

4th International Conference on **Nanotek & Expo**

December 01-03, 2014 DoubleTree by Hilton Hotel San Francisco Airport, USA

Nanostructured self-assembled P3HT thin films and their application to enhance organic solar cell efficiency

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Nanostructured conjugated polymer thin films represent a promising material for applications such as sensing or organic photovoltaics due to their enhanced interface and semi-conducting properties. While most researchers focus their studies on either elaborated chemistry or time and energy-consuming nano-imprinting methods, we here demonstrate that nanostructured P3HT thin films are easily obtained by using commercially available polymers through self-assembly followed by selected removal of one of the phases. P3HT is among the most widely used conjugated polymers, especially for transistors, sensors and photovoltaic applications. Our simple and cost-effective fabrication process is based on spin-coating of polymer-polymer blends. In order to obtain relatively ordered structures, the compatibility between the two polymers must be given particular attention. For instance, we find that highly incompatible polymers form bilayers rather nanostructured films. With the adequate system, we further investigate the influence of the molecular weights and the relative concentration of the two polymers to control the dimensions of the nanostructures obtained (nanopores and nanoislands). Playing on these parameters, we observe how an increased interface between donor and acceptor molecules in organic solar cells can enhance the device performances. Furthermore, a careful study using angle dependent FTIR and ellipsometry revealed that the conjugated polymer crystallites in the nanostructured films undergo a reorientation at the polymer-polymer interface which is beneficial for an enhanced charge collection within the semi-conducting layer of the solar cells. This low-cost and adaptable method could be applied to a variety of materials to fabricate innovative and original functional devices.

Biography

Varun Vohra has completed his PhD at the age of 26 years from the University of Milano-Bicocca (Italy) and postdoctoral studies from Japan Advanced Institute of Science and Technology. He was awarded with the prestigious Marie-Curie (European Commission) and JSPS (Japan) Fellowships. He was appointed as a tenure track assistant professor at the University of Electro-Communications at the age of 30, with the challenging opportunity of establishing his own research laboratory focusing on organic electronics and polymer process. He has authored 14 papers in reputed journals such as Advanced Materials, ACS Nano and Applied Physics Letters.

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