E-MRS 2011
Spring Meeting

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Spring 11 N: Controlling and characterising the structure of organic semiconductor films

Key to the development of organic semiconductor technology is the ability to control film microstructure. As control of microstructure can only be achieved if we can also characterise microstructure, this symposium seeks to bring together experts in the device-making and structural characterisation communities to address this challenging issue.

Scope:

The performance of organic electronic devices is highly sensitive to the structure of the active organic semiconductor layer(s). The structure of organic semiconductor films is in turn highly complicated, being in general neither wholly amorphous nor wholly crystalline. Dual challenges in the development of organic semiconductor technology are the ability to control and characterise film microstructure.

Organic semiconductor films are in general processed either through solution or vacuum deposition. The former offers obvious advantages for manufacturing but typically comes at a cost of higher structural disorder. Vacuum deposition on the other hand offers the ability to create well defined and ordered structures which are necessary for understanding the fundamental properties of organic semiconductors. Significant advances have been made recently, however, in the ability to control the structure of solution-processed films and will be one of the focuses of this symposium.

For both solution- and vacuum-processed films a detailed knowledge of thin film structure is required. Due to the complexity of organic thin films, specialist techniques are required to fully determine their structure, especially on the length scales relevant to device performance. It is often beyond the scope of the device scientist to also master these techniques, however those characterising thin film structure also need to ensure they are addressing technologically relevant problems.

This symposium is aimed to bring together scientists with expertise in the areas of device engineering, structural characterisation and semiconductor physics. The symposium will address structural issues pertaining to the performance of devices including (but not limited to) organic solar cells, field-effect transistors (FETs) and light-emitting diodes (LEDs), as well structural issues relating to our understanding of key semiconductor processes such as charge injection and transport. Both small molecule and polymeric materials will be covered, along with solution- and vacuum-based deposition methods.

16:30 **COMPUTATIONAL STUDY OF THE INFLUENCE OF NANOSTRUCTURE ON THE ELECTRICAL PROPERTIES OF A POLYMER LED**

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Resume : One advantage in using conjugate polymers as the active component in optoelectronic devices, like light emitting diodes (LEDs), is the possibility of being deposited in solution. However, several experimental studies have shown that the nanostructure of the thin film depends on the conditions used to deposit the polymer, since it will affect the way that the long conjugated polymer chains stack and align relative to the electrodes, creating domains with different sizes and shapes. In this way, understand and control the polymer 3D nanostructure is of great importance since it will influence the efficiency of the optoelectronic device where it is used. Here we present the results obtained by us using our mesoscopic model based on a generalized dynamic Monte Carlo method to understand how the spatial arrangement of polymer strands affects the functioning of a polymer LED. Our results clearly show that the electrical properties of a polymer LED (i.e. current density, charge density, internal electric field and charge recombination) are strongly influenced by the orientation of the polymers strands relative to the electrodes at nanoscale.

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