Avviso di Seminario

30 giugno 2017 – ore 10

Presso il Diparitmento di Fisica e Astronomia (Viale Berti Pichat 6/2) – Sala Riunioni – Piano 1

"Organic Semiconductor Devices and Nanostructures for (Opto)Electronics"

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Conjugated molecular and supramolecular materials now provide a class of semiconductors in its own right, with potential application to devices such as light-emitting diodes, LEDs, displays, transistors, and solar cells.

Basic understanding of the fundamental device physics (such as charge injection and related energy level alignment at electrodes, or exciton splitting at heterojunctions), together with materials discovery and tailoring, and advanced device engineering (architecture design and optimisation), are all needed to advance the current state-of-the-art. In addition, the remarkably interdisciplinary nature of organic electronics means that achieving progress in this area requires the ability to integrate and build on the latest advances in disciplines such as chemistry (e.g. supramolecular), materials science, electrical engineering, and the ever more pervasive nanoscience and nanotechnology.

I will start my presentation with a brief introduction to conjugated polymers. As an illustrative example of the tools that can be used to study the underpinning device physics, I will then present an electro-optical technique for the non-invasive probing of internal built-in fields in finished sandwich devices (LEDs or solar cells). In combination with data from ultraviolet photoelectron spectroscopy (UPS) and Kelvin Probe characterisation, electroabsorption can be used for analysis of the energy level line-up at organic semiconductors/electrodes interfaces, and thus applied to advance electrodes engineering for all types of organic electronic applications.

I will also present an approach to high-resolution lateral patterning of electroluminescent polymers, based on either near-field lithography with apertured probes, or with scanning thermal probes. We demonstrated minimum resolutions of 50 nm or less (e.g. 28 nm with thermal probes) with such techniques, thus enabling the prototyping of a number of structures with potential for photonics or optoelectronics (e.g. solar cells, or transistors).

Last but not least, I would like to present results on the optical and electroluminescent properties of self-assembled nanostructures such as those represented by cyclodextrin-threaded conjugated polymers, since these give a compelling demonstration of how supramolecularly engineering can provide model semiconductors with controlled intermolecular interactions, and therefore insight into the influence of such interchain interactions on the fundamental properties of semiconducting wires.

Short Biography

Franco Cacialli is Professor of Physics at both the Department of Physics and Astronomy at UCL and the London Centre for Nanotechnology (LCN, www.london-nano.ucl.ac.uk). His research interests focus on the physics and application of organic semiconductors (OS) to Photovoltaic/light-emitting diodes, and to field-effect transistors with particular attention to the electronic properties of the electrode-semiconductors interface, an issue of fundamental importance in virtually all device applications. Research interests also include supramolecular architectures for the control and tailoring of intermolecular interactions, and thus of OS photophysics, and high-resolution nanolithography by means of the scanning near-field optical microscope (SNOM) or the scanning thermal microscope (SThM). He received his degree and PhD in Electronic Engineering from the University of Pisa, and after post-doctoral work at Cambridge has been a Royal Society University Research Fellow in the period 1996-2004, first at Cambridge until 2001, then at UCL, as a Lecturer (2001-2003), a Reader (2003-2005), and Professor of Physics since 2005. A Fellow of the Institute of Physics (FinstP since 2001), a former member of the Advisory Board of "Materials Today" and of the Journal of Physics C: Condensed Matter, and a current member of the EPSRC Peer Review College, and of the Advisory Board of Advanced Materials Technologies (Wiley) he (co)authored over 250 publications and 6 patents. Franco has coordinated an 11-partner Marie-Curie Research Training Network (RTN) dedicated to investigation of threaded molecular wires (THREADed Molecular wIres as supramoLecularly engineered muLtifunctional materials – THREADMILL – www.threadmill.eu) and currently coordinates a European Training Network (ETN) (SupramolecularlY eNgineered arCHitectures for optoelectRonics and photONICS – SYNCHRONICS, http://synchronics-etn.eu). He also co-edited (with P Samorì – Strasbourg) the book “Functional Supramolecular Architectures” (Wiley – 2010). Franco has been elected to a Fellowship of the American Physical Society in 2009 and is the recipient of a Royal Society Wolfson Research Merit Award (2015-2019).

Please see https://www.ucl.ac.uk/cmmp/cmmp-people/group-pages/organic-semiconductors for further details about publications and research.

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