Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Characterization and Improvement on the Morphology in Polymer-Based Solar Cells HAO SHEN, WENLUAN ZHANG, BRETT GURALNICK, MICHAEL MACKAY, University of Delaware, BRIAN KIRBY, CHARLES MAJKRZAK, National Institute of Standards and Technology — Polymer-based solar cells are promising for their cost-effective solar energy, yet this technology is still far from practical application owing to its low energy conversion efficiency. It has been known that the morphology in the active layer, or the nano-scaled intermixing between the polymer and fullerene derivative, is critical to the device performance. We have quantitatively measured the morphology in one of the most-studied polymer-based solar cells consisting of poly(3-hexylthiophene) (P3HT) and [6,6]-phenyl-C61-butyric acid methyl ester (PCBM), by means of neutron and x-ray scattering techniques. In particular, the effects of thermal and co-solvent-assisted annealing on the PCBM cluster formation and vertical distribution are characterized. Basing on the observations, we are proposing a new design of solar cell architecture to approach a more controlled morphology in the active layer, by utilizing a thermodynamically-driven assembly of fullerenes onto the surface of silica microspheres. This presentation will focus on its application in the P3HT:PCBM system.

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Date submitted: 25 Jan 2011 Electronic form version 1.4