagnostics in Physiological Media"
Sahika Inal
King Abdullah University of Science and Technology, Saudi Arabia

Abstract: Organic Bioelectronics Lab, Biological and Environmental Science and Engineering Division, King Abdullah University Conjugated polymers provide a unique toolbox for establishing electrical communication with biological systems. I will show how modulating the chemistry of these materials can lead to interfaces that maximize interactions with biological systems while maintaining electronic transport properties. These materials are then used in organic electrochemical transistors (OECTs) to detect biological species in physiological media. I will introduce two types of OECT based sensors; one that detects metabolites with performance exceeding the state-of-the-art, and the other that detects coronavirus spike proteins at the physical limit. Having challenged these sensors with patient samples and cellular media, I will discuss areas where proof-of-concept platforms may fail and how to prolong the operation in biological environments. By tackling each of these problems, we improve device performance to a level that marks a considerable step toward label-free diagnostics.

INVITED SPEAKERS



"Wearable Energy Harvesting from the Human Body Toward Personalized Healthcare"
Wei Gao
California Institute of Technology, USA

Abstract: Electronic skin (e-skin) is expected to play a crucial role in the next generation of robotics and medical devices. However, existing e-skin-based sensing platforms primarily focus on monitoring physical parameters and rely on the power from the batteries or near field communication, which significantly hinders their broad use and sustainability toward continuous wireless sensing. Here I will introduce our recent works on flexible self-powered integrated electronic skin for multiplexed metabolic sensing in situ. These battery-free wearable sensors contain biosensors as well as highly efficient energy harvesters (enzymatic biofuel cells and triboelectric nanogenerators) that utilize a unique integration of 0 dimensional to 3 dimensional nanomaterials to achieve remarkably high power intensity and long-term stability. The wearable devices could selectively monitor key metabolites and electrolytes during prolonged physical activities, and wirelessly transmit the data to the user interface. Such battery-free soft wearable systems with highly efficient energy harvesting from the human body hold great promise for robotics and personalized healthcare applications.

"What is a Sustainable use of ICT?"
Roland Hischier
EMPA, Switzerland

Abstract: Purchasing every year a new mobile ICT device got something normal in our modern society – and few people realize that the production of new ICT devices equals to high environmental impacts. Several studies showed in the recent past, that this development is unsustainable. In the same time, there have been also studies showing the opportunities related to the development of ICT – including the increasing energy and material efficiency of such devices, the substitution potential e.g. in the area of physical transports, etc. So yes, ICT can contribute to sustainability … if it is used in the right way.

INVITED SPEAKERS

"Fully Printed CMOS Integrated Circuits: A Key Block Towards Pervasive Smart Electronics Systems"
Giorgio Dell'Erba
Fleeptech, Italy

Abstract: Billions of electronic objects are expected to be distributed worldwide in the upcoming years according to the framework of pervasive electronics and the concepts of IoT, distributed healthcare and connected environments. Printed electronics has gained its place as a candidate for succeeding in the challenge of consolidating a complete technology that enables sustainable production and end-of-life management of such items. However, as of now, some fundamental building blocks, and notably printed integrated circuitry, still lag behind in terms of technological readiness compared to other printed components, such as sensors or displays. This undermines the capability of manufacturing complete integrated electronic systems solely through printing techniques, which would unlock new powerful approaches for more sustainable production of electronic systems throughout their whole life cycle, at lower costs. Here, FLEEPTech presents their technology platform for the manufacturing of fully printed CMOS integrated circuits. PrintIC is based on additive printing methods, which not only allow for reduced use of solvents and no waste of material, but also offer the benefit of easy reconfiguration of the machinery for the manufacturing of multiple applications with little downtime. PrintIC is solely based on organic and carbon-based materials, deposited in thin films such that the active layers only constitute a small part, well below 5 %, of the total mass of the smart system (including substrate and encapsulation). The availability of a CMOS process, enabling the use of established architectures and design procedures for low-power circuits, combined with the capability of operating at a voltage as low as 5 V, makes PrintIC a perfect match for portable applications integrating printed batteries or energy harvesters.

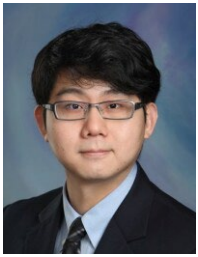
"Reliability Assessment of Flexible Wearable Electronics"
Suresh K. Sitaraman
Georgia Institute of Technology, USA

Abstract: In this presentation, I will discuss some of the uniaxial and multi-axial stretch and bend test techniques that are under development in our lab. I will present how these test techniques with their in-situ measurement capabilities can be adapted to complex surfaces associated with, for example, human body, aerospace and automotive structures, food and pharmaceutical items, energy harvesting and storage elements, entertainment and communication devices, and other internet-of-things. I will discuss how failure mechanisms and limiting strains change when printed conductors are subjected to multiaxial stretching compared to uniaxial stretching. Using computational models and failure analyses, I will provide insight into the underlying failure mechanisms in these test techniques. I will conclude the talk by providing specific case studies for flexible and wearable electronics where innovative characterization techniques and new test protocols are necessary.

INVITED SPEAKERS

"Flexible and Transparent Solutions for Sensing Electronics and Electromagnetics"
Kaarle Jaakkola
VTT, Finland

Abstract: Flexible substrates and methods of attaching components as a roll-to-roll process have made it possible to implement fully flexible and conformable electronic devices. Wireless connectivity together with wireless charging of battery enable such structures e.g. to be overmolded with elastomers to provide hermetic seal. As an alternative to conventional flexible substrates such as polyimide, nanocellulose-polyurethane composite provides the possibility to tune the mechanical properties of the substrate by varying its composition, which is an important feature for wearable medical devices. As a promising alternative for conductor material, aluminium doped zinc oxide (AZO) can be used as a transparent conductor, e.g. to implement transparent antennas, but its thermoelectric properties are also potentially useful in energy harvesting or temperature sensing. In addition, the use of graphene has been studied to exploit its best properties in the field of flexible electronics.



"Soft and Flexible Bioelectronics for Brian-Machine Interface"
Jia Liu
Harvard University, USA

Abstract: Large-scale brain mapping via brain-machine interface is important for deciphering neuron population dynamics, understanding and alleviating neurological disorders, and building advanced neuroprosthetics. Ultimately, brain mapping aims to simultaneously record activities from millions, if not billions, of neurons with single-cell resolution, millisecond temporal resolution and cell-type specificity over the time course of brain development, learning, and aging. In this talk, I will first introduce "tissue-like" soft bioelectronics that possess tissue-like properties, capable of tracking the electrical activities from the same neurons in the brain of behaving animals. Specifically, I will discuss the fundamental limits to the electrochemical impedance stability of soft electronic materials in bioelectronics and introduce our strategies to overcome these limits, enabling a scalable platform for the large-scale brain mapping. Then, I will discuss the building of "cyborg organisms", where stretchable mesh-like electrode arrays are embedded in 2D sheets of stem/progenitor cells and reconfigured through 2D-to-3D organogenesis, enabling continuous 3D brain electrophysiology during brain development. Finally, I will discuss future perspectives that leverage the soft bioelectronics-brain interface to integrate single-cell spatial transcriptomics with electrical recording, opening opportunities for cell-type-specific brain mapping and functional brain cell atlas

INVITED SPEAKERS

"Large-Area Interfaces for Single-Molecule Label-Free Bioelectronic Detection"
Luisa Torsi
University of Bari, Italy

Abstract: Bioelectronic transducing surfaces that are nanometric in size have been the main route to detect single molecules. Though enabling the study of rarer events, such methodologies are not suited to assay at concentrations below the nanomolar level. Bioelectronic field-effect-transistors with a wide (μm2–mm2) transducing interface are also assumed to be not suited, because the molecule to be detected is orders of magnitude smaller than the transducing surface. Indeed, it is like seeing changes on the surface of a one-kilometer-wide pond when a droplet of water falls on it. However, it is a fact that a number of large-area transistors have been shown to detect at a limit of detection lower than femtomolar; they are also fast and hence innately suitable for point-of-care applications. This review critically discusses key elements, such as sensing materials, FET-structures, and target molecules that can be selectively assayed. The amplification effects enabling extremely sensitive large-area bioelectronic sensing are also addressed.

"Screen-Printed Amperometric Biosensors: A Balancing Act of Manufacturing Properties, Cost Efficiency and Sensitivity"
Eva Melnik
AIT Austrian Institute of Technology GmbH, Austria

Abstract: Amperometric sensors can be used for many applications, as they can be excellently manufactured in roll-to-roll printing processes. However, careful material selection is of particular importance for high sensitivity and selectivity. For example, the choice of reference electrode material is critical to ensure potential stability, and the working electrode material must be selected to match the redox system used. For biosensor applications, the immobilisation of the receptor molecules via printing technologies must be ensured, on which the sensor materials have again a significant impact. To illustrate these challenges, examples are presented for the detection of small molecules, proteins and DNA.

INVITED SPEAKERS

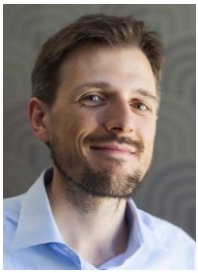
"A Thermodynamic Theory to Describe the Neuromorphic Properties of Organic Electrochemical Transistors"
Hans Kleemann
University of Dresden, Germany

Abstract: The increasing hunger for energy of software-based artificial intelligence demands the development of hardware-based, neuromorphic neural networks. A key element of future neuromorphic computing, in particular concerning applications in real-time biosignal classification, is the organic electrochemical transistor (OECT) that, by employing a mixed ion-electron conducting materials, can perform switching tasks in electrolytic environments and serve as a sensor or actor element. OECTs differ substantially from their inorganic field-effect counterparts, mainly due to their electrochemical, rather than electrostatic, gate operation principle. However, the working mechanism of OECTs is modeled like the one of field-effect transistors. This approach, however, fails to give quantitative agreement with experimental observation and ignores the material properties of the channel and the chemical dynamics that stem from the operation of the device. Here, we present a new comprehensive, unified model that can explain the behavior (including neuromorphic properties) of OECTs across a broad range of materials, designs, and operation regimes. We treat the polymeric channel as a thermodynamic binary system and show that the entropy of mixing is the primary driving force behind the operation of the OECT. We can quantify the entropic and enthalpic interactions between charged species for various materials and solvents and harness this knowledge to provide guidelines for material modeling and insights for device fine-tuning for targeted applications. Finally, our thermodynamic model describes the intrinsic origin of the ubiquitous hysteretic behavior of OECTs.

"Challenges and Perspectives for Energy-Efficient Brain-Inspired Ege Computing Applications"
Erika Covi
NaMLab gGmbH, Germany

Abstract: In recent years, Artificial Intelligence has shifted towards edge computing paradigm, where systems compute data in real-time on the edge of the network, close to the sensor that acquires them. The requirements of a system operating on the edge are very tight: power efficiency, low area footprint, fast response times, and online learning. Moreover, in order to fully optimize sensor performance and broaden applications by developing smart wearable and implantable devices, solutions must be compatible with flexible substrates. Brain-inspired architectures such as Spiking Neural Networks (SNNs) use artificial neurons and synapses that perform low-latency computation and internal-state storage simultaneously with very low power consumption. However, SNNs at present are mainly implemented on standard CMOS technologies, which makes it challenging to meet the above-mentioned constraints. In this respect, memristive technology has shown promising results, due to its ability to support fast and energy-efficient non-volatile storage of the SNN parameters in a nanoscale footprint. In this perspective work, the main challenges to achieve a neuromorphic-memristive hardware are presented, particularly in the context of optimizing such systems for applications on the edge. The aspects to be considered for integration with flexible substrates will also be discussed.

INVITED SPEAKERS



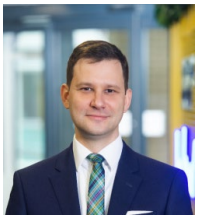
"Development of Edible Electronic Components Towards Edible Systems in Smart Pharmaceuticals and Direct Food Tagging"
Mario Caironi
Istituto Italiano di Tecnologia, Italy

Abstract: Enhanced biocompatibility and ease of processability of conjugated organic materials have spurred the work of the bioelectronics community towards the development of an increasing number of organic electronic biosensors and bioactuation devices. A further inspiring opportunity stems from the use of natural or bioinspired materials to develop edible electronic systems, composed of devices that can be safely ingested and degraded within the body after performing its function. Edible electronics could potentially target a significant number of biomedical applications, such as monitoring patients compliance to medications, and of applications in the food packaging as well, by providing ingestible smart tagging of perishable goods. Here I will first give an introduction to this emerging field and propose long-term opportunities in terms of environmentally friendly smart technologies, remote healthcare monitoring, along with the challenges ahead. Then, I will report on our recent progress in the development of edible circuitry and components, towards future integrated edible electronic systems.

"Sensors Design and Circuit Implementation Using a Flexible Hybrid Organic Process Design Kit"
Jasmin Aghassi-Hagmann
Karlsruhe Institute of Technology (KIT), Germany

Abstract: Printed and flexible electronics enable interesting novel applications in the fields of sensors and bioelectronics. To design complex circuitry and hybrid integrated systems, the sensor and the near sensor computing part is fabricated in printed electronics, which are complemented by silicon electronics to form an integrated hybrid system. I will show how we have developed a dedicated flexible hybrid organic process design kit, suitable for running in commercial CAD Tools (Cadence Virtuoso) which supports a full front to back design flow. The design flow includes schematic entry, initial simulation, and layout generation for prototyping. Additional we have developed dedicated transistor models, capacitance models as well as parasitic extraction to allow for high precision modelling. As an example for the capability of our FH_OPDK I will show a flexible pressure sensor integrated with an organic active matrix backplane addressed by binary decoders and analog multiplexer based on organic field effect transistors and metal resistors. [1] G. C. Marques, F. Rasheed, J. Aghassi-Hagmann, M.B. Tahoori, Proceedings of the 23rd Asia and South Pacific Design Automation Conference (ASP-DAC), 658–663, (2018), doi: 10.1109/ASPDAC.2018.8297397 [2] X. Feng, G. Marques; F. Rasheed, M. B. Tahoori, J. Aghassi-Hagmann, IEEE transactions on electron devices, 66 (12), 5272–5277, (2019), doi:10.1109/TED.2019.2947787 [3] This process design kit integrated in the Cadence EDA platform has been developed within the 2-HORISONS project including the cluster members Innovation Lab, Karlsruhe Institute of Technology, University of Heidelberg, BASF, Cadence.

INVITED SPEAKERS



"Key Considerations for Obtaining High Performance Contact-Controlled Devices"
Radu Sporea
University of Surrey, Guildford, UK

Abstract: Contact-controlled transistors have seen renewed interest in the past few years, owing to their properties suited to high gain, low-power and variability-resilient large area circuits. In contrast with conventional thin-film transistors, the design and optimisation of such devices focuses on obtaining reliable and consistent contact barriers, where channel length is replaced, as a design parameter, by the source injection area. With a focus on physical simulation, this talk will review the chief considerations for achieving optimal performance through the interplay between material properties, interfaces, and desired circuit function.

"Circular Economy & Flexible, Printable Sensors & Systems"
Colin Fitzpatrick
University of Limerick, Ireland

Abstract: The concept of a circular economy seeks to eliminate waste and to circulate products and materials at their highest value for the longest time possible. While the advent of flexible systems presents many opportunities for the integration of electronics into novel applications, likewise it poses many challenges in how they can be deployed in a circular fashion. This talk will focus on the resource efficiency challenges associated with electronic products in general and seek to consider how the deployment of flexible systems can be undertaken in a sustainable fashion.

"Environmental Monitoring Using Printed and Biodegradable Electronics"
Gregory Whiting
University of Colorado Boulder, USA

Abstract: High spatial density monitoring of the environment is essential for improving the understanding and management of natural systems. This is of particular importance for soils, where sensing can enable optimization of agricultural inputs, reduction of energy use, increased carbon storage, and enhanced soil health. Print-based manufacturing of electronic systems enables the fabrication of large numbers of unconventional devices that utilize a wide range of materials enabling improved compatibility with natural environments. This proposal will describe recent progress in the development of printed electronic devices and systems formed from biodegradable and biocompatible materials for real-time monitoring of soil and plant conditions including moisture and nutrient concentrations, and microbial activity.

INVITED SPEAKERS

"Simulation Tool Chain for Neuromorphic Oscillatory Neural Networks Based on Beyond-CMOS Vanadium Dioxide Devices"

Stefania Carapezzi
Microelectronics Department, LIRMM, University of Montpellier, CNRS, Montpellier, France

Abstract: Neuromorphic circuit design inspired by the functions of the human brain has recently attracted huge interest, from basic scientific research to technological applications, as a route for overcoming the limitations of the traditional von Neumann computing paradigm. Neuromorphic systems are being developed using CMOS and beyond CMOS devices in the quest to embed more functionality and increase energy efficiency. Thus, a multi-scale simulation flow able to integrate into a multi-faceted framework 1) materials properties, 2) device geometries, and 3) circuit behavior is a fundamental asset for the design and optimization of brain-inspired hardware. In this talk, I will illustrate a simulation toolchain using commercial technology computer-aided design (TCAD) software suite by Silvaco Victory to simulate neuro-mimicking oscillatory neural networks (ONNs) based on Beyond CMOS Vanadium Dioxide (VO2) oscillators. Such oscillators are compact and scalable because they can be realized by inserting a VO2 two-terminal device in series with an RC parallel circuit. The principle of operation of the oscillator circuit is as follows. The VO2 channel experiences a volatile resistive switch (from insulator to metallic state) induced by the temperature due to the Joule effect. Depending on the VO2 device being in an ON/OFF state, the external capacitor will charge/discharge, yielding the oscillatory behavior. I will avail of a dedicated TCAD approach developed to simulate such an intertwined electrothermal mechanism. Based on it, I will show simulations of VO2 oscillator obtained as 3D electrothermal TCAD simulations of VO2 device with external resistor and capacitor as lumped element boundaries. Finally, I will present the mixed-mode SPICE – TCAD procedure to simulate the dynamics of circuits of coupled VO2 oscillators, where TCAD 3D electrothermal simulation of the VO2 device is solved self-consistently to SPICE simulation of the circuit. Overall, my talk will showcase how multi-physics simulations are essential for highlighting the interplay between VO2 material properties, device geometry, and circuit dynamics to provide guidelines for developing the ONN technology.

"Skin-Interfaced Wearable Biosensors"

Wei Gao
California Institute of Technology, USA

Abstract: The rising research interest in personalized medicine promises to revolutionize traditional medical practices. This presents a tremendous opportunity for developing wearable devices toward predictive analytics and treatment. In this talk, I will introduce our efforts in developing fully-integrated skin-interfaced biosensors for non-invasive molecular analysis. Such wearable biosensors can continuously, selectively, and accurately measure a broad spectrum of sweat analytes including metabolites, electrolytes, hormones, drugs, and other small molecules. The clinical value of our wearable sensing platforms is evaluated through multiple human studies involving both healthy and patient populations toward physiological monitoring, nutritional monitoring, disease diagnosis, mental health assessment, and drug personalization. This talk will feature our recent works on self-powered battery-free electronic skins and mHealth-based biosensors for multiplexed COVID-19 diagnosis and management. These wearable and flexible devices could open the door to a wide range of personalized monitoring, diagnostic, and therapeutic applications.

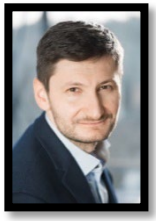
INVITED INDUSTRY SPEAKERS

Ahmed Nejim
Silvaco, UK

Francois Germain
Linxens, France

Feras Alkhalil
PragmatIC Semiconductor, UK

Vahid Akhavan
PulseForge, Texas, USA



Filip Granek
XTPL, Poland

Tom Watt
Haleon, UK

Donna Dykeman
ANSYS, UK

PulseForge® Digital Thermal Processing™

SILVACO

XTPL®

PragmatIC®

Linxens

HALEON

Ansys

TUTORIALS

"Perovskite Photovoltaic Cells for Indoor Energy Harvesting"
Thomas M. Brown
University of Rome-Tor Vergata, Italy

Abstract: Wireless sensing networks and the Internet of Things (IoT) revolution require easily integratable low-cost power sources to enable things, surfaces and systems to become "smart". New generation printed photovoltaic (PV) cells have recently come to the fore for application in powering low-energy electronics since they can be fabricated with low-cost printing techniques as well as delivering power conversion efficiencies (PCEs) under artificial indoor light that are considerably higher than those achieved with PV cells based on the commercial conventional semiconductor silicon. Perovskite solar cells have been shown to consistently convert more than ~30% of incoming optical power from LED or compact fluorescent lighting.

"Printed Thermoelectric Generators for Energy Harvesting"
Uli Lemmer
Karlsruhe Institute of Technology (KIT), Germany

Abstract: Thermoelectric generators (TEGs) convert heat to electricity without any movable parts. Such devices can play an important role in powering wearables, autonomous sensor nodes, and the Internet-of-Things (IoT). Conjugated polymers and printable inorganic nanomaterials offer the unique advantage of being processable with printing technologies. This opens a pathway for the fabrication of powerful thermoelectric generators with unprecedented low costs for mass applications. We have developed printable organic and inorganic materials for printing processes on ultrathin plastic foils. The latter class of materials has proven to exhibit high figures of merit and good processability [1]. The TEGs are then subsequently fabricated by an automated folding process that allows the ability to adapt the geometry of the devices so that the desired thermal impedance is matched. Using this approach in combination with designed low power electronics forms the basis for several wireless sensor nodes. The talk will introduce the working mechanisms, the choice of the materials, the design considerations, and the system integration [2]. References: [1] Md Mofasser Mallick, Leonard Franke, Andres Georg Rösch, and Uli Lemmer, Shape-Versatile 3D Thermoelectric Generators by Additive Manufacturing, ACS Energy Lett. 6, 85 (2021).

TUTORIALS

"Additive Manufacturing of Geometrically-Complex Electronics and Electromagnetics"
Eric MacDonald
The University of Texas at El Paso, USA

Abstract: 3D printing has been historically relegated to fabricating conceptual models and prototypes; however, increasingly, research is now focusing on fabricating functional end-use products. As patents for 3D printing expire, new low-cost desktop systems are being adopted more widely and this trend is leading to a diversity of new products, processes and available materials. However, currently the technology is generally confined to fabricating single material static structures. For additively manufactured products to be economically meaningful, additional functionalities are required to be incorporated in terms of electronic, electromechanical, electromagnetic, thermodynamic, chemical and optical content. By interrupting the printing processes and employing complementary manufacturing, additional functional content can be included in mass-customized complex structures. The two-hour short course will provide a comprehensive overview of the full taxonomy of additive manufacturing processes as defined by the ISO/ASTM 52900 standard. Each of the seven additive manufacturing processes will be described in terms of both operation and in the context of benefits and challenges for electronics and electromagnetics. A diversity of case studies will be provided highlighting the profound benefits of fabricating electronics with the design freedom, mass customization and geometrical-complexity that additive manufacturing brings to bear.

"Large Area Manufacturing of Flexible Nanoelectronics"
Dimitra Georgiadou
University of Southampton, UK

Abstract: Flexible electronics technology has made significant strides in the last decade. The potential for electronics that can be lightweight, flexible, bendable, practically conformable to any surface, is huge and has opened many new opportunities in growing sectors, such as wearables, biomedical applications and the Internet of Things. From a manufacturing standpoint, flexible electronics are known to be compatible with printing and in general low temperature (<150° C) solution-based techniques that are inexpensive and scalable to large areas. However, the high performance achieved in many incumbent electronic devices comes from extreme downscaling of device dimensions to tens of nanometres and/or the use of nanoscale materials (nanomaterials), which pose certain limitations to device structure design. More importantly, some of the processes commonly used in rigid electronics are not always compatible with flexible large area substrates, or they are not scalable, impeding the full commercial exploitation of this technology. In this tutorial, I will present some examples of nanopatterning techniques that allow fabrication of nanostructures at any type of substrate. I will show how they can be employed in the development of radiofrequency diodes, nanoscale light-emitting diodes, photodetectors and resistive switching memories using a variety of advanced materials deposited from solution at low temperatures, fully compatible with plastic (flexible) substrates. Then I will refer to specific applications in (opto) electronics and photonics that can be enabled by these advances in nanomanufacturing.

TUTORIALS

"High-Performance Flexible and Printed Electronics"
Abhishek S. Dahiya
University of Glasgow, UK

Abstract: Printing technologies are revolutionizing the growing field of flexible sensors and electronics by providing cost-effective routes for processing diverse electronic materials at temperatures that are compatible with diverse substrates including plastic. Printed and flexible devices/circuits are advantageous due to their ability to conform over different shapes and curvy surfaces which is needed for the advancement of numerous emerging applications including wearable systems, soft robotics, electronic-skin, bendable displays, and healthcare monitoring systems. This will also have an impact on the development of Internet of Things (IoT) concept where smart and interactive electronics is needed. Along with the flexible form factor, applications including IoT, smart healthcare etc. demands high device performance (fast data processing) leading to myriad machine-to-machine and/or human-to-machine connectivity at 5G communications. Advancement in inorganic-materials based printed electronics open avenues for the fabrication of intricate devices/circuits with performance comparable with the conventional planar integrated circuits (ICs). The merging of novel form factors, high-performance, diversification and functionality by printing technology is an appealing new aspect for electronics to be more interacting with their environment. This tutorial will bring together various printing techniques to realise superior grade electronic layers from nano to chip scale inorganic functional elements. Focus would be on integrating these elements over soft substrates. Potential capabilities and critical limitations of each printing technology will be highlighted, and possible solutions or alternatives will be discussed. The tutorial will also present some recent examples of high performance printed and flexible devices including transistors, sensors etc. using inorganic nano/microscale materials.

"The Road of Printed Electronics: Technology, Potential and Applications"
Shweta Agarwala
Department of Electrical and Computer Engineering, Aarhus University, Denmark

Abstract: Printed electronics, a category of 3D printing technique, is rapidly gaining attention due to its potential for creating next-generation devices. Printed electronics is indeed emerging as a transformative technology capable of impacting areas from consumer electronics, wearables, healthcare to automobiles. This tutorial will provide an overview of the printed electronics landscape by discussing the technology, materials, processes and applications.

TECHNICAL PROGRAM - MONDAY, JULY 11

8:30 - 8:45
Welcome and Introduction
Room: EI 8 Pötzl Hörsaal

8:45 - 9:45
Keynote Speaker: Thuc-Quyen Nguyen, *University of California, Santa Barbara*
Room: EI 8 Pötzl Hörsaal

Organic Semiconductors in Opto-Electronic Devices
Thuc-Quyen Nguyen
University of California, Santa Barbara, USA

9:45 - 10:15
Coffee Break

10:15 - 11:45
A1L-A: Emerging Materials 1
Room: EI 8 Pötzl Hörsaal
Session Chair: Michael Turner, *University of Manchester,* Thomas Anthopoulus, *KAUST*

10:15
INVITED TALK: Ultra-High Conductivity Sepia Melanin Ink Films for Environmentally Benign Electronics
Clara Santato
Polytechnique Montreal, Canada

10:45
Inkjet-Printing of Carbon Nano Onions for Sensor Applications in Flexible Printed Electronics
Rui M. R Pinto, Siva Nemala, Mohammadmahdi Faraji, Andrea Capasso, Kb Vinayakumar
International Iberian Nanotechnology Laboratory, Portugal

11:00
3D-Printed Elastomer Foam-Based Soft Capacitive Pressure Sensors
Xenofon Karagiorgis, Markellos Ntagios, Peter Skabara, Ravinder Dahiya
University of Glasgow, United Kingdom

11:15
Nanoparticle Chain Based Materials for Shielding and Flexible Devices
Hua Fan, William Le Boeuf, Vivek Maheshwari
University of Waterloo, Canada

11:30
Localised Catalyst Printing for Flexible Conductive Lines by Electroless Copper Deposition on Textiles
Christian Biermaier, Carolin Gleißner, Thomas Bechtold, Tung Pham
University of Innsbruck, Austria

10:15 - 11:45
A1L-B: Emerging Applications 1
Room: El 9 Hlawka Hörsaal
Session Chair: Nanshu Lu, *Texas Materials Institute (TMI),* Pedro Barquinha, *FCT-NOVA*

10:15
INVITED TALK: Soft and Flexible Bioelectronics for brain-Machine Interface
Jia Liu
Harvard University, United States

10:45
3D Printed Embedded Strain Sensor with Enhanced Performance
Habib Nassar, Ravinder Dahiya
University of Glasgow, United Kingdom

11:00
Flexible Microplasma Discharge Device for Treating Burn Wound Injuries Against Fungal Infections
Parinaz Eskandari, Carol L. Beaver, Silvia Rossbach, Dinesh Maddipatla, Massood Atashbar
Western Michigan University, United States

11:15
Screen Printed, Skin-Compliant Sensors for Mouse Electrocardiography
Liam Johnson, David Bechtold, Alex Casson
University of Manchester, United Kingdom

11:30
Towards Robust 3D Object Recognition with Dense-to-Sparse Deep Domain Adaptation
Prajval Kumar Murali{3}, Cong Wang{2}, Ravinder Dahiya{4}, Mohsen Kaboli{1}
{1}BMW Group and Radboud University, Germany; {2}BMW Group and Technical University of Munich, Germany; {3}BMW Group and University of Glasgow, Germany; {4}University of Glasgow, United Kingdom

11:45 - 13:15
A2L-A: Hybrid Integration & Packaging
Room: EI 8 Pötzl Hörsaal
Session Chair: Emre Ozer, *Arm Ltd.,* Kris Myny, *IMEC and KU Leuven*

11:45
INVITED TALK: Fully Printed CMOS Integrated Circuts: A Key Block Towards Pervasive Smart Electronics Systems
Giorgio Dell'Erba
Fleeptech, Italy

12:15
Direct Write 3D-Printed Interconnects for Heterogenous Integration of Ultra Thin Chips
Sihang Ma, Abhishek Singh Dahiya, Ravinder Dahiya
University of Glasgow, United Kingdom

12:30
Depositon of Micrometer-Size Features on Complex Substrates for Heterogeneous Integration
Aneta Wiatrowska, Karolina Fiączyk, Piotr Kowalczewski, Mateusz Łysień, Łukasz Witczak, Jolanta Gadzalińska, Ludovic Schneider, Łukasz Kosior, Filip Granek
XTPL SA, Poland

12:45
Ultra-Thin Chips (UTC) Integration on Inkjet-Printed Papers
Muhammad Hassan Malik{2}, Lukas Rauter{2}, Hubert Zangl{1}, Alfred Binder{2}, Ali Roshanghias{2}
{1}Alpen-Adria-Universität Klagenfurt, Austria; {2}Silicon Austria Labs GmbH, Austria

13:00
Processing and Chracterisation of an Ultra-Thin Image Sensor Chip in Flexible Foil System
Shuo Wang, Jan Dirk Schulze Spüntrup, Björn Albrecht, Christine Harendt, Joachim Burghartz
Institut für Mikroelektronik Stuttgart IMS CHIPS, Germany

11:45 - 13:15
A2L-B: Printed Smart Tags & Communication Devices 1
Room: El 9 Hlawka Hörsaal
Session Chair: Gaetano Marrocco*, University of Roma Tor Vergata,* Shweta Agarwala*, Aarhus University*

11:45
INVITED TALK: Flexible and Transparent Solutions for Sensing Electronics and ELECTROMAGNETICS
Kaarle Jaakkola
VTT Technical Research Centre of Finland, Finland

12:15
A Novel Design for Flexible and Conformable 3D-Printed Dielectric Resonator Antennas for WiFi and IoT Applications
Francesco Paolo Chietera, Riccardo Colella, Luca Catarinucci
University of Salento, Italy

12:30
Flexible Multi-Layer Sensor for the Wireless Implementation of Dual-Heat-Flux Monitoring of Body Temperature
Nicoletta Panunzio, Arianna Diamanti, Gaetano Marrocco
University of Rome Tor Vergata, Italy

12:45
Towards In-Mould Antennas for Geolocation Tags
Laura López-Mir{2}, Alassane Sidibe{4}, Aina López-Porta{2}, Enric Pascual{2}, Oriol Font{2}, Benjamin Dhuiège{3}, Gael Depres{1}
{1}Arjowiggins, France; {2}Eurecat S.A., Spain; {3}GenesInk, France; {4}Uwinloc, France

13:00
Demonstration of Near-Field Capacitive Standard Communication Bus for Ultrathin Reconfigurable Sensor Nodes
Mathias Fayolle, Séverine De Mulatier, Roger Delattre, Sylvain Blayac
École des Mines de Saint-Étienne, Flexible Electronics Laboratory, France

13:15 - 14:00
Lunch

14:00 - 15:30
Industry Session 1
Room: EI 8 Pötzl Hörsaal

14:00
XTPL
Filip Granek

14:20
Pulse Forge
Vahid Akhavan

14:40
Silvaco
Ahmed Nejim

15:10
ANSYS
Donna Dykeman

15:30 - 16:00
Coffee Break

16:00 - 17:30
A4L-A: Printed Biosensors for Point-of-Care Diagnostics 1 Room: EI 8 Pötzl Hörsaal
Room: EI 8 Pötzl Hörsaal
Session Chair: Rainer Hainberger, *AIT Austrian Institute of Technology GmbH,* Giorgio Mutinati, *AIT Austrian Institute of Technology GmbH*

16:00
INVITED TALK: Large-Area Interfaces for Single-Molecule Label-Free Bioelectronic Detection
Luisa Torsi
Università degli Studi di Bari Aldo Moro, Italy

16:30
INVITED TALK: Screen-Printed Amperometric Biosensors: A Balancing Act of Manufacturing Properties, Cost Efficiency and Sensitivity
Eva Melnik{1}, Vanessa Thöny{1}, Steffen Kurzhals{1}, Giorgio C. Mutinati{1}, Malahat Asadi{2}, Pooyan Mehrabi{2}, Thomas Schalkhammer{2}, Rainer Hainberger{1}
{1}AIT Autsrian Institute of Technology GmbH, Austria; {2}Attophotonics Biosciences GmbH, Australia; {2}Attophotonics Biosciences GmbH, Austria

17:00
Power-Aware System-on-Chip for Point-of-Care Diagnostic Applications
Christian Zajc{3}, Markus Haberler{3}, Inge Siegl{3}, Gerald Holweg{2}, Christian Steger{1}
{1}Graz University of Technology, Austria; {2}Infineon Technology Austria AG, Austria; {3}Infineon Technology Austria AG and Institute of Electronics, Graz University of Technology, Austria

17:15
Inkjet-Printing for Bio-Functionalizing Paper-Based Electrochemical Biosensors
Tim Kothe{1}, Thomas Maier{1}, Giorgio C. Mutinati{1}, Mike Pickrell{5}, Silvia Vosseler{4}, Tobias Wittwer{4}, Marcel Haft{3}, Thomas Elschner{3}, Wolfgang Schmidt{2}, Rainer Gumbiowski{2}, Rainer Hainberger{1}

{1}AIT Autsrian Institute of Technology GmbH, Austria; {2}Felix Schoeller Holding GmbH & Co. KG, Germany; {3}Papiertechnische Stiftung, Germany; {4}R-Biopharm AG, Germany; {5}Sun Chemical Ltd., United Kingdom

16:00 - 17:30
A4L-B: Energy Harvesting & Storage 1
Room: EI 9 Hlawka Hörsaal
Session Chair: Ravinder Dahiya, *University of Glasgow*

16:00
INVITED TALK: Wearable Energy Harvesting from The Human Body Toward Personalized Healthcare
Wei Gao
California Institute of Technology, United States

16:30
A Modeling Approach for Optimization of Printed NMC622 Cathode for Capacity Density Improvement Under Fast Charging Condition- 3D Simulation and Experimental Validation
Soma Ahmadi{2}, Ying Wang{1}, Dinesh Maddipatla{2}, Daxian Cao{1}, Hongli Zhu{1}, Qingliu Wu{2}, Massood Atashbar{2}
{1}Northeastern University, United States; {2}Western Michigan University, United States

16:45
A Novel Laser Patterned Flexible Graphene Nanoplatelet Electrode for Fast Charging Lithium-Ion Battery Applications
Himanaga Rama Krishn Emani, Valliammai Palaniappan, Soma Ahmadi, Xingzhe Zhang, Dinesh Maddipatla, Bradley J. Bazuin, Qingliu Wu, Massood Atashbar
Western Michigan University, United States

17:00
Assessment of a Cyclic Bending Test Method for Printed Flexible Supercapacitor
Zhao Fu{1}, Aarne Jauho{1}, Kaisa-Leena Väisänen{2}, Marja Välimäki{2}, Jari Keskinen{1}, Matti Mäntysalo{1}
{1}Tampere University, Finland; {2}VTT Technical Research Centre of Finland, Finland

17:15
Textile Triboelectric Nanogenerators as Self Powered Wearable Temperature Sensors
Guanbo Min, Gaurav Khandelwal, Abhishek Singh Dahiya, Daniel Mulvihill, Ravinder Dahiya
University of Glasgow, United Kingdom

TECHNICAL PROGRAM - TUESDAY, JULY 12

8:45 - 9:45
Keynote Speaker: Antonio Facchetti, *Northwestern University*
Room: EI 8 Pötzl Hörsaal

Unconventional Materials and Platforms for Stretchable Transistor-and Resistor-Based Sensors
Antonio Facchetti
Northwestern University, IL, USA

9:45 - 10:15
Coffee Break

10:15 - 12:30
Poster Session

Synergy of PMN-PT with Piezoelectric Polymer Using Sugar Casting Method for Sensing Applications
Rolan Mansour{2}, Oluwaseun Omoniyi{2}, Andrew Reid{2}, Will Brindley{1}, Brian Stewart{2}, James Windmill{2}
{1}Offshore Renewable Energy Catapult, United Kingdom; {2}University of Strathclyde, United Kingdom

Room Temperature ZnO Nanowire UV Sensors by Spray-Coating
Mindaugas Ilickas, Rasa Mardosaitė, Brigita Abakevičienė, Simas Račkauskas
Kaunas University of Technology, Lithuania

Graphene-Based Flexible Dry Electrodes for Biosignal Detection
Babar Ali, Hossein Cheraghi Bidsorkhi, Alessandro Giuseppe D'Aloia, Marco Laracca, Maria Sabrina Sarto
Sapienza University of Rome, Italy

Direct Ink Writing of Tunnelling Graphite Based Soft Piezoresistive Pressure Sensors
Mahdieh Shojaei Baghini, Ravinder Dahiya
University of Glasgow, United Kingdom

Metal Patterning via Arc Etching for Thin Film Electronics
Aswathi R Nair{2}, Sanjiv Sambandan{1}
{1}Indian Institute of Science Bangalore, India; {2}National Institute of Technology Calicut, India

A Direct Transfer Process for Laser-Induced Graphene Sensors on Any Substrate
Lukas Neumaier, Lukas Rauter, Sabine Lengger, Sherjeel Khan, Jürgen Kosel
Silicon Austria Labs GmbH, Austria

A Hybrid Casting and Screen-Printing Based Manufacturing Method for Flexible Sensors
Sherjeel Khan, Jürgen Kosel
Silicon Austria Labs GmbH, Austria

Development of FHE Based Wearable Patch for Comfortable, Noninvasive Body Temperature Monitoring
Niraliben Patel, Nathaniel Richards, Samantha Stevens, Benjamin Liesegang, Eric Tyson, Jörg Richstein, Sai Guruva Reddy Avuthu
Jabil Inc., United States

Flexible Polymer Rectifying Diode on Plastic Foils with MoO3 Hole Injection
Miao Li{1}, Nazmul Rafi{1}, Paul Berger{2}, Donald Lupo{1}, Matti Mäntysalo{1}
{1}Tampere University, Finland; {2}Tampere University and Ohio State University, Finland

Selective Removal of Contact Printed Nanowires for Lithography-Free Patterning
Luca De Pamphilis, Adamos Christou, Abhishek Singh Dahiya, Ravinder Dahiya
University of Glasgow, United Kingdom

Aerosol Jet Printed Tactile Sensor on Flexible Substrate
Olalekan Olowo, Ruoshi Zhang, Danming Wei, Dilan Ratnayake, Douglas Jackson, Dan Popa
University of Louisville, United States

PEDOT: PSS Polymer Aerosol Jet-Printing for Robotic Skin Sensors
Olalekan Olowo, Danming Wei, Dilan Ratnayake, Brian Goulet, Alexander Curry, Andriy Sherehiy, Ruoshi Zhang, Dan Popa
University of Louisville, United States

Direct-Write 3D Printing of Interconnects for Fan-Out Wafer-Level Packaging
Jacob Dawes, Matthew Johnston
Oregon State University, United States

Fully Flexible Organic LED Fabricated by a Solution-Based Process
Seyedfakhreddin Nabavi{2}, Yiwen Chen{2}, Nathaniel Lasry{1}, Sharmistha Bhadra{2}
{1}iMD Research Inc, Canada; {2}McGill University, Canada

3D Printed Flexible Photoplethysmography Sensor Array for Tissue Oximetry
Matas Petreikis, Manish Tiwari
University College London, United Kingdom

Inkjet-Printed Flexible Oxide Photodetectors for Scalable User Interfaces
Georgios Bairaktaris, Fasihullah Khan, Radu Sporea
University of Surrey, United Kingdom

Performance Evaluation and Optimisation of Multi-Point Waveguide Based Optical Sensor for Soft Robots
Ahmed Hassan, Faisal Aljaber, Ivan Vitanov, Kaspar Althoefer
Queen Mary University of London, United Kingdom

A Smart Wearable Oximeter Insole for Monitoring SpO2 Levels of Diabetics' Foot Ulcer
Masoud Panahi{2}, Simin Masihi{2}, Anthony Hanson{2}, Jose Rodriguez-Labra{2}, Ahmad Masihi{1}, Dinesh Maddipatla{2}, Binu B. Narakathu{2}, Daryl Lawson{2}, Massood Atashbar{2}
{1}Sharif University, Iran; {2}Western Michigan University, United States

Multidirectional Strain Sensor Using Multimaterial 3D Printing
Radu Chirila{2}, Oliver Ozioko{1}, Philippe Schyns{2}, Ravinder Dahiya{2}
{1}University of Derby, United Kingdom; {2}University of Glasgow, United Kingdom

Velcro Hook Electroencephalogram Textrode for Brain Activity Monitoring
Granch Berhe Tseghai{1}, Benny Malengier{1}, Kinde Anlay Fante{2}, Lieva Van Langenhove{1}
{1}Ghent University, Belgium; {2}Jimma University, Belgium

Fabrication and Characterization of Low-Cost Humidity Sensor
Venkata Prasanth Pasupuleti, Anshu Sarje
International Institute of Information Technology Hyderabad, India

A Fully Flexible Handheld Wireless Estrogen Sensing Device
Alex Whipple, Marie Bridges, Anthony Hanson, Dinesh Maddipatla, Massood Atashbar
Western Michigan University, United States

Facile Fabrication of Graphene Oxide-Based Flexible Temperature Sensor and Improving its Humidity Stability
Sajjad Hajian, Soma Ahmadi, Dinesh Maddipatla, Parinaz Eskandari, Simin Masihi, Masoud Panahi, Binu B. Narakathu, Bradley J. Bazuin, Massood Atashbar
Western Michigan University, United States

Printed Sensors for Damage Detection in Large Engineering Structures
Daniel Zymelka, Takeshi Kobayashi
National Institute of Advanced Industrial Science and Technology, Japan

Reusability of RuO2-Nafion Electrodes, Suitable for Potentiometric pH Measurement
Maryna Lazouskaya{1}, Ott Scheler{3}, Kiranmai Uppuluri{2}, Krzysztof Zaraska{2}, Martti Tamm{1}
{1}Center of Food and Fermentation Technologies, Tallinn University of Technology, Estonia; {2}Łukasiewicz Research Network – Institute of Microelectronics and Photonics, Poland; {3}Tallinn University of Technology, Estonia

Directly Conductive, Flexible, 3D Printed, EEG Electrodes
Le Xing, Alex Casson
University of Manchester, United Kingdom

Inkjet and Extrusion Printed Silver Biomedical Tattoo Electrodes
Yoland El-Hajj, Milad Ghalamboran, Gerd Grau
York University, Canada

Flexible Photonic Crystal Slabs for Microfluidic Integration
Fabio Aldo Kraft, Martina Gerken
Kiel University, Germany

Electrochemical Sensor for Phosphate Ions Based on Laser Scriber Reduced Graphene Oxide
Bernardo Patella{3}, Federico Gitto{3}, Michele Russo{1}, Giuseppe Aiello{3}, Alan O'Riordan{2}, Rosalinda Inguanta{3}
{1}Dipietro Group, Italy; {2}Tyndall National Institute, Ireland; {3}University of Palermo, Italy

Electrochemical Investigation of Self-Assembling Monolayers Toward Ultrasensitive Sensing
Angelo Tricase{1}, Anna Imbriano{1}, Eleonora Macchia{2}, Rosaria Anna Picca{1}, Davide Blasi{1}, Luisa Torsi{1}, Paolo Bollella{1}
{1}Università degli Studi di Bari Aldo Moro, Italy; {2}Università degli Studi di Bari Aldo Moro and Åbo Akademi University, Italy

Design and Manufacture of Flexible Epidermal NFC Device for Electrochemical Sensing of Sweat
Adina Bianca Barba, Giulio Maria Bianco, Luca Fiore, Fabiana Arduini, Cecilia Occhiuzzi, Gaetano Marrocco
University of Rome Tor Vergata, Italy

Impact of Analyte pH on the Sensitivity of Screen-Printed Flexible Ammonium Sensor
Akshaya Kumar Aliyana{1}, Aiswarya Baburaj{1}, Harikrishnan Muralee Jalajamony{3}, Naveen Kumar S K{2}, Ravinder Dahiya{4}, Renny Edwin Fernadez{3}
{1}Mangalore University, India; {2}Mangalore University and Kuvempu University, India; {3}Norfolk State University, United States; {4}University of Glasgow, United Kingdom

MoS2 Modified Screen Printed Carbon Electrode Based Flexible Sensor for Detection of Copper
Deepan Kumar Neethipathi, Priyanka Ganguly, Ajay Beniwal, Marian Scott, Adrian Bass, Ravinder Dahiya
University of Glasgow, United Kingdom

Screen Printed Ide Modified Metal Oxide Carbon Nanotube Composite Layer for Urea Fertilizer Detection
Naveen Kumar S K{2}, Aiswarya Baburaj{1}, Akshaya Kumar Aliyana{1}, Harikrishnan Muralee Jalajamony{3}, Renny Edwin Fernadez{3}
{1}Mangalore University, India; {2}Mangalore University and Kuvempu University, India; {3}Norfolk State University, United States

Design and Fabrication of a Solid-State Chemiresistive Sensor for the Detection of Hexavalent Chromium
Shweta Shekar, S Subramanian, Praveen Ramamurthy
Indian Institute of Science Bangalore, India

Conducting Polymer Based Field-Effect Transistor for Volatile Organic Compound Sensing
Ashutosh Panchal, Ankit Malik, Bidisha Nath, Praveen Ramamurthy
Indian Institute of Science Bangalore, India

Flexible All-Organic Composites with Ultrahigh Energy Storage Density for Wearable Electronics
Jindong Wei, Zhongyang Cheng
Auburn University, United States

Investigating the Performance of Triboelectric Nanogenerators (TENGs) Fabricated Using Various Flexible Polymeric Materials
Sam Ali, Valliammai Palaniappan, Xingzhe Zhang, Dinesh Maddipatla, Bradley J. Bazuin, Massood Atashbar
Western Michigan University, United States

Improving Registration Accuracy of Multilayer Screen-Printed Graphite Electrodes with Secondary Pore Networks for Fast Charging Lithium-Ion Batteries
Valliammai Palaniappan, Dinesh Maddipatla, Soma Ahmadi, Himanaga Rama Krishn Emani, Guanyi Wang, T. Hanson, Binu B. Narakathu, Bradley J. Bazuin, Qingliu Wu, Massood Atashbar
Western Michigan University, United States

A Novel High Voltage SBS/PVDF Based Flexible Triboelectric Nanogenerator
Xingzhe Zhang, Duo He, Himanaga Rama Krishn Emani, Masoud Panahi, Simin Masihi, Dinesh Maddipatla, Qiang Yang, Massood Atashbar
Western Michigan University, United States

Highly Conductive Flexible Printed PEDOT:PSS Films for Green Humidity Sensing Applications
Junjie Shi, Mahmoud Wagih, Steve Beeby
University of Southampton, United Kingdom

Finite Element Analysis of Stress Distribution in Soft Sensors Under Torsional Loading
Adamos Christou, Abhishek Singh Dahiya, Ravinder Dahiya
University of Glasgow, United Kingdom

Torsional and Bending Endurance Analysis of Screen-Printed Interconnects on Various Flexible Substrates
Rudra Mukherjee, Abhishek Singh Dahiya, Ravinder Dahiya
University of Glasgow, United Kingdom

Impact of Torsion on Flexible Interconnects
Ekrem Altinozen, Ana Vukovic, Phillip Sewell
George Green Institute of Electromagnetics Research, University of Nottingham, United Kingdom

Finite Element Analysis of a Flexible Tactile Sensor with Circular Pattern
Ruoshi Zhang, Ji-Tzuoh Lin, Dan Popa
University of Louisville, United States

Evaluation of Post Thermo Formed Screen Printed Silver Electrode Capacitive Sensor
Srinivasan K.P., Muthuramalingam T.
SRM Institute of Science and Technology, India

Printed Wireless Battery-Free Humidity Sensor for Integration Into Lightweight Construction Parts
Lukas Rauter{3}, Johanna Zikulnig{3}, Thomas Moldaschl{3}, Dominik Holzmann{3}, Hubert Zangl{1}, Lisa-Marie Faller{2}, Jürgen Kosel{3}
{1}Alpen-Adria-Universität Klagenfurt, Austria; {2}Carinthia University of Applied Sciences, Austria; {3}Silicon Austria Labs GmbH, Austria
Optimizing the Number of Printed Layers in a PET Inkjet-Printed Chipless RFID Sensor
Enrico Zanazzi{1}, Giada Marchi{1}, Viviana Mulloni{1}, Massimo Donelli{2}, Leandro Lorenzelli{1}
{1}Fondazione Bruno Kessler, Italy; {2}Università di Trento, Italy

Reliability Analysis of Screen-Printed Tags with Low-Power Electronics on Flexible Substrates
Moupali Chakraborty, Rudra Mukherjee, Ravinder Dahiya
University of Glasgow, United Kingdom

A Static Characterization of Stretchable 3D-Printed Strain Sensor for Restoring Proprioception in Amputees
Francesco Castelli Gattinara, Livio D'Alvia, Zaccaria Del Prete, Eduardo Palermo
Sapienza University of Rome, Italy

Flexible Ferroelectret for Zero Power Wearable Application
Pedro González-Losada{1}, Hao Yang{2}, Rui M. R Pinto{1}, Mohammadmahdi Faraji{1}, Rosada Dias{1}, Vinayakumar Basavarajappa{1}
{1}International Iberian Nanotechnology Laboratory, Portugal; {2}International Iberian Nanotechnology Laboratory and Xi'an Jiaotong University, China

An Empirical Evaluation of Various Information Gain Criteria for Active Tactile Action Selection for Pose Estimation
Prajval Kumar Murali{2}, Ravinder Dahiya{3}, Mohsen Kaboli{1}
{1}BMW Group and Radboud University, Germany; {2}BMW Group and University of Glasgow, Germany; {3}University of Glasgow, United Kingdom

Structurally Modified PDMS-Based Capacitive Pressure Sensor
Lakhvir Singh, Dayarnab Baidya, Mitradip Bhattacharjee
Indian Institute of Science Education and Research, Bhopal, India

Ultrasonic Power Transfer in Biomedical Implants Using Flexible Transducer
Ariba Siddiqui, Kamalesh Tripathy, Mitradip Bhattacharjee
Indian Institute of Science Education and Research, Bhopal, India

Flexible and Stretchable Conductive Fabric for Temperature Detection
Taehyong Eom{2}, Minhyun Jung{2}, Jihyun Bae{1}, Sanghun Jeon{2}
{1}Hanyang University, Korea; {2}Korea Advanced Institute of Science and Technology, Korea

Wearable Pressure Sensor Based on Solution-Coated Fabric for Pulse Detection
Taehyong Eom{2}, Kyungkwan Kim{3}, Minhyun Jung{2}, Jihyun Bae{1}, Sanghun Jeon{2}
{1}Hanyang University, Korea; {2}Korea Advanced Institute of Science and Technology, Korea; {3}Korea University, Korea
Preliminary Tests with Screen-Printed Piezoresistive Pressure Sensors on Pet and Textile Substrates
Pedro Martins{2}, Carolina Silva{2}, Juliana Oliveira{1}, Arcelina Marques{2}
{1}Nanopaint, Lda, Portugal; {2}Polytechnic of Porto, Portugal

Dopamine Fluorescent Sensor Based on Green Synthesized Copper Oxide Nanoparticles and Tyrosinase
Pavithra N, Srishti Johri, Praveen Ramamurthy
Indian Institute of Science Bangalore, India

10:30 - 11:30
Diversity Panel
Room: EI 8 Pötzl Hörsaal
Session Chair: Aida Todri-Sanial, *CNRS*, Tse Nga (Tina) Ng, *University of California San Diego*

Thuc-Quyen Nguyen
University of California, Santa Barbara, USA

Luisa Torsi
University of Bari, Italy

Ingrid Graz
Johannes Kepler University Linz

12:30-13:30
Lunch

13:30 - 15:00
Industry Session 2
Room: EI 8 Pötzl Hörsaal

13:30
Haleon
Tom Watt

13:50
Linxens
Francois Germain

14:10
Pragmatics
Feras Alkhalil

15:00 - 15:30
Coffee Break

15:30 - 17:30
B3L-A: Advanced Manufacturing of Printed & Flexible Electronics 1
Room: EI 8 Pötzl Hörsaal
Session Chair: Ravinder Dahiya, *University of Glasgow,* Sheng Xu, *University of California San Diego*

15:30
INVITED TALK: Artificial Sense Technology
Xiaodong Chen
Nanyang Technological University, Singapore

16:00
Method for Fabricating Flexible Solar Cell Perovskite Semiconductors via a Sheet of Paper Applicator Soaked in Anti-Solvent
Nazila Zarabinia{2}, Giulia Lucarelli{1}, Reza Rasuli{2}, Francesca De Rossi{1}, Babak Taheri{1}, Hamed Javanbakht{1}, Francesca Brunetti{1}, Thomas Brown{1}
{1}CHOSE, University of Rome Tor Vergata, Italy; {2}University of Zanjan, Iran

16:15
A System to Measure the Complex Permittivity of 3D-Printing Materials
Andrea Alimenti{3}, Nicola Pompeo{3}, Kostiantyn Torokhtii{3}, Erika Pittella{1}, Emanuele Piuzzi{2}, Enrico Silva{3}
{1}Pegaso University, Italy; {2}Sapienza-University of Rome, Italy; {3}Università Roma Tre, Italy

16:30
Flexible Inkjet Printed Gold Based Electrochemical Sensor for Aqueous Lead Detection
Annatoma Arif, Robert C. Roberts
University of Texas at El Paso, United States

16:45
High-Toughness Aluminum-N-Doped Polysilicon Wiring for Flexible Electronics
Adwait Deshpande, Chayanjit Ghosh, Erfan Pourshaban, Mohit Karkhanis, Aishwaryadev Banerjee, Hanseup Kim, Carlos Mastrangelo
University of Utah, United States

17:00
Mechanical Interlocking for Connecting Electrical Wires to Flexible, FDM, 3D-Printed Conductors
Alexander Dijkshoorn, Vinod Ravi, Patrick Neuvel, Stefano Stramigioli, Gijs Krijnen
University of Twente, Netherlands

17:15
Growth Kinetics and Integration of Inorganic Nanowires for Flexible Electronics
Dhayalan Shakthivel, Adamos Christou, Abhishek Singh Dahiya, Ravinder Dahiya
University of Glasgow, United Kingdom

15:30 - 17:30
B3L-B: Biosensors Towards Advanced Diagnostic Applications
Room: El 9 Hlawka Hörsaal
Session Chair: Eleonora Macchia, *Åbo Akademi University,* Wei Gao, *California Institute of Technology*

15:30
INVITED TALK: Conjugated Polymer Based Electronics for Diagnostics in Physiological Media
Anil Koklu, Keying Guo, Shofarul Wustoni, Escarlet Díaz-Galicia, Raik Grunberg, Stefan Arold, Sahika Inal
Empa / TeKing Abdullah University, Saudi Arabiachnology & Society Lab, Switzerland

16:00
Large-Area Bio-Electronic Sensors for Early Detection of Pancreatic-Biliary Cancer Protein Markers
Lucia Sarcina{3}, Fabrizio Viola{1}, Francesco Modena{1}, Paolo Bollella{3}, Mario Caironi{1}, Irene Esposito{2}, Luisa Torsi{3}, Fabrizio Torricelli{5}, Eleonora Macchia{4}
{1}Center for Nano Science and Technology POLIMI Istituto Italiano di Tecnologia , Italy; {2}Institute of Pathology, Heinrich-Heine University and University Hospital of Düsseldorf, Germany; {3}Università degli Studi di Bari Aldo Moro, Italy; {4}Università degli Studi di Bari Aldo Moro and Åbo Akademi University, Italy; {5}Università degli Studi di Brescia, Italy

16:15
System-on-Board Integrated Flexible OEGFET Aptasensor for Saliva Testing of Cortisol
Roslyn Massey, Bruno Gamero, Ravi Prakash
Carleton University, Canada

16:30
Impedance-Based Cell Density Measurement with Inkjet Printed Flexible Sensorlexible Organic Photodetector with High Responsivity in Visible Range
{1}Fraunhofer Institute for Microelectronic Circuits and Systems-IMS, Germany; {2}University of Duisburg-Essen, Germany

16:45
Enzymatic Boolean Logic Gates Toward ON/OFF Sensing
Paolo Bollella{1}, Eleonora Macchia{2}, Luisa Torsi{1}
{1}Università degli Studi di Bari Aldo Moro, Italy; {2}Università degli Studi di Bari Aldo Moro and Åbo Akademi University, Italy

17:00
Influence of Thickness of Screen Printed Carbon Electrodes on Electrochemical Sensing
Priyanka Ganguly, Deepan Kumar Neethipathi, Ajay Beniwal, Ravinder Dahiya
University of Glasgow, United Kingdom

17:15
PEDOT:PSS Modified Screen Printed Graphene-Carbon Ink Based Flexible Humidity Sensor
Ajay Beniwal, Priyanka Ganguly, Deepan Kumar Neethipathi, Ravinder Dahiya

19:00 - 23:00
Gala Dinner
Vienna City Hall

TECHNICAL PROGRAM - WEDNESDAY, JULY 13

8:45 - 9:45
Keynote Speaker: Tsuyoshi Sekitani, *The Institute of Scientific and Industrial Research, Osaka University*
Room: EI 8 Pötzl Hörsaal

Ultra Flexible Elastic Integrated Circuit System for Comprehensively Monitoring Brain Activity
Tsuyoshi Sekitani
The Institute of Scientific and Industrial Research, Osaka University

9:45 - 10:15
Coffee Break

10:15 - 11:45
C1L-A: Reliability, Simulation & Modelling 1
Room: EI 8 Pötzl Hörsaal
Session Chair: Masood Atashbar, *Western Michigan University*, Sanjiv Sambandan, *Indian Institute of Science/University of Cambridge*

10:15
INVITED TALK: Reliability Assessment of Flexible Wearable Electronics
Suresh K. Sitaraman
Georgia Institute of Technology, GA, USA

10:45
Sensitivity Analysis of ZnO NWs Based Soft Capacitive Pressure Sensors Using Finite Element Modeling
Shashank Mishra{2}, Mahdieh Shojaei Baghini{2}, Dhayalan Shakthivel{2}, Beena Rai{1}, Ravinder Dahiya{2}
{1}TCS Research, India; {2}University of Glasgow, United Kingdom

11:00
Reliability of Conductive Textile Sensors Exposed to Ageing and Prolonged Use
Phillip Petz, Florian Eibensteiner, Josef Langer
University of Applied Sciences Upper Austria, Austria

11:15
Investigation of the Mechanical Reliability of a Velostat-Based Flexible Pressure Sensor
Anis Fatema, Ivin Kuriakose, Deeksha Devendra, Aftab Hussain
International Institute of Information Technology Hyderabad, India

10:15 - 11:45
C1L-B: Green & Low-Power Electronics 1
Room: EI 9 Hlawka Hörsaal
Session Chair: Fabrizio Torricelli, *University of Brescia*, Aida Todri-Sanial, *CNRS*

10:15
INVITED TALK: What Is a Sustainable Use of ICT?
Roland Hischier
Empa / Technology & Society Lab, Switzerland

10:45
High Performance n- and p-Channel Flexible Transistors Using Roll Printed Silicon Nanoribbons
Ayoub Zumeit, Abhishek Singh Dahiya, Adamos Christou, Ravinder Dahiya
University of Glasgow, United Kingdom

11:00
Flexible Microcrystalline Silicon Source-Gated Transistors with Negliglible DC Performace Degradation at 2.5 mm Bending Radius
Eva Bestelink{2}, Jean-Charles Fustec{1}, Olivier de Sagazan{1}, Hao-Jing Teng{2}, Radu Sporea{2}
{1}University of Rennes, IETR-DMM-UMR6164, France; {2}University of Surrey, United Kingdom

11:15
Flexible Organic Photodetector with High Responsivity in Visible Range
Bidisha Nath, Praveen Ramamurthy, D Roy Mahapatra, Gopalkrishna Hegde
Indian Institute of Science Bangalore, India

11:45 - 13:15
C2L-A: Physical Sensors & Smart Systems 1
Room: EI 8 Pötzl Hörsaal
Session Chair: Sherjeel Khan, *Silicon Austria Labs*, Jurgen Kosel, *Silicon Austria Labs*

11:45
INVITED TALK: Recent Advances of Sensor Structures Embedded in Organic Coatings on Metallic Substrates
Thomas Voglhuber-Brunnmaier
Johannes Kepler University, Austria

12:15
Flexible Chipless RFID Temperature Memory Sensor
Sheikh Dobir Hossain, Miguel A. Palacios Mora, Annatoma Arif, Bhushan Lohani, Robert C. Roberts
University of Texas at El Paso, United States

12:30
Influence of Encapsulation on the Performance of V2O5 Nanowires-Based Temperature Sensors
Joao Neto, Abhishek Singh Dahiya, Ravinder Dahiya
University of Glasgow, United Kingdom

12:45
Laser-Induced Graphene Pressure Sensors Manufactured via Inkjet PCB Printer
Landon Ivy{2}, Ved Gund{2}, Benyamin Davaji{3}, Carlos Ospina{1}, Di Ni{2}, Peter Doerschuk{2}, Amit Lal{2}
{1}BotFactory Inc., United States; {2}Cornell University, United States; {3}Northeastern University, United States

13:00
Microfabricated Ultra-Sensitive Permeation Sensors for Real-Time Monitoring of Compliant Implantable Bioelectronics
Massimo Mariello{2}, Kangling Wu{2}, Marion Von Allmen{1}, Matthias Van Gompel{1}, Stéphanie Lacour{2}, Yves Leterrier{2}
{1}Comelec SA, Switzerland; {2}École Polytechnique Fédérale de Lausanne, Switzerland

11:45 - 13:15
C2L-B: Brain Inspired Computing
Room: EI 9 Hlawka Hörsaal
Session Chair: Aida Todri-Sanial, *CNRS*, Yoeri van de Burgt, *TU Eindhoven*

11:45
INVITED TALK: Challenges and Perspectives for Energy-Efficient Brain-Inspired Edge Computing Applications
Erika Covi{2}, Suzanne Lancaster{2}, Veeresh Deshpande{1}, Catherine Dubourdieu{1}, Stefan Slesazeck{2}, Thomas Mikolajick{2}
{1}Helmholtz-Zentrum Berlin, Germany; {2}NaMLab gGmbH, Germany

12:15
INVITED TALK: Temperature-Dependence of All-Solid-State Organic Electrochemical Transistors
Lukas Bongartz, Anton Weißbach, Matteo Cucchi, Karl Leo, Hans Kleemann
Technische Universität Dresden, Germany

12:45
Sensorimotor Correlation Using Printed Synaptic Transistors and Conditioning PCB
Fengyuan Liu, Mahdieh Shojaei Baghini, Moupali Chakraborty, Adamos Christou, Ravinder Dahiya
University of Glasgow, United Kingdom

13:00
AI-Based Liquid Classification with Laser-Induced Graphene Flex-Sensor
Ibrahim Bozyel, Alper Endes, Aybuke Akkoca, Baris Yuksekkaya, Dincer Gokcen
Hacettepe University, Turkey

13:15 - 14:00
Lunch

14:00 - 15:30
C3L-A: TCAD for Micro/Nanosystems
Room: EI 8 Pötzl Hörsaal
Session Chair: Samar Saha, *Prospicient Devices*, Ahmed Nejim, *Silvaco*

14:00
INVITED TALK: Key Considerations for Obtaining High Performance contact-Controlled thin-Film Transistors
Radu Sporea
University of Surrey, United Kingdom

14:30
INVITED TALK: Sensor Design and Circuit Implementation Using a Flexible Hybrid Organic Process Design Kit
Jasmin Aghassi-Hagmann{2}, Gabriel Cadilha Marques{2}, Palak Gupta{2}, Justas Lukosiunas{1}, Josef Mittermaier{1}
{1}Cadence Design Systems GmbH, Germany; {2}Karlsruher Institut für Technologie, Germany

15:00
Physical Modelling of Large-Area Single-Molecule Organic Transistors
Fabrizio Torricelli{4}, Eleonora Macchia{3}, Paolo Bollella{2}, Cinzia Di Franco{1}, Zsolt M. Kovács-Vajna{4}, Gaetano Scamarcio{2}, Luisa Torsi{2}
{1}CNR, Istituto di Fotonica e Nanotecnologie and Università degli Studi di Bari Aldo Moro, Italy; {2}Università degli Studi di Bari Aldo Moro, Italy; {3}Università degli Studi di Bari Aldo Moro and Åbo Akademi University, Finland; {4}Università degli Stu

15:15
Adaptive Dielectric Thin Film Transistors: Device Physics and Modeling
Piyush Ranjan{2}, Prasenjit Bhattacharya{1}, Sanjiv Sambandan{3}
{1}Global Foundries, India; {2}Indian Institute of Science, India; {3}Indian Institute of Science Bangalore, India

14:00 - 15:30
C3L-B: e-Textile Sensor Systems 1
Room: EI 9 Hlawka Hörsaal
Session Chair: Sanghun Jeon, *KAIST*, Jihyun Bae, *Hanyang University*

14:00
INVITED TALK: Development of Edible Electronic Components Towards Edible Systems in Smart Pharmaceuticals and Direct Food Tagging
Mario Caironi
Center for Nano Science and Technology POLIMI Istituto Italiano di Tecnologia , Italy

14:30
V2O5 Nanowires Coated Yarn Based Temperature Sensor for Smart Textiles
Gaurav Khandelwal, Abhishek Singh Dahiya, Ravinder Dahiya
University of Glasgow, United Kingdom

14:45
Wearable DIY Capacitive Touch Interface on Fabric Substrate for Digital Switch Control
Muhammad Mateen Fawad, Muhammad Nasir, Muhammad Hamza Zulfiqar, Muhammad Zubair, Muhammad Qasim Mehmood, Kashif Riaz
Information Technology University of the Punjab, Pakistan

15:00
Feasibility Analysis of a Textile Metal Detector Utilizing a Conductive Yarn
Stephan Schuler, Phillip Petz, Florian Eibensteiner
University of Applied Sciences Upper Austria, Austria

15:15
Opportunities and Challenges of Smart Textile Systems for Occupational Safety of Electricians
Silke Wohnsdorf, Jasmin Simon, Ulrich Klapper
Adaptive Regelsysteme Gesellschaft m.b.H., Austria

15:30 - 16:00
Coffee Break

16:00-17:30
C4L-A: e-Waste & Sustainable Electronics
Room: EI 8 Pötzl Hörsaal
Session Chairs: Jeff Kettle, *University of Glasgow*, Emanuel Carlos, *Universidade NOVA de Lisboa*

16:00
INVITED TALK: Environmental Monitoring Using Printed and Biodegradable Electronics
Gregory Whiting, Eloise Bihar, Elliot Strand, Madhur Atreya, Anupam Gopalakrishnan, Catherine Crichton
University of Colorado Boulder, United States

16:30
INVITED TALK: Circular Economy & Flexible, Printable Sensors & Systems
Colin Fitzpatrick
University of Limerick, Ireland

17:00
All-Printed ZnO Nanowire Based High Performance Photodetectors
Sihang Ma, Abhishek Singh Dahiya, Adamos Christou, Ravinder Dahiya
University of Glasgow, United Kingdom

17:15
Recycled Plastic Waste-Based Triboelectric Nanogenerator Reinforcing Circular Economy
Arshad Khan{2}, Muhammad Umaid Bukhari{3}, Khawaja Qasim Maqbool{1}, Kashif Riaz{3}, Amine Bermak{2}
{1}Bahria University, Pakistan; {2}Hamad Bin Khalifa University, Qatar; {3}Information Technology University of the Punjab, Pakistan

16:00-17:30
C4L-B: Sensors Councils Young Professionals 1
Room: EI 9 Hlawka Hörsaal
Session Chairs: Joseph Andrews, *University of Wisconsin*, Mitradip Bhattacharjee, *Indian Institutes of Science Education and Research*

16:00
INVITED TALK: Skin-Interfaced Wearable Biosensors
Wei Gao
California Institute of Technology, CA

16:30
INVITED TALK: Simulation Toolchain for Neuromorphic Oscillatory Neural Networks Based on Beyond-CMOS Vanadium Dioxide Devices
Stefania Carapezzi, Corentin Delacour, Aida Todri-Sanial
LIRMM, Université de Montpellier, CNRS, France

17:00
Scalable 4-D Printed Tactile Sensor for the Detection of Shear Forces in Aid of Plantar Measurements
Constantinos Heracleous, Julian Leong, Rui Loureiro
University College London, United Kingdom

17:15
Spray Coated Piezoresistive Bend Sensor for Controlled Movements in Soft Robots
Oliver Ozioko{1}, Ravinder Dahiya{2}
{1}University of Derby, United Kingdom; {2}University of Glasgow, United Kingdom

17:30 - 17:45
Concluding Remarks
Moments Captured Award Winner Announcment
Room: EI 8 Pötzl Hörsaal

NOTES

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