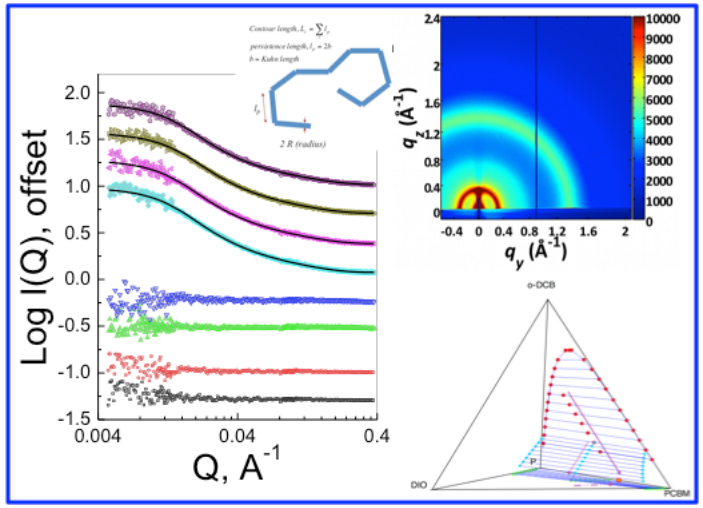
Understanding the nanoscale assembly of organic photovoltaic donor/acceptor films



Neutron scattering/Reflectometry (left), X-ray scattering (top of right), and Flory-Huggins theoretical analyses (bottom right) reveal both the lateral and vertical morphological effects of the processing additive diiodooctane, DIO, on the formation of bulk-heterojunctions and the resulting OPV device parameters starting from a donor/acceptor polymer blend PBDTTT-C-T:PC71BM in solution, to the spin-cast films

M. Shao, J. K. Keum, R. Kumar, J. Chen, J. F. Browning, S. Das, W. Chen, J. Hou, C. Do, K. C. Littrell, A. Rondinone, D. B. Geohegan, B. G. Sumpter, K. Xiao, "Understanding how processing additives tune the nanoscale morphology of high efficiency organic photovoltaic blends: From casting solution to spun-cast thin film," *Advanced Functional Materials* (in press). DOI: 10.1002/adfm.201401547

Scientific Achievement

Neutron and X-ray scattering, theory, and modeling were used to understand how a processing additive, diiodooctane, improves the power conversion efficiency of organic photovoltaic films, showing the pathways by which improved molecular ordering and phase segregation of donor and acceptor polymers (PBDTTT-C-T and $PC_{71}BM$) occur during the drying of the film.

Significance and Impact

Understanding how polymer blend films develop their nanophase morphologies, starting in solution and during drying into a thin film, is crucial to rationally design and achieve donor / acceptor networks that self-assemble for organic photovoltaics with improved efficiency.

Research Details

- *Neutron scattering/reflectometry and X-ray scattering* were used to measure the structural and interfacial morphology effects of the processing additive on the aggregation and morphology of photoactive blends from solution to thin films used for devices.
- *Theory and computer simulation* were used to deduce the transformational pathways responsible for the improved morphology.

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This research was conducted at the Center for Nanophase Materials Sciences (CNMS), High flux Isotope Reactor (HFIR) and Spallation Neutron Source (SNS) at Oak Ridge National Laboratory.

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