Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Understanding the Role of Additives in Improving the Performance of Polymer:Fullerene Bulk Heterojunction Solar Cells WEI CHEN, Materials Science Division, Argonne National Laboratory; Institute for Molecular Engineering, the University of Chicago — Solar cells based on the polymer:fullerene bulk heterojunction (BHJ) represent one of the most promising technologies for next-generation solar energy conversion due to their low-cost and scalability. In the last fifteen years, research efforts have led to organic photovoltaic (OPV) devices with power conversion efficiencies (PCEs) $\sim$ 12%, but these values are still insufficient for the devices to become widely marketable. To further improve solar cell performance, a thorough understanding of the complex processing-structure-performance relationships in OPV devices is required. Recently, the use of processing additives have been proved to be one of the most effective methods to tune the nanomorphology of polymer:fullerene active layer, as the incorporation of a small percentage of solvent additives results in a nearly doubling of device efficiency. However, the physics behind these improved performances by processing additives still remains unclear. In this work, by taking advantage of resonant soft x-ray scattering (RSoXS) and energy-filtered transmission electron microscopy (EFTEM), we have determined that the solvent additives induce the change in the formation mechanism of polymer:fullerene nanomorphologies in the process of film casting. Progress established in the course of these studies on structural and morphological characterizations will serve as the foundation for further improving the efficiency of polymer solar cells to realize their large-scale commercial use.

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Date submitted: 01 Nov 2013 Electronic form version 1.4