

# Fostering international collaborations

## IEC TC 119 - “Printed Electronics” visit to the Henry Royce Institute

FRIDAY, 25th October 2024

VENUE: Room 1.014/1.015

### AGENDA:

09:30 – 10:00	Registration + Coffee
10:00 – 10:15	Henry Royce Institute (HRI) Welcome
10:15 – 10:30	Introduction to the “ <b>Atoms to Devices</b> ” research area at the HRI ( <b>Dr J. Boland</b> , Dept. of Materials, University of Manchester)
10:30 – 10:45	Introduction to the “ <b>Biomedical Materials</b> ” research area at the HRI ( <b>Prof. A. Casson</b> , Dept. of EEE, University of Manchester)
10:45 – 11:00	<b>Dr A. Willert</b> (Chair of the IEC TC 119 – Printed Electronics) – “Standardisation activities of Printed Electronics”
11:00 – 11:30	<b>Prof. T. Anthopoulos</b> (Dept. of EEE, University of Manchester) – “Nanomanufacturing paradigms for sustainable Large-Area Electronics”
11:30 – 12:00	<b>Prof. H. Y. Li</b> (Dept. of Materials, University of Manchester) – “Textile electronic bioengineering: towards breathable, wettable, flexible, wearable electronics”
12:00 – 13:00	Catered Lunch + Networking
13:00 – 14:00	Tour of Royce Facilities & Demonstrations
14:00 – 14:30	Coffee + Networking
14:30 – 15:00	<b>Prof. C. Casiraghi</b> (Dept. of Chemistry, University of Manchester) – “Water based 2D-material inks for printed electronics and biomedical applications”
15:00 – 15:30	<b>Dr J. Labram</b> (Dept. of Electronic and Electrical Engineering, University College London) – “Event driven optical sensors based on organic semiconductors”
15:30 – 15:45	Closing Remarks



## **Dr Jessica Boland**

Senior Lecturer in Functional Materials & Devices

Organisation: Department of Materials, University of Manchester, Manchester, United Kingdom

E-mail: [jessica.boland@manchester.ac.uk](mailto:jessica.boland@manchester.ac.uk)

### **Brief Bio**

Dr Jessica Boland is a Senior Lecturer of Functional Materials and Devices in the Department of Materials at the University of Manchester. She is a member of the Photonic Materials and Devices Group in the Photon Science Institute and her research is directly aligned with the Atom to Devices and 2D Materials theme within Henry Royce Institute. Her current research focuses on combining ultrafast optical-pump terahertz-probe spectroscopy with scanning near-field optical microscopy to provide a unique tool for examining the ultrafast carrier dynamics of III-V nanostructures, 2D materials and topological insulators with femtosecond temporal resolution, nanometre spatial resolution and surface-sensitivity.

Webpage: <https://research.manchester.ac.uk/en/persons/jessica.boland>



## **Prof. Alex Casson**

Professor of Biomedical Engineering

Organisation: Department of Electrical and Electronic Engineering, University of Manchester, Manchester, United Kingdom

E-mail: [alex.casson@manchester.ac.uk](mailto:alex.casson@manchester.ac.uk)

### **Brief Bio**

Alex Casson is Professor of Biomedical Engineering at the University of Manchester. He is a specialist in non-invasive bioelectronic interfaces: the design and application of wearable sensors, and skin-conformal flexible sensors, for human body monitoring and data analysis from highly artefact prone naturalistic situations. This work is highly multi-disciplinary, spanning ultra-low power sensing, signal processing and machine learning in power constrained rich environments, and real-time data analysis towards closed loop systems for remote monitoring and digital therapeutics.

Webpage: <https://research.manchester.ac.uk/en/persons/alex.casson>



## **Dr Andreas Willert**

Chair of IEC TC 119 – Printed Electronics

Deputy Head of Department Printed Functionalities

Organisation: Fraunhofer Institute for Electronic Nano Systems (ENAS), Chemnitz, Germany

Email: [andreas.willert@enas.fraunhofer.de](mailto:andreas.willert@enas.fraunhofer.de)

## **Standardisation activities of Printed Electronics**

### **Abstract**

This talk will introduce the work of IEC TC 119 – Printed Electronics. Starting at the involvement of countries, an overview about the Working Groups Terminology and Roadmap, Materials, Equipment, Printability, Quality Assessment as well as Sustainability is given. Examples of actual standardization work are given.

### **Brief Bio**

Dr Andreas Willert has experience in printed electronics and the deposition of catalyst layers for PEM fuel cells. He has a PhD in physics and has been working on the application of printing technologies since 2003. He is working on the deposition of functional material by inkjet printing processes. Andreas is active in the standardization of printed electronics and has taken over the chairmanship of IEC TC 119 – Printed electronics in 2021.

Webpage: <https://www.linkedin.com/in/andreas-willert>



## **Prof. Thomas D. Anthopoulos**

Professor of Emerging Optoelectronics

Organisation: Department of Electrical and Electronic Engineering, University of Manchester, Manchester, United Kingdom

E-mail: [thomas.anthopoulos@manchester.ac.uk](mailto:thomas.anthopoulos@manchester.ac.uk)

### Nanomanufacturing paradigms for sustainable Large-Area Electronics

#### Abstract

Adapting existing manufacturing methods to emerging forms of large-area nanostructured electronics presents major technological and economic challenges. Despite the difficulties, several new processing concepts have gained ground, transforming the broader marketplace and relevant manufacturing infrastructure. This talk will discuss our recent efforts toward scalable manufacturing of large-area nanostructured electronics. I will show how developing innovative patterning technologies with engineered nanomaterials can lead to more sustainable optoelectronics with dramatically improved performance characteristics. Particular emphasis will be placed on the development and evolution of adhesion lithography (a-Lith) and self-forming nanogap lithography techniques and their use in an expanding range of applications, from ultra-fast optoelectronics to new chemical reactors and sensors.

#### Brief Bio

Thomas D. Anthopoulos is a Professor of Emerging Optoelectronics at the University of Manchester. Following the award of his B.Eng. and D.Phil. degrees, he spent two years at the University of St. Andrews (UK), where he worked on organic semiconductors for application in light-emitting diodes before joining Philips Research Laboratories in The Netherlands to focus on printable microelectronics. From 2006 to 2017, he held faculty positions at Imperial College London (UK), first as an EPSRC Advanced Fellow and later as a Reader and Professor of Experimental Physics. From 2017 to 2023, he was a Professor of Material Science at King Abdullah University of Science and Technology (KAUST) in Saudi Arabia. His research interests are diverse and cover the development and application of novel processing paradigms and the physics, chemistry, and application of functional materials.

Webpage: <https://research.manchester.ac.uk/en/persons/thomas-anthopoulos>



## **Prof. Henry Yi Li**

Professor of Textile Science and Engineering

Organisation: Department of Materials, University of Manchester, Manchester, United Kingdom

E-mail: [henry.yili@manchester.ac.uk](mailto:henry.yili@manchester.ac.uk)

### Textile electronic bioengineering: towards breathable, wettable, flexible, wearable electronics

#### Abstract

To address the global healthcare challenges, there is an urgent need to develop advanced technologies for creating innovative remote, home-based, and personalized digital technologies. This could be achieved by developing novel techniques to engineer advanced materials (e.g. graphene) into and/or onto textile fibre-based breathable, wettable, flexible, wearable electronics that is interfaced with the human body and the outside world using wireless communications. To achieve this goal, a scientific framework needs to be developed to address the key theoretical and technical challenges. This talk will cover some of them, including: (1) the establishment of scientific understanding and engineering principles to fabricate advanced nanoscale functional materials into flexible and strong smart fibres with sensing, energy harvesting, energy storage and/or actualization functions; (2) development of advanced manufacturing techniques to produce advanced wearable smart textile materials (fabrics) using smart fibres; (3) development of science for smart fabrics system integration with microelectronics to produce smart devices; (4) derivation of technical solutions to integrate smart devices with wireless data communication technologies to transfer data to cloud servers; (5) development of cloud-based databases, data analysis techniques, as well as computational modelling and simulation of human biological behaviour to establish digital biological health avatar with AI based diagnosis capability for individuals; and (6) development of technical solutions to provide real-time medical professional diagnosis and feedback to individuals and/or healthcare workers.

#### Brief Bio

Henry Yi Li is a Chair and full Professor of in the Department of Materials at the University of Manchester. He is a Life-Fellow of Royal Society of Art and International Biographical Association and Fellow of the Textile Institute. He is the chairman of Textile Bioengineering and Informatics Society, deputy council chairman of International Digital Health and Intelligent Materials Innovation Association, chairman of Board of Directors for Fashion Big Data Foundation, and Editor-in-Chief of "Journal of Fiber Bioengineering and Informatics". He has over 600 scientific publications and is recognized as an international leading expert in advanced textile materials. To date, he has given more than 150 invited keynote/plenary talks and received 56 awards for outstanding research papers, as well as owns more than 46 patents granted in the USA, China and Australia, and 30 IPs transferred to the industry.

Webpage: <https://research.manchester.ac.uk/en/persons/henry.yili>



## **Prof. Cinzia Casiraghi**

Professor of Nanoscience

Organisation: Department of Chemistry, University of Manchester, Manchester, United Kingdom

E-mail: [cinzia.casiraghi@manchester.ac.uk](mailto:cinzia.casiraghi@manchester.ac.uk)

### Printable and biocompatible 2D material inks based on supramolecular chemistry

#### Abstract

Solution processing of 2D materials allows simple and low-cost techniques, such as ink-jet printing, to be used for fabrication of heterostructure-based devices of arbitrary complexity. Our group has developed a supramolecular-based approach able to provide highly concentrated, defect-free, printable and water-based 2D crystal inks. I will give examples of printed photodetectors on plastic, printed capacitors, transistors and memristors on flexible and rigid substrates, as well as wearable sensors for breathing monitoring. Finally, our supramolecular approach allows to easily tune the charge of graphene, enabling production of amphoteric, cationic and anionic graphene. Cytotoxicity tests confirm biocompatibility of the graphene inks, with cationic graphene having exceptional intracellular uptake profile as well as stability in the biological medium, making it very attractive for various applications in drug delivery and imaging.

#### Brief Bio

Cinzia Casiraghi is a Professor of Nanoscience in the Department of Chemistry, University of Manchester. She received her B.Sc. and M.Sc. in Nuclear Engineering from Politecnico di Milano (Italy) and her Ph.D. in Electrical Engineering from the University of Cambridge (UK). In 2005, she was awarded an Oppenheimer Early Career Research Fellowship, followed by the Humboldt Research Fellowship and the prestigious Kovalevskaja Award (1.5M Euro). Her current research work is focused on the development of biocompatible 2D inks and their use in printed electronics and biomedical applications. She is a leading expert on Raman spectroscopy, used to characterize a wide range of carbon-based nanomaterials. She is the recipient of the Leverhulme Award in Engineering (2016), the Marlow Award (2014), given by the Royal Society of Chemistry in recognition of her work on Raman spectroscopy, an ERC Consolidator grant (2015), an ERC Proof of Concept Grant (2021) and the recent Gibson-Fawcett Award (RSC) in recognition of her contribution in the development of water-based 2D inks.

Webpage: <https://research.manchester.ac.uk/en/persons/cinzia.casiraghi>



## Dr John Labram

Associate Professor in Electronic Engineering

Organisation: Department of Electronic and Electrical Engineering, University College London, London, United Kingdom

E-mail: [j.labram@ucl.ac.uk](mailto:j.labram@ucl.ac.uk)

### Event driven optical sensors based on organic semiconductors

#### Abstract

While great progress has been made in visual object recognition in recent years, almost all strategies occur in software, relying on conventional video input. This represents a major bottleneck that could limit the speed at which objects can be identified. Recently, we have demonstrated simple capacitive event-driven sensors inspired by the way that animals perceive visual stimuli. These so-called retinomorphic sensors provide a spiking voltage in response to changes in illumination, but no response under constant illumination. In this talk I will discuss our motivations for detecting light in this way, strategies to achieve this experimentally, and how we expect arrays of these sensors to interpret the visual field. We have demonstrated sensors which employ both metal halide perovskites and organic semiconductors as the absorber layer, with each system exhibiting vastly different behaviour. Our latest devices can detect objects which spend less than 10  $\mu\text{s}$  in the visual field, and generate an output voltage with zero input voltage. I will end my talk by describing a framework to quantify behaviour in these devices, evaluate performance limits, and discuss strategies to improve functionality in the future.

#### Brief Bio

John Labram is an Associate Professor in Electrical and Electronic Engineering at University College London (UCL). John received his undergraduate degree in Physics (MPhys) from the University of Warwick in 2008. He received his PhD from Imperial College London in Physics, under the supervision of Thomas Anthopoulos, in 2011. Between 2013 and 2014 John was a Postdoctoral Research Associate at Imperial College. In 2014 John was awarded the Elings Prize Fellowship to join the California NanoSystems Institute at the University of California, Santa Barbara, USA. Between 2017 and 2022 John was an Assistant Professor in the Department of Electrical Engineering and Computer Science at Oregon State University. John was appointed as a Lecturer at UCL in March 2022 and promoted to Associate Professor in October 2024.

Webpage: <https://www.ucl.ac.uk/electronic-electrical-engineering/people/dr-john-labram>