

NANOIMPRINTED POLYMERIC AND PEROVSKITE PHOTOVOLTAICS: EFFECTS OF GEOMETRY ON 3D CHAIN ALIGNMENT AND PERFORMANCE ENHANCEMENT

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Engineering Building 2, Rm W122

Nanostructure is the core enabling technology for future semiconductor manufacturing and emerging nanotechnology applications in renewable energy and medicine. For example, nanostructures of conjugated polymer has greatly enhanced the performance of organic photovoltaic devices (OPV). A vertically bicontinuous and interdigitized heterojunction between donor and acceptor has been regarded as one of the ideal structures to enable both efficient charge separation and transport. In this talk, I will present our work of using nanoimprint lithography (NIL) as a new approach to simultaneously control both the heterojunction morphology and polymer chains in OPV. We found that nanoimprint procedure changes the initial edge-on alignment in non-imprinted P3HT to a vertical orientation which favors the hole transport, with an organization height over 170 nm and width in the range of 60- 210 nm. Better chain alignment improves hole mobility in P3HT nanogratings to be $0.03 \text{ cm}^2/\text{Vs}$. It is also found that NIL enables stronger chain alignments in high molecular weight (MW) P3HT, showing its potential to release the benefits of high MW polymers that are not suitable for bulk heterojunction devices due to severe chain entanglement. These findings are further proved by increases in power conversion efficiency of OPVs using imprinted P3HT/PCBM nanostructures. Finally, I will show our recent results of using NIL to pattern perovskite nanostructures with improved crystallinity, which is very promising to further improve the performance of perovskite devices.



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SPEAKER BIO

Dr. Walter (Wenchuang) Hu is currently an associate professor of Dept. of Electrical Engineering of University of Texas at Dallas (UTD). He received the BSEE from Peking University (Beijing), Ph.D. from University of Notre Dame (IN), and post-doc at University of Michigan, MI. Walter Hu has 16 years research experience in nanolithography, nanofabrication, nanomaterials, and semiconductor devices and processing. Besides conventional semiconductor applications, his research also explores emerging applications of nano-biosensor, nanostructured photovoltaics, nano-medicine, and tissue engineering. Dr. Hu has published 50 journal and 91 peer-reviewed conference papers/abstracts and 10 filed patents. Dr. Hu is a senior member of IEEE and currently serves as Chair of Technical Committee of Nanofabrication of IEEE Nanotechnology Console (NTC). Dr. Hu received NSF Career Award in 2010, NSF AIR award in 2012, Faculty Research Award of UTD in 2013, Gushu Tech Award (China) in 2014, Shanghai 1000 Talent Award in 2015, IEEE NTC Distinguished Lectureship in 2016, and CNSF's Oversea Distinguished Chinese Scholar Award 2016.

Contact Professor Jiming Bao at jbao@uh.edu if you would like to arrange for a time to meet with Dr. Hu.

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