innoLAE 2024

20 February 2024
Cripps Court Conference Centre

Large Area Electronics Short Courses

innoLAE (Innovations in Large-Area Electronics) is pleased to provide three short courses on LAE technologies, two of which are new additions for innoLAE 2024.

Organic Bioelectronics

This course will cover what bioelectronics is and why it holds so much promise for meeting today's unmet medical needs, with a focus on organics, a class of materials extremely suitable for the fabrication of state-of-the-art bioelectronic devices. In this context, we will discuss why conducting polymers' unique set of features allowed them to enter the world of bioelectronics, giving rise to the era of Organic Bioelectronics.

Wet Processing Technologies for Large Area Electronics

This course covers the inks and printer technology required for deposition techniques including screen, inkjet and flexo/gravure printing. The course also covers coating techniques such as doctor blade and slot die, drawdown, spin and spray coating. In each case the advantages, disadvantages and technological challenges of each technique will be covered, along with issues arising in scale up for manufacture.

Bioelectronic Devices Base on Electrical Double-Layers

This course focuses on electrical methods to characterise devices that use electrical double-layers for bioelectronic sensing. These devices encompass a wide array of applications. A critical aspect of developing these types of bioelectrical devices lies in understanding the design principles that yield optimal sensing performance. This involves careful consideration of device geometry and a judicious selection of materials used in their fabrication.

Organic Bioelectronics

Tuesday 20 February 2024

08:30 – 09:00 Registration
09:00 Course begins

Introduction to bioelectronics

Organic materials

10:30 - 11:00 Coffee break

Organic bioelectronic devices (conducting polymer electrodes, OFETs, OECTs) and their fabrication approaches

Organic bioelectronic devices applications (e.g., electrophysiology, biosensing, bioelectronic medicine)

12:30 Course ends

Speaker

Dr Dimitrios Koutsouras, Physics Researcher Implantable Therapeutics
imec, The Netherlands

Dimitrios Koutsouras is a Physics Researcher in Implantable Therapeutics at IMEC-NL, in Eindhoven (The Netherlands). He received a BS in Physics and a second one in Pharmacy from Aristotle University of Thessaloniki (Greece), and a MSc in Materials Physics from the same university. He then obtained a PhD in Organic Bioelectronics from École des Mines de Saint-Etienne in Gardanne (France), before moving to Mainz (Germany) to work as a postdoctoral researcher at the Max Planck Institute for Polymer Research (MPIP). At MPIP he worked on conducting polymer devices for biosensing, biomedical and pharmaceutical applications. At IMEC-NL, his research is focused on bioelectronic devices for improved biomedical solutions. In particular, he is interested in the design, (micro)fabrication and clinical translation of multimodal bioelectronic devices with biosensing, stimulating and therapeutic functions.

Wet Processing Technologies for Large Area Electronics

Tuesday 20 February 2024

13:00 – 13:30 Registration
13:30 Course begins

Wet Processing (Formulation, Coating and Printing) - PEL

Materials and Formulation

- Inks
  - Silver, copper, carbon and other ink materials
- Formulation
  - Rheology
  - Solvent-based inks
  - Curable inks
  - Ink formulation components
  - Mixing and scale-up
- Substrates
  - Polymers, glass, paper, textiles and metals

15:00 - 15:30 Coffee break

Printing - Printed Electronics Limited

- Inkjet
- Screen print
- Other print technologies such as flexography, gravure etc.

17:00 Course ends

Speakers

Dr Neil Chilton, Technical Director
Printed Electronics Limited, UK

Neil has more than twenty years' experience in the field of electronics and electronic components. After completing his BSc and PhD in Physics, his technical career took him to Japan where he worked for four years at the advanced materials research division of Nippon Steel Corporation. After returning to the UK he joined Europe's then largest printed circuit board manufacturing company where he was later part of an MBO team and technical director. In 2006, together with co-founder Dr Steve Jones, he started Printed Electronics Limited to focus on the practical use of inkjet for manufacturing electronic interconnects, devices and systems.

Dr Clare Conboy, Formulation Chemist
Printed Electronics Limited, UK

Clare has more than 20 years' experience of formulating and characterising fluids for spray and printing applications. This includes many years of working with inkjet inks for piezo and thermal DOD printheads, initially for graphics and in recent years for materials deposition applications, including a diverse range of materials including metals, inorganics and adhesives in a range of solvent systems. Following completion of a PhD in Chemistry, she has worked for a number of organisations with a focus on inkjet technology, including Xaar and Plastic Logic. Clare has been involved with Printed Electronics Limited since its establishment.

Organic Bioelectronics

Tuesday 20 February 2024

13:00 – 13:30 Registration
13:30 Course begins

Introduction

Fundamental concepts about electrical measurements in bioelectronic devices

The electrical double layer (EDL)

- The EDL and its role in bioelectronic sensing devices.
- The electrical impedance of the EDL
- Drifts and long-term electrical stability of the EDL.
- The noise generated by the EDL and the detection limits in voltage and in the current detection method.
- Geometrical design rules to optimize devices that use the EDLs for sensing.
- Material strategies to optimize the EDL impedance for sensing.
- Electrical probing of changes in the electrical double-layer. Steady-state techniques, transient analysis.
- Electrical modeling of the EDL and parameter extraction for sensing purposes.
- Neuromorphic behaviour of ELDs.

Electrical stimulation through electrical double-layers (tissues and cells)

- The displacement current across capacitors and their impact on cells and tissues.
- Transient analysis of EDL using equivalent circuits.
- Electrochemical drifts and calibration.

Electrolyte gated transistor devices

- Operation principle.
- Diode-gated transistors.
- Geometrical design rules for electrolyte-gated transistors.
- Recipes for a proper electrical characterization of electrolyte-gated transistors.
- Electrical techniques for probing electrolyte gated transistors when used as sensors.

Electrophysiological sensing

- Bioelectrical signals in excitable and non-excitable cells, including bioelectrical signals in plants.
- Detection amplification of ultra-low frequency bioelectrical signals.
- Instrumentation, amplification, and bandwidth consideration.
- Electrical noise.

Applications of bioelectronic devices

- Skin adherent devices.
- Brian-machine interfaces.
- Electrophysiological monitoring of biological tissues and cells.
- Devices for monitoring plants and their applications in agriculture.
- Detect
- Detection of microorganisms (bacteria, algae, etc)

Speaker

Dr Henrique Leonel Gomes, Associate Professor
Coimbra University, Portugal

Henrique Leonel Gomes is Associate Professor in the Department of Electrical and Computer Engineering at Coimbra University, Coimbra, Portugal. He heads the Organic Electronics and Bioelectronics research group. He was awarded BSc in Physics from the Universidade de Aveiro, Portugal and a PhD in Electronic Engineering in 1994 from the University of Wales, Bangor.

Henrique Gomes established at the Coimbra University a renowned infrastructure that provides a broad range of electrical measuring techniques to evaluate device performance, electrical stability, electrical noise and device reliability.