Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

The importance of domain purity for performance in P(NDI2OD-T2)-based all-polymer solar cells revealed by resonant x-ray scattering HARALD ADE, NCSU, BRIAN COLLINS, NIST, MARCEL SCHUBERT, STEFFEN ROLAND, ROBERT STEYRLUETHNER, University Potsdam, ZHIHUA CHEN, ANTONIO FACCHETTI, Polyera, DIETER NEHER, University Potsdam — The nanostructure of bulk heterojunction organic solar cells has long been recognized as critical to their performance. To date, the primary morphological characteristics under investigation have been the level and nature of crystallinity of the materials. Yet the recent and wide-spread measurement of molecular mixing and diffusion of the electron donor and acceptor materials in amorphous regions has focused attention on the non-crystalline portions in these films as well. Here we investigate both aspects using x-ray diffraction and resonant scattering techniques to measure crystallinity and the domain sizes and purities, respectively, of devices based on P3HT:P(NDI2OD-T2) blends. The repercussions of the nanostructure is revealed in measurements of exciton bandwidth and photoluminescence quenching. We find that through variation of solvent blends and film drying conditions can significantly alter domain size and purity. This results in significant increases in device performance that correlate with increased domain purity and exciton bandwith of the P3HT crystals. This strongly indicates that molecular mixing of these materials is detrimental to performance in harvesting solar energy.

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Date submitted: 28 Nov 2012 Electronic form version 1.4