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Innovative solutions for low-cost and sustainable fabrication of semi-transparent polymer solar cells

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Since 2015, several studies have demonstrated that polymer solar cells (PSCs) can yield power conversion efficiencies over 10%.[1] As they employ thin semi-transparent active layers, PSCs have a great potential for the fabrication of low-cost transparent technologies such as photovoltaic windows produced through high volume roll-to-roll processing. However, the conventional methods for active layer and electrode deposition, namely, spin-coating from chlorinated solvents and vacuum metal evaporation, considerably increase the material and chlorinated solvent wastes generated during device fabrication. Here, I will present studies in which costly evaporated silver or gold electrodes were successfully replaced with conductive polymers, silver nanowires or graphene electrodes deposited in air.[2] These alternative materials and processes remove the necessity for costly equipment such as vacuum evaporating chambers, shorten the production time by avoiding the long waiting periods necessary to achieve vacuum conditions and decrease the amount of costly material wasted on the vacuum chamber walls. Similarly, when it comes to active layer fabrication, spin-coating generates materials and solvent wastes that are ejected outside of the substrate through centrifugal forces. Chlorinated solvents are extremely harmful to the human health and the environment. Our recent works on conjugated polymer nanoparticle dispersions in water[3] and the eco-friendly push-coating process[4] provide solutions for sustainable fabrication of efficient PSC active layers. Although most researchers in the PSC field focus solely on increasing their photovoltaic performances, our group develops original processes which open the path to sustainable yet efficient PSC fabrication through high volume production, which may facilitate their large-scale commercialization.

Biography

Varun Vohra received his PhD from the University of Milano-Bicocca (Italy) in 2009 for his study on organic semiconductors funded through a Marie Curie Fellowship. Between 2010 and 2014, he investigate polymer solar cells at the Japan Advanced Institute of Science and Technology through two prestigious JSPS Fellowships. Since 2014, he is Assistant Professor at the University of Electro-communication where he leads a research group focusing on next-generation polymer optoelectronics. He has published over 30 papers on academic journals including *Advanced Materials* or *Nature Photonics* and has fabricated .

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