Innovations in Large-Area Electronics Conference

20 - 22 February 2024

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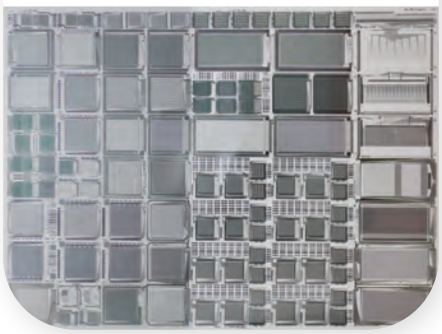

LinkZill values the various needs of our customers and customizes the design of our TFT chips accordingly. TFT chip design from different customers will be pieced together and integrated for overall tape-out and manufacturing.

TFT Device Type: a-Si, IGZO, LTPS, Organic TFT, LTPO, et al. Substrate material (glass or plastic) and size (up to G6.5 line) can be customized.

TruEbox 03MR (64×64)

This product mainly for collecting the current signal of sensor array and imaging, which can support up to 64*64 definition array. Matrix readout system can provide 64 selecting signals, 2 DC bias voltages and 64 current readout channels. All current data will be transmitted to android terminal device through Bluetooth and converted to a 256 grey level image based on the strength of the current. It very suitable for light or pressure imaging by thin film transistor (TFT) array chip.

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LinkZill also combines TFT semiconductor technology with life sciences through our TFT bio-chip platform, and has achieved industrial applications in high-throughput DNA synthesis, precise biological droplet manipulation, in-vitro diagnostics (IVD) and bio-sensing.

So far, LinkZill has served more than 100 companies, universities and research institutes worldwide with our core TFT chip technology, and has accumulated technical capabilities and experience from TFT chip design, simulation, process to system integration.

Contact Us >>>

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Day 1 - Wednesday 21st February 2024

08:00	Registration - Browse the Posters and Exhibition Stands				
09:00	**Introduction**	(SHCT) Dr Tim Phillips, innoLAE 2024	Welcome to Day 1		
09:10	**Session 1**	(SHCT) Gold Sponsor Presentation - LinkZill			
09:20	**Keynote 1**	(SHCT) Prof Jonathan Rivnay, Northwestern University	Organic mixed conductors for bioelectronics		
10:05	Break - Sponsor Exhibitions & Posters				
10:35	**Session 2**	**(SHCT) Manufacturing I** Session Chair: Dr Dimitra G. Georgiadou, University of Southampton	**Session 3**	**(ER) Bioelectronics I** Session Chair: Prof Krishna Persaud, University of Manchester	
	2.1	**Prof Thomas Anthopoulos, University of Manchester (Invited)** Nanomanufacturing paradigms for sustainable large-area electronics	3.1	**Prof Fabio Cicoira, Polytechnique Montreal (Invited)** Self-healing, stretchable and recyclable electronics	
	2.2	**Mariana Cortinhal, CENIMAT|I3N and UNINOVA-CEMOP** Multilayer gate dielectrics deposited by atomic layer deposition for low-temperature and low-voltage oxide thin-film transistors	3.2	**Dr Scott Keene, University of Cambridge** Mixed ionic-electronic transport in conjugated polymers for bioelectronics	
	2.3	**Dr Prakash Karipoth, University of Leeds** Direct writing of strain sensors on soft robots with aerosol jet printing	3.3	**Dr Ying Fu, University of Strathclyde** Development of bioelectronics for highly sensitive detection of biomarkers	
	2.4	**Catarina Ribeiro, University of Minho** Printed electronics using fused filament fabrication for thermoforming applications	3.4	**Prof Dr Jean Manca, X-LAB / Universiteit Hasselt** Biological nanofibers towards biodegradable electronics and e-biologics	
	2.5	**Dr Zixin Wang, IDTechEx** Technologies and markets of 3D/additive electronics	3.5	**Ruben Ruiz-Mateos Serrano, University of Cambridge** High-density, conducting polymer electrode arrays for advanced cardiac disease diagnosis	
12:40	Lunch - Sponsor Exhibitions & Posters				
14:00	**Session 4**	(SHCT) Gold Sponsor Presentation - Paragraf			
14:10	**Keynote 2**	(SHCT) Prof Alberto Salleo, Stanford University	Ions, electrons and polymers: fast ion insertion towards GHz iontronics		
14:55	Break - Sponsor Exhibitions & Posters				
15:25	**Session 5**	**(SHCT) Novel Devices & Systems I** Session Chair: Dr Natasha Conway, Paragraf	**Session 6**	**(ER) Bioelectronics II** Session Chair: Cathy Curling, Curling Consulting	
	5.1	**Prof Sayani Majumdar, Tampere University (Invited)** Low-thermal budget ferroelectric devices for neuromorphic computing and adaptive sensing	6.1	**Simon McMaster, Footfalls & Heartbeats (Invited)** Knitting the future	
	5.2	**Prof Cecilia Mattevi, Imperial College London (Invited)** A platform of 3D printed energy storage devices to power wearable sensors	6.2	**Dongxun Lyu, University of Cambridge** Exploring Ion gating of conducting polymer PEDOT:PSS by Operando NMR Spectroscopy	
	5.3	**Carme Martinez-Domingo, Institut de Ciencia de Materials de Barcelona** Ultrahigh sensitive direct X-ray detectors employing transistors based on a fully organic small molecule semiconductor/polymer blend active layer	6.3	**Prof Sahaki Inal, King Abdullah University of Science and Technology (KAUST) (Invited)** Responsive polymeric mixed conductors for diagnostics and therapy	
	5.4	**Dr Sarah-Jane Potts, Swansea University** Enhancing the performance of the mesoporous screen-printed layers in printed perovskite photovoltaics through novel rheological analysis techniques	6.4	**Faustyna Brańko, IQ Biozoom** Ink-jet printed thin-film transistor for a non-invasive glucose monitoring device	
	5.5	**Bowen Liu, Tsinghua University** A 1024-channel neurostimulation system enabled by organic thin-film transistors with high uniformity	6.5	**Jon Harwell, University of Glasgow** Transfer printing for fully biodegradeable PCBs with ultralow sheet resistance and narrow track width	
17:30	Networking Reception with drinks & snacks				
19:00	Walk across the road to The Old Hall				
19:20	Gala Dinner				
21:30	Walk Back To Cripps Court Conference Centre				
	Day 1 Ends				

*SHCT Sir Humphrey Cripps Theatre (Auditorium)
*ER East Room

Day 2 - Thursday 22nd February 2024

09:00	**Session 7**	(SHCT) Dr Tim Phillips, innoLAE 2024	Welcome to Day 2	
09:05	**Keynote 3**	(SHCT) Prof Ana Claudia Arias, University of California, Berkeley	Tracking nitrogen in soil with printed electronics	
09:50	Break - Sponsor Exhibitions & Posters			
10:20	**Session 8**	**(SHCT) Novel Devices & Systems II** Session Chair: Dr Simon Johnson, CPI	**Session 9**	**(ER) High Performance Materials I** Session Chair: Prof Henning Sirringhaus, University of Cambridge
	8.1	Prof Tina Ng, University of California San Diego (UCSD) (Invited) Reinforced interfaces to realize multifunctional supercapacitors	9.1	Dr Yan Wang, University of Cambridge (Invited) Ultra clean interfaces on two dimensional semiconductors
	8.2	Dr Chiara Labanti, Cambridge Display Technology (CDT) SWIR organic photodetectors for imaging applications	9.2	Prof Martin Heeney, King Abdullah University of Science and Technology (KAUST) Development of conjugated polymers for bioelectronic applications
	8.3	Nishadi Perera, Nottingham Trent University Design and development of micro-pressure sensors embedded textiles	9.3	Ian Jacobs, University of Cambridge Effects of processing-induced contamination on organic electronic devices
	8.4	Zixing Peng, University of Manchester Fully printed 2D material-based memristors	9.4	Rebecca Coleman, Paragraf Optimising the fabrication of high-performance graphene Hall effect sensors
	8.5	Prof Sébastien Sanaur, Ecole des Mines de Saint-Etienne Contact resistances in short channel organic electrochemical transistors	9.5	Prof Francisco Molina-Lopez, KU Leuven Laser-printed bismuth telluride-based ultraflexible thermoelectrics for the IoT
12:25	Lunch - Sponsor Exhibitions & Posters			
14:00	**Session 10**	(SHCT) Sponsor Presentation		
14:10	**Keynote 4**	(SHCT) Dr Carl Naylor, Intel	Is the future 2D?	
14:55	Break - Sponsor Exhibitions & Posters			
15:25	**Session 11**	**(SHCT) Manufacturing II, High Performance Materials II and Novel Devices & Systems III** Session Chair: Prof Luisa Petti, Free University of Bolzano	**Session 12**	**(ER) Applications and Sustainability & Energy Efficiency** Session Chair: Prof Cinzia Casiraghi, University of Manchester
	11.1	Prof Beatrice Fraboni, University of Bologna (Invited) Large area flexible detectors for real-time dose monitoring during radio/proton therapy	12.1	Dr Eleonora Macchia, Åbo Akademi University (Invited) Single-molecule bioelectronic sensor: improving reliability with machine learning approaches
	11.2	Pedro Moreira, NOVA School of Science and Technology (FCT-NOVA) Inkjet printing of non-critical raw materials for thin film transistor application	12.2	Dr Hugh Glass, Paragraf Mapping current in battery systems using graphene Hall effect sensors
	11.3	Francis Lockwood Estrin, University College London Single-step printed circuitry deposited via Atmospheric Pressure Plasma Jet(APPJ)	12.3	Dr Quentin Jeangros, CSEM Large-area perovskite thin films for energy harvesting, lighting and visual light communication
	11.4	Matthew Spink, Nottingham Trent University Laser annealing and infra-red spectroscopic ellipsometry: promising alternatives for manufacturing and quality control for LAE	12.4	Harry Delalis, FlexEnable Enhancing augmented reality with flexible liquid crystal dimming technology
	11.5	Dr Stefano Pecorario, University of Cambridge Enhancing charge transport in Sn-based halide perovskites thin films for high-mobility field-effect transistors and thermoelectrics	12.5	Prof Shery Huang, University of Cambridge Small fibres for large-area transient electronic interfaces with minimised environmental footprints
17.30	**Session 13**	(SHCT) Speaker Prize Sponsored by LinkZill (SHCT) Poster Prize Sponsored by Paragraf with prizes supplied by The Royal Society of Chemistry		
17:50	Conference Ends			

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SESSION 1: KEYNOTE

1.1 Organic Mixed Conductors for Bioelectronics

Prof Jonathan Rivnay, Northwestern University

Organic mixed ionic/electronic conductors (OMIECs) have gained considerable interest in bioelectronics, power electronics, circuits, and neuromorphic computing. These organic, often polymer-based, semiconductors rely on a combination of ionic transport, electronic transport, and high volumetric charge storage capacity to yield functional devices. Furthermore, the are often soft, can be integrated as hydrogel or elastomeric composites, and can take on form factors not possible with traditional electronic materials. In this talk, I will highlight recent synthetic and processing approaches used to tailor electrochemical device properties revealing new classes of OMIEC active materials, as well as new opportunities enabled by such advances. Control of ionic transport and trapping for example presents a promising avenue towards the development of non-volatile electrochemical transistors, which can mimic biological synapses. In addition, the bulk transport properties of OMIECs enable device concepts that achieve co-localization of sensing with signal processing including amplification of electrophysiological and biochemical sensors, and devices that readily integrate with biological systems from lipids and proteins to cells and tissues, opening exciting directions in health diagnostics and therapeutics.

Jonathan Rivnay is a Professor of Biomedical Engineering and Materials Science & Engineering at Northwestern University. Jonathan earned his BSc in 2006 from Cornell University. He then moved to Stanford University, where he earned a MSc and PhD in Materials Science and Engineering, studying the structure and electronic transport properties of organic electronic materials. In 2012, he joined the Department of Bioelectronics at the Ecole des Mines de Saint-Etienne in France as a Marie Curie postdoctoral fellow, working on conducting polymer-based devices for bioelectronics. Jonathan spent 2015-2016 as a member of the research staff in the Printed Electronics group at the Palo Alto Research Center (PARC, a Xerox Co.) before joining the faculty at Northwestern in 2017. He is a recipient of a Faculty Early Career Development (CAREER) award from the National Science Foundation (2018), a research fellowship from the Alfred P. Sloan Foundation (2019) and was named a Materials Research Society Outstanding Early Career Investigator (2020)

SESSION 2: MANUFACTURING

Session Chair: Dr Dimitra G. Georgiadou, University of Southampton

2.1 Nanomanufacturing paradigms for sustainable large-area electronics
Prof Thomas Anthopoulos, University of Manchester (Invited)

Adapting existing manufacturing methods to emerging forms of large-area electronics presents major technological and economic challenges. In this talk, I will discuss our recent work toward advancing scalable manufacturing of large-area electronics with nanometer-scale critical device features. I will show how combining innovative patterning technologies with scalable material processing methods and engineered nanomaterials can lead to more sustainable optoelectronic devices with extraordinary performance characteristics.

2.2 Multilayer gate dielectrics deposited by atomic layer deposition for low-temperature and low-voltage oxide thin-film transistors
Mariana Cortinhal, CENIMAT|I3N and UNINOVA-CEMOP

Attempts have been made to combine materials in the form of multilayers, resulting in characteristics that are a trade-off of those from the materials that have been mixed. Thin films of Ta2O5 and Al2O3 and multilayers, were deposited by ALD. Optimized multilayer thin films exhibited a high dielectric constant and breakdown field, and low leakage current density. The multilayer gate dielectrics integrated in IGZO TFTs, resulted in performance metrics similar to state-of-the-art IGZO TFTs, with the advantage of ultra-low Von.

2.3 Direct writing of strain sensors on soft robots with aerosol jet printing
Dr Prakash Karipoth, University of Leeds

The rapidly developing field of soft and compliant robotics offers the prospect of new capabilities with respect to traditional rigid robot counterparts, owing to the low elastic modulus and high strain resilience of their constituent material parts. However, for practical end-user applications, soft robots require reliable embedded sensors to deliver state and/or contact information, as required for closed-loop control and optimized manipulation. We show the potential of AJP for direct writing of sensors onto soft robots.

2.4 Printed electronics using fused filament fabrication for thermoforming applications
Catarina Ribeiro, University of Minho

This study explores the potential application of printed conductive filaments for 3D printed electronics. Using Fused Filament Fabrication (FFF), conductive PLA samples of 0.5 and 0.8 mm were printed onto foils. These samples were thermoformed, and also submitted to heated electromechanical tests. In the last case, all the prints, despite the high values of final resistance, were able to withstand a deformation of 250 %. This approach seems promising along with the further development of highly conductive and thermoformable filaments.

2.5 Technologies and markets of 3D/additive electronics
Dr Zixin Wang, IDTechEx

3D/additive electronics integrate electronics within the devices, enabling high electronic functionality, simple manufacturing and assembly process, and reduced material waste. Industry interest in applying electronics onto 3D surfaces is increasing. This talk will cover technology developments in laser direct structuring, printing methods, and emerging technologies in 3D electronics. Insights on the application opportunities and challenges across this market are also provided in this talk.

SESSION 3: BIOELECTRONICS I

Session Chair: Prof Krishna Persaud, University of Manchester

3.1 Self-healing, stretchable and recyclable electronics
Prof Fabio Cicoira, Polytechnique Montreal (Invited)

Materials able to regenerate after damage have attracted a great deal of attention since the ancient times. For instance, self-healing concretes, able to resist earthquakes, ageing, weather, and seawater are known since the times of ancient Rome and are still the object of research. In this talk, various types of self-healing will be presented and correlated with the electrical and mechanical properties of the materials. The use of the self-healing gels and films as epidermal electrodes and other devices will be also discussed.

3.2 Mixed ionic-electronic transport in conjugated polymers for bioelectronics
Dr Scott Keene, University of Cambridge

Organic mixed ionic-electronic conductors (OMIECs) have recently risen as a promising material choice for bioelectronic devices. These OMIECs enable "electrochemical doping" where ion transport into the conjugated polymer modifies the charge carrier concentration in the electrode, lowering the interfacial impedance between bioelectronic devices and biological tissue. Using hyperspectral differential transmission microscopy, we probe the fundamental steps of electrochemical gating in operando to build a deeper understanding of the driving forces and kinetics of mixed ionic-electronic transport.

3.3 Development of bioelectronics for highly sensitive detection of biomarkers
Dr Ying Fu, University of Strathclyde

The analysis of biomarkers plays an important role in the early diagnosis of diseases and will greatly benefit patients with a higher cure rate. However, the low abundance of biomarkers in physiological environments requires ultrahigh sensitivity of a detection technology. We have developed a portable and smart-phone-controlled biosensing platform based on disposable OECT for ultrasensitive analysis of microRNA (miRNA) biomarkers within 1 hour. This portable sensing platform can be used as point-of-care device for diagnostic monitoring of a wide range of diseases.

3.4 Biological nanofibers towards biodegradable electronics and e-biologics
Prof Dr Jean Manca, X-LAB / Universiteit Hasselt

Electroactive bacteria and their nanowires have emerged as a new route toward electronic biological materials (e-biologics). Recent studies on electron transport in cable bacteria— filamentous, multicellular electroactive bacteria—showed centimeter long electron transport in an organized conductive fiber structure with high conductivities and remarkable intrinsic electrical properties. Based on these intrinsic electrical properties, we show cable bacteria filaments to have interesting potential as for instance interconnects and transistor channels in a new generation of biobased and biodegradable electronics.

3.5 High-density, conducting polymer electrode arrays for advanced cardiac disease diagnosis
Ruben Ruiz-Mateos Serrano, University of Cambridge

Cardiovascular diseases (CVD) pose a significant global health challenge, being responsible for approximately 32% of worldwide mortality. These conditions not only result in substantial loss of life but also strain healthcare systems. In particular, valvular heart diseases (VHD) are a major contributor to cardiovascular mortality, affecting approximately 75 million people every year. In this work, the use of high-density ECG body surface potential mapping (BSPM) as an alternative technique to achieve non-invasive cardiac electrical activity measurements with high spatial resolution is proposed.

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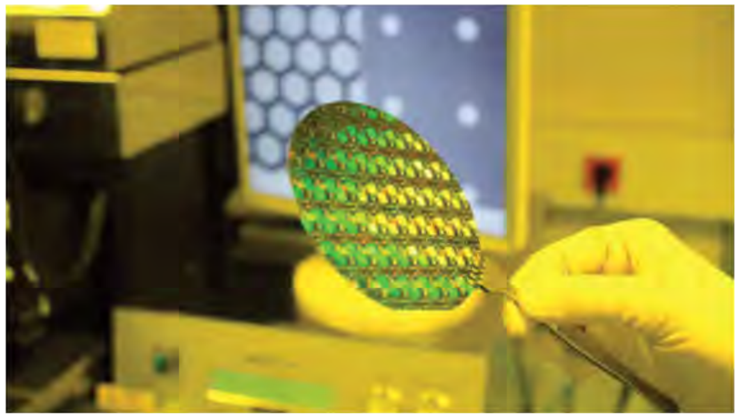

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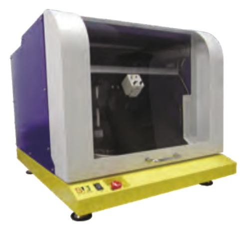

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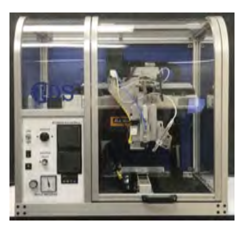

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SESSION 4: KEYNOTE

4.1 Ions, electrons and polymers: fast ion insertion towards GHz iontronics

Prof Alberto Salleo, Stanford University

The charge density in electrochemically active polymers can be modulated over a wide range by ion insertion. In inorganic materials this process is slow and energetically costly. Polymers on the other hand can insert ions with minimal strain. Furthermore, the soft nature of the material and its microstructure alllows fast ion modulation. As a result of this combination, polymer-based "iontronics", ie devices relying on the modulation of electronic properties via electrolytes, may be able to reach frequencies well into MHz and possibly into the GHz regime. I will show examples of fast iontronic devcies, modulating electronic properties within ~10ns with accompanying structural characterization to explain their operation. Polymer-based iontronics could develop into a technology that takes advantage of the features of conjugated polymers (e.g. a relatively open structure) to enable unique functionalities such as deep optical modulation or brain-like computation.

Alberto Salleo is currently Professor of Materials Science and Department Chair at Stanford University. Alberto Salleo holds a Laurea degree in Chemistry from La Sapienza and graduated as a Fulbright Fellow with a PhD in Materials Science from UC Berkeley in 2001. From 2001 to 2005 Salleo was first post-doctoral research fellow and successively member of research staff at Xerox Palo Alto Research Center. In 2005 Salleo joined the Materials Science and Engineering Department at Stanford as an Assistant Professor. While at Stanford, Salleo won the NSF Career Award, the 3M Untenured Faculty Award, the SPIE Early Career Award, the Tau Beta Pi Excellence in Undergraduate Teaching Award, and the Gores Award for Excellence in Teaching, Stanford's highest teaching award. He has been a Clarivate Highly Cited Researcher since 2015 and was elected to the European Academy of Sciences in 2021, a Fellow of the Materials Research Society in 2022, and a Member of the Academia Europaea in 2023.

SESSION 5: NOVEL DEVICES & SYSTEMS I

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Session Chair: Dr Natasha Conway, Paragraf

5.1 Low-thermal budget ferroelectric devices for neuromorphic computing and adaptive sensing
Prof Sayani Majumdar, Tampere University (Invited)

Neuromorphic computing requires novel devices with properly engineered properties. Ferroelectric memories have shown promising performances in recent years as analog, multibit memory components with ultralow power consumption, fast read-write operations, non-volatile or volatile data retention & high endurance making them suitable for programmable synaptic plasticity and neuronal leaky-integrate-and-fire operations. I will discuss the potentials for these emerging devices from scalability, performance and heterogeneous integration perspectives for neuromorphic computing and adaptive sensing application operating at extreme-edge.

5.2 A platform of 3D printed energy storage devices to power wearable sensors
Prof Cecilia Mattevi, Imperial College London (Invited)

Global societal health challenges are increasingly reliant on wearable devices which can enable continuous monitoring of key indicators used to trigger aimed interventions. Wireless and continuous monitoring can be achieved by self-powered platforms whichrely on energy storage devices such as batteries. Commercially available batteries are normally not conformable to wearable platforms. I will present our work on 3D printed miniaturized supercapacitors and rechargeable batteries beyond lithium to power wearable sensors platforms.

5.3 Ultrahigh sensitive direct x-ray detectors employing transistors based on a fully organic small molecule semiconductor/polymer blend active layer
Carme Martinez-Domingo, Institut de Ciencia de Materials de Barcelona

X-rays, with their ability to penetrate opaque substances, are extensively used in healthcare, astrophysics and security. Current X-ray detectors, relying on inorganic semiconductors, face limitations for large, curved detectors. Organic semiconductors (OSCs) provide a solution, being lightweight, flexible, and cost-effective. Blending 1,4,8,11-tetramethyl-6,13-triethylsilylethynyl pentacene (TMTES-Pentacene) with polystyrene produces high-performance organic field-effect transistors (OFETs). These OFETs exhibit exceptional sensitivity, surpassing perovskite film-based detectors. A proof-of-concept involves capturing a sub-millimeter pixel-sized X-ray image using a 4-pixel array, highlighting the potential of organic X-ray detectors.

5.4 Enhancing the performance of the mesoporous screen-printed layers in printed perovskite photovoltaics through novel rheological analysis techniques
Dr Sarah-Jane Potts, Swansea University

Triple-mesoscopic carbon-based perovskite solar cells (mCPSCs) offer good stability, low-cost fabrication, and commercial scalability via screen-printing. The impact of print quality becomes more notable with scale, with print defects hindering device power conversion efficiency (PCE). To enable improved print homogeneity and performance of the mesoporous printed layers, a combination of traditional shear rheology with the novel screen-printing visualisation technique was used alongside surface characterisation techniques. This resulted in improved printed film thickness, surface roughness, and resultant performance of the mCPSCs.

5.5 A 1024-channel neurostimulation system enabled by organic thin-film transistors with high uniformity
Bowen Liu, Tsinghua University

Electrical neurostimulation technologies have been successful for the therapeutic modulation of nervous systems, but challenges remain. We need new electronics technology capable of flexibility, large area integration, simultaneous neurostimulation, and high channel counts. We report a 4-mask OTFT integration technology showing suitable performance. We propose a 4T1C stimulation circuit designed for independently storing stimulation intensity information, simultaneously stimulating all channels & discharging stimulation electrodes. We verify the electrical function of the complete neurostimulation system, making it suitable for this application.

East Room

SESSION 6: BIOELECTRONICS II

Session Chair: Cathy Curling, Curling Consulting

6.1 Knitting the Future
Simon McMaster, Footfalls & Heartbeats (Invited)

Knit has been covering humans, for thousands of years. It has become an area of electronic investigation. One may reasonably think that mixing the two would be both simple and uninteresting. However, far from it, the two lead to complex and fascinating behaviours. These behaviours are governed by the knit structure, yarn interaction and the complexity that knitting allows. Knitting is micromechanical structure with n degrees of freedom that can integrate large arrays of sensors into almost any textile.

6.2 Exploring Ion gating of conducting polymer PEDOT:PSS by Operando NMR Spectroscopy
Dongxun Lyu, University of Cambridge

The conducting polymer poly(3,4-ethylenedioxythiophene) complexed with poly(styrene sulfonate) (PEDOT:PSS) is one of the most promising organic mixed ionic-electronic conductors (OMIECs). The high conductivity and volumetric capacitance of PEDOT:PSS enables efficient charge storage and signal transduction, making them an outstanding candidate in applications, including bioelectronic, optoelectronic, energy conversion/storage and photocatalytic applications. Here, I demonstrate that operando NMR spectroscopy possesses unique advantages in selectively probing and quantifying ion transport and ionic-electronic coupling during doping/dedoping of poly(3,4-ethylene dioxythiophene):polystyrene sulfonate films, the most widely used organic mixed conductor.

6.3 Responsive polymeric mixed conductors for diagnostics and therapy
Prof Sahaki Inal, King Abdullah University of Science and Technology (KAUST) (Invited)

The ability to sense and react to environmental stimuli is crucial in the development of next-generation sensors, actuators, and robotics. In this presentation, I will introduce n-type conjugated polymers as multifunctional bioelectronic interfaces. Firstly, I will demonstrate how these polymers can be tailored to establish favorable interactions with catalytic enzymes. Then I will delve into the potential pathways through which the polymer film generates charges and address stability concerns. I will explore how these polymer films respond to visible and near-infrared (NIR) light by generating voltage drops at the aqueous electrolyte interface. Finally, I will unveil a novel application of the n-type films, demonstrating their capacity to enhance stem cell maturation.

6.4 Ink-jet printed thin-film transistor for a non-invasive glucose monitoring device
Faustyna Brańko, IQ Biozoom

The number of people suffering from diabetes increases significantly from year to year. Monitoring the level of glucose in the body several times a day usually involves pricking and taking a blood sample, which is a painful procedure and carries the risk of infection. In recent years, methods and materials used to produce thin-film transistors used in sensitive, low-power and non-invasive biosensors monitoring physiological parameters such as glucose concentration in body fluids (sweat, saliva) have been developed. This work demonstrates optimal process of thin-film transistor fabrication in glucose detection device application.

6.5 Transfer printing for fully biodegradeable PCBs with ultralow sheet resistance and narrow track width
Jon Harwell, University of Glasgow

Electronic waste (e-waste) is a rapidly growing problem that poses a major environmental challenge. As electronic devices become smaller and more disposable, there are an increasing number of cases where the efficient recycling of the device at its end of life is either unlikely or impractical. Hence there is a pressing need for "zero waste" systems which can easily biodegrade after use without contributing to landfill or pollution issues. In this work we help address this issue by designing a simple process to produce fully biodegradeable PCBs with similar performance to regular copper-based substrates.

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GALA DINNER

Gala Dinner at The Old Hall, Magdalene College, University of Cambridge

Continue networking and unwind in true Cambridge style at the conference gala dinner - hosted in The Old Hall at Magdalene College.

*Please note that this is only available for those who have registered to attend the gala dinner.

Th Old Hall is a short walk away from the conference centre and we will be heading across the road at 19:00, so please make sure you are ready to leave on time.

The innoLAE Gala Dinner always receives positive feedback as this dinner gives you an excellent opportunity to indulge in the rich history of Cambridge, enjoying a delicious three course meal and continue to network in a relaxing atmosphere.

SESSION 7: KEYNOTE

7.1 Tracking nitrogen in soil with printed electronics

Prof Ana Claudia Arias, University of California, Berkeley

Plant-available nitrogen, often in the form of nitrate, is an essential nutrient for plant growth, but excessive nitrate in the environment and watershed has harmful impacts on both human health and natural ecosystems. Current nitrate measurements techniques, in both soil and water quality monitoring, involve taking samples from the environment or field to a lab, where they can be analyzed with chromatography or spectrographic methods. Such measurements are highly accurate, but they are also expensive and labor-intensive, and give data for only one point in time and space. A distributed network of nitrate sensors could better quantify and monitor nitrogen in agriculture and the environment. Here, I will discuss how a suit of printed sensors can be distributed over large areas and used to track nitrogen and other drivers to nitrox oxide emission in soil.

Prof Arias received her PhD in Physics from the University of Cambridge, UK in 2001. Prior to that, she received her master and bachelor degrees in Physics from the Federal University of Paraná in Curitiba, Brazil in 1997 and 1995 respectively.

She joined the University of California, Berkeley in January of 2011. Prof. Arias was the Manager of the Printed Electronic Devices Area and a Member of Research Staff at PARC, a Xerox Company. She went to PARC, in 2003, from Plastic Logic in Cambridge, UK where she led the semiconductor group.

Her research focuses on the use of electronic materials processed from solution in flexible electronic systems. She uses printing techniques to fabricate flexible large area electronic devices and sensors.

SESSION 8: NOVEL DEVICES & SYSTEMS II

Session Chair: Dr Simon Johnson, CPI

8.1 Reinforced interfaces to realize multifunctional supercapacitors
Prof Tina Ng, University of California San Diego (UCSD) (Invited)

Today's electrochemical storage devices are restricted in capacity, a key challenge that limits the operational time of wireless devices. To increase the energy storage capacity, multifunctional structures such as structural supercapacitors combine load-bearing and energy-storage functions into the same device, resulting in weight savings and safety improvements. To achieve an efficient structural supercapacitor, we developed strategies based on interfacial engineering to improve both the electrodes and electrolytes.

8.2 SWIR organic photodetectors for imaging applications
Dr Chiara Labanti, Cambridge Display Technology (CDT)

Short Wave Infrared (SWIR) imaging has clear advantages in many applications when compared to Visible or Near infrared (NIR) imaging. However, widespread adoption of CMOS image sensors is limited to wavelengths absorbed by Si, and therefore have rapidly diminishing photoresponse at wavelengths above 1 µm. Here we present a series of novel OSCs with tailored thin film absorption wavelength up to 1.5 µm. We further demonstrate organic photodetectors targeting different SWIR wavelengths using these materials. The potential opportunities and challenges from the perspectives of materials development, photodiode performance and monolithic integration designs are discussed.

8.3 Design and development of micro-pressure sensors embedded textiles
Nishadi Perera, Nottingham Trent University

A pressure sensing textile has been developed to aid in venous leg ulcer (VLU) management. This novel pressure sensor embedded textile can continuously monitor the pressure between a compression bandage and the skin, which provides useful feedback to the medical practitioners when dressing the bandage and could improve patient outcomes. The main objectives of this work were to design a functional pressure sensing E-yarn, to optimize the encapsulation material, and to characterize the developed prototype over a range of relevant pressures.

8.4 Fully printed 2D material-based memristors
Zixing Peng, University of Manchester

The development of memristic devices capable of storing multiple states of information is required for many applications, ranging from data computation to neuromorphic circuits and adaptive systems. 2-Dimensional Materials (2DMs) offer an attractive solution for the realization of high density and reliable memristors, compatible with printed and flexible electronics. In this work we fabricate a fully inkjet printed MoS2-based resistive switching memory, where graphene is used as top electrode and silver is used as bottom electrode.

8.5 Contact resistances in short channel organic electrochemical transistors
Prof Sébastien Sanaur, Institut Mines- Telecom / Mines Saint-Etienne

Organic ElectroChemical Transistors (OECTs) are today emerging as potential devices for next generation biosensors and/or biomimetic devices, as instance for organic neuromorphics applications. Nonetheless, some operation mechanisms in the device physics remain less explored. Surprisingly, few investigations were reported concerning contact resistances, even if physical processes between the Source electrode and Organic Mixed ion-to-Electron Conductors (OMIECs) drive the electronic performances. Here, we explore contact resistances in PEDOT:PSS OECTs; more particularly we investigated behavior of such devices for short channel dimensions.

SESSION 9: HIGH PERFORMANCE MATERIALS I

Session Chair: Prof Henning Sirringhaus, University of Cambridge

9.1 Ultra clean interfaces on two dimensional semiconductors
Dr Yan Wang, University of Cambridge (Invited)

Exploitation of fundamental properties of atomically thin (two-dimensional, 2D) semiconductors – particularly those from the transition metal dichalcogenide (TMD) family – for electronics will require ultra-clean contacts with resistances approaching the quantum limit. The lack of high quality, low contact resistance p- and n-type contacts on 2D semiconductors has limited progress in next generation of low power devices such as the tunnel field effect transistors. In this presentation, we summarize strategies and provide guidance for making clean van der Waals (vdWs) contacts on mono-layered semiconductors that can efficiently inject both spins and charges.

9.2 Development of conjugated polymers for bioelectronic applications
Prof Martin Heeney, King Abdullah University of Science and Technology (KAUST)

Conjugated polymers exhibiting mixed ionic-electronic conduction are attractive for a number of applications. I will discusses approaches to make suitable materials, which can be readily functionalised by post-polymerisation functionalisation. This allows libraries of materials with consistent dispersity and length to be developed, facilitating the development of structure-property relationships. Using such approaches, the role of side-chain length and ionic density will be explored, and the propensity of such materials to undergo functionalization with biorecognition moieties will be discussed.

9.3 Effects of processing-induced contamination on organic electronic devices
Ian Jacobs, University of Cambridge

Organic semiconductors are often touted as 'defect tolerant', however to date there have been relatively few systematic studies of the role of impurities on device performance. In particular, little attention has been paid to processing-induced contaminants, originating from e.g. the glovebox atmosphere or solvents, even though anecdotal reports have long indicated that such factors may be important.We present a systematic study of processing-induced contamination on the performance of indacenodithiophene-co-benzothiadiazole (IDTBT) organic field effect transistors (OFETs).

9.4 Optimising the fabrication of high-performance graphene Hall effect sensors
Rebecca Coleman, Paragraf

Fabrication of high-performance graphene hall effect sensors begins with the growth of high-quality graphene. To translate this quality into a final device requires optimisation of the device design as well as consideration of the materials and deposition techniques used to construct the device. Development of the fabrication process has increased understanding of Paragraf's graphene performance, allowing commercially viable devices to be developed with key performance metrics that outperform silicon-based sensors currently on the market.

9.5 Laser-Printed Bismuth Telluride-Based Ultraflexible Thermoelectrics for the IoT
Prof Francisco Molina-Lopez, KU Leuven

The development of printed and flexible high-performing thermoelectrics will be presented. Laser powder bed fusion is used to print bismuth telluride, the best thermoelectric material, directly on a flexible polyimide substrate. Besides allowing digital additive manufacturing over large areas, laser printing unlocks very particular material morphologies leading to top performance and unprecedented flexibility. Flexible devices can be easily integrated on the skin, smart textiles and other curved hot surfaces to power wearables and nodes for the Internet of Things.

SESSION 10: KEYNOTE

10.1 Is the future 2D?

Dr Carl Naylor, Intel

Semiconductor sales reached over $570 billion worldwide in 2022, a gigantic industry that keeps on growing with increasing demand for faster, more powerful, and smaller chips. However, as we keep scaling CMOS transistors, the silicon (Si) transistor will soon reach its physical limit, and there is a pressing need to find an alternative post-Si material to enable the continuation of Moore's Law. Furthermore, as we scale our interconnects and further constrain our metals, resistivity soars, there is a critical need to alleviate this resistance hit. As we search for this set of next generation materials, 2D materials such as Transition Metal Dichalcogenides (TMDs), at angstrom thicknesses, have been shown in academia to possess remarkable properties. Could 2D materials play a role in future electronic devices?

In this talk, I will present some of Intel's published research on 2D materials focusing on TMDs, from synthesis and characterization to innovative applications. How each year, we take a step further to attaining our vision of stacked 2D nanoribbons, while also continuously finding novel applications for 2D materials. I will demonstrate, that in Components Research at Intel, we are always looking for ways to improve future technologies and enable the continuation of Moore's Law.

Carl H. Naylor is the SRC Program manager, alternate SAB rep for JUMP2.0, and Research Scientist with Intel Corporation. He received his B.A. and M.S. degree in physics from the University Joseph Fourier (Grenoble, France), followed by a Ph.D degree in physics from the University of Pennsylvania (Philadelphia, USA). He has held multiple research positions with universities across the globe: in southeast Asia, western Europe, and across north America.

He joined Intel as a Senior Research Engineer with Intel Components Research in the Novel Device Materials group, where he developed and synthesized novel nanomaterials, and searched for unique applications where they can be implemented across an Intel chip. He is now with the Corporate University Research team focused on Intel's external engagements with Academia.

He holds over 50 co-authored publications in peer reviewed journals, over 50 U.S. patents filed, and numerous industrial and academic accolades.

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SESSION 11: MANUFACTURING II
HIGH PERFORMANCE MATERIALS II
NOVEL DEVICES & SYSTEMS III

Session Chair: Prof Luisa Petti, Free University of Bolzano

11.1 Large area flexible detectors for real-time dose monitoring during radio/proton therapy
Prof Beatrice Fraboni, University of Bologna (Invited)

The development of detectors for high energy photons, protons and heavy particles is a long-lasting research topic for fundamental applications and medical applications in radio and hadron therapy. Organic small molecules and perovskites are promising active layers for advanced dosimetry purposes. We report on their performance under exposure to intense photons and MeV protons radiation fields and will discuss how to detect and exploit the energy absorbed both by the organic semiconducting layer and by the plastic substrate, allowing to extrapolate information on the irradiation history of the detector.

11.2 Inkjet printing of non-critical raw materials for thin film transistor application
Pedro Moreira, NOVA School of Science and Technology (FCT-NOVA)

We present a methodology for the uniform and reproducible ink-jet printing of semiconductor (zinc tin oxide-ZTO) and dielectric (aluminum oxide-AlOx) inks for TFTs. Inks rheology was optimized by incorporating an optimal volume percentage of ethylene glycol (EG). We achieved high-quality dielectric layers, exhibiting exceptional electrical properties, (breakdown field above 2.9 ± 0.3 MV.cm-1, oxide capacitance of 210.1 ± 15.6 nF.cm-2, and a dielectric constant of 7.7 ± 0.7). Additionally, TFTs with ZTO/AlOx layers exhibited IOn/IOff ratios of 103 and saturation mobility up to 2.2 cm2.V-1.s-1.

11.3 Single-step printed circuitry deposited via Atmospheric Pressure Plasma Jet(APPJ)
Francis Lockwood Estrin, University College London

The acceleration of smart technologies and growing internet-of-things, creates a need to integrate circuity onto unusual surfaces. We present a single-step method of plasma jet deposition, unique in that it operates at atmospheric pressure and requires no complex preparation of precursors, or post processing. Copper and silver tracks have been successfully deposited on a glass, Kapton, PTFE and MACOR®, all showed conductivity of around 5 % Bulk for copper and 20 % bulk for silver.

11.4 Laser annealing and infra-red spectroscopic ellipsometry: promising alternatives for manufacturing and quality control for LAE
Matthew Spink, Nottingham Trent University

Further steps in processing and quality control are necessary to reduce the cost and technological constraints in Large-Area Electronics (LAE). Laser annealing (LA) and Infra-Red Spectroscopic Ellipsometry (IRSE) offer alternative processing and characterisation steps without vacuum, but with amenability to LAE. This work presents several sol-gel, metal oxide devices processed with LA and characterised with IRSE to determine chemical conversion state of the sol-gel materials. LA and IRSE implementation into LAE would provide invaluable in-line processing and quality control techniques. .

11.5 Enhancing charge transport in Sn-based halide perovskites thin films for high-mobility field-effect transistors and thermoelectrics
Dr Stefano Pecorario, University of Cambridge

Sn-based perovskites show promise for high-mobility FETs and thermoelectrics, but mitigating ionic defect migration is crucial. Pb–Sn alloying in FA–Cs perovskites enhances charge transport and reduces ion migration, achieving near-ideal FET performance with the optimised composition yielding p-type mobility of 5.4 cm2 V–1 s–1, among the highest reported for 3D perovskite FETs. We explore film composition and device architecture's impact on suppressing ion migration and electrochemical reactions, enhancing charge transport and stability, and discuss optimizing thermoelectric coefficients through compositional engineering.

SESSION 12: APPLICATIONS AND SUSTAINABILITY & ENERGY EFFICIENCY

Session Chair: Prof Cinzia Casiraghi, University of Manchester

12.1 Single-molecule bioelectronic sensor: improving reliability with machine learning approaches
Dr Eleonora Macchia, Åbo Akademi University (Invited)

The single molecule bio-electronic smart system array for clinical testing - SiMBiT - technology has been developed, leveraging on the single molecule with large transistor (SiMoT) lab-based technology that can perform single-molecule detection of both proteins and DNA bio-markers. The SiMBiT prototype has proven its potency in early detection of pancreatic cancer, being capable to discriminate among low-grade and high-grade mucinous cyst's lesions in peripheral biofluids, such as plasma samples, with diagnostic-specificity and sensitivity ≥95%.

12.2 Mapping current in battery systems using graphene Hall Effect sensors
Dr Hugh Glass, Paragraf

A significant challenge in the electric automotive industry is the risk of fire due to thermal runaway in batteries. Prevention of thermal propagation requires effective mapping of current flow within a cell to identify the defects which cause thermal runaway. Paragraf has developed a graphene-based hall effect sensors capable of high-resolution current measurement across an extremely wide range. This enables identification of potential thermal runaway sources in advance of danger, with applications in both the manufacturing and real-time monitoring.

12.3 Large-area perovskite thin films for energy harvesting, lighting and visual light communication
Dr Quentin Jeangros, CSEM

Metal halide perovskite thin-film materials have the potential to advance energy harvesting, lighting and sensing technologies. This contribution will review the progress made by PeroCUBE, which is focusing on the development of novel perovskite inks with optimized processability and high performance for sheet-to-sheet and roll-to-roll deposition on large areas. The final goals of the projects are to demonstrate large-area perovskite solar modules and light-emitting diodes (LEDs) on both rigid and flexible substrates, and eventually perovskite-based wearable devices combining energy harvesting and visual light communication capabilities.

12.4 Enhancing augmented reality with flexible liquid crystal dimming technology
Harry Delalis, Flexenable Technology Limited

Augmented Reality (AR) technology advances blend virtual and real-world environments but struggles with brightness discrepancies, especially outdoors. Liquid crystal dimming proposes a solution, adapting AR headsets to changing light conditions and improving virtual object realism. Traditional AR struggles with black areas, causing reduced contrast. Pixelated dimming using FlexEnable's liquid crystal optics technology offers a solution by locally adjusting brightness. This innovation provides color-neutral, lightweight, and versatile dimming capabilities, enhancing AR immersion and usability in various lighting conditions and beyond.

12.5 Small fibres for large-area transient electronic interfaces with minimised environmental footprints
Prof Shery Huang, University of Cambridge

Enhancing the functionality and sensory capabilities of living structures with LAE presents exciting possibilities for the fields of biology-machine interface and wearable health technologies. Nevertheless, current large-area sensor and electronic designs can pose challenges by interfering with the natural sensations of their biological hosts. Another hurdle is finding ways to expand the use of transient, LAE structures without significantly increasing their environmental and ecological impact. This presentation will demonstrate biofabrication and fibre printing towards sustainable and imperceptible electronics.

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SESSION 13: POSTERS

13.1 Manufacturing

Jon Harwell, University of Glasgow
Nanoimprint Lithography for nanoscale back-contact perovskite solar cells

Rodrigo Abreu, NOVA School of Science and Technology (FCT-NOVA)
Manganese oxide - enhanced laser-induced graphene on paper for micro-supercapacitor applications

Iulia Salaoru, De Montfort University
Digital manufacturing of two terminal memory devices

Steve Haws, The Henry Royce Institute
Introduction to the Royce Ambient Cluster

13.2 High Performance Materials

Roshni Satheesh Babu, University of Southampton
Investigating the role of counter-cation on nanoscale polyoxometalate (POM)-based memories

Emilie Gerouville, University of Southampton
Optimising polyoxometalate-based nanoscale electronic devices for in-memory computing

Febin Paul, Edinburgh Napier University
Screen printed RuO2 films for energy storage and electrochemical sensors

Towseef Ahmad, University of Manchester
Gamma irradiation study of printed films made with water-based graphene inks

Minghao Zhao, University of Manchester
Inkjet-printed sensors based on 2-dimensional ReS2

Libu Manjakkal, Edinburgh Napier University
Spray-coating fabrication and characterization electrochromic inorganic oxide thin films

Sunil Kumar, Indian Institute of Science
Unlocking unprecedented electrical conductance in non-conducting polymers via vibrational strong coupling

SESSION 13: POSTERS

13.3 Novel Devices & Systems

Dr José Diego Fernandes Dias, São Paulo State University
EGOFETs based organic optical synaptic devices with perylene derivatives

Chandini Kumar, Edinburgh Napier University
The influence of variation in PVA: LiCl hydrogel electrolyte on the performance of transparent electrochemical devices

David Carvalho, NOVA School of Science and Technology (FCT-NOVA)
ZnO and ZTO solution-based nanostructures for UV sensing applications

Evangelos Moutoulas, University of Southampton
Nanogap electrode-based Schottky diodes for fast temperature sensing

Yuxin Xia, University of Southampton
Bidirectional self-powered organic photodetector with multiple narrow-band response

Yanguang Zhang, National Research Council of Canada
Flexible/stretchable piezoelectric and triboelectric nanogenerators for energy harvesting and self-powered sensing

Ned Dreamer, University of Bath
On predictability of transconductance in organic electrochemical transistors

13.4 Bioelectronics

Franciszek Witkowski, IQ Biozoom
Enzyme-modified electrode for non-invasive multipurpose testing device

Ziming Wang, University of Oxford
Wireless RFID triggering system for automatic control of liquids and suspended matter

Miriam Seiti, KU Leuven
Aerosol Jet® printing for 3D bioelectronics and tissue engineering

Shunsuke Yamamoto, Tohoku University
Molecular orientation in organic mixed conducting polymer films

SESSION 13: POSTERS

13.5 Applications & Energy Efficiency

Dr Jaspreet Kainth, Paragraf
Graphene Hall sensors designed for quantum computing applications

Neil Graddage, National Research Council of Canada
Liquid Monitoring using Printed Electronics

Yize Li, University of Manchester
High uniformity graphene for EMI shielding and EM absorption applications by picosecond laser-direct writing

Xiaoyu Xiao, University of Manchester
Non-volatile RF frequency reconfigurable graphene nanoflakes printed flexible meandered-line dipole antenna on paper substrate for low-Cost RFID and sensing applications

13.6 Sustainability

Jack Maxfield, Centre for Process Innovation
Development of de-bondable electrically conductive adhesives to enable sustainable, reusable printed electronics for a circular economy

Mustehsan Beg, Edinburgh Napier University
Eco-friendly water hyacinth cellulose nanofiber separator for flexible paper energy storage devices

Dr Tim Mortensen Haydale
Revolutionising energy efficiency: functionalised graphene underfloor heating technology

Neri Alves, São Paulo State University (UNESP)
Honey-printed electrolyte gated transistor using laser-induced graphene electrodes and paper as substrate

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