Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Hierarchical Nanomorphologies Promote Exciton Dissociation in Polymer: Fullerene Bulk Heterojunction Solar Cells[1] WEI CHEN, SETH DARLING, Center for Nanoscale Materials, Argonne National Laboratory — In the last fifteen years, research efforts have led to organic photovoltaic (OPV) devices with power conversion efficiencies (PCEs) up to ∼8%, 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 structure-property relationships in the OPV devices is required. In this work, we demonstrated that the OPV active layer of PTB7:fullerene bulk heterojunction (BHJ) solar cells, which set a historic record of PCE (7.4%), involves hierarchical nanomorphologies ranging from several nanometers of crystallites to tens of nanometers of nanocrystallite aggregates in PTB7-rich and fullerene-rich domains, themselves hundreds of nanometers in size. These hierarchical nanomorphologies with optimum crystallinity and intermixing of PTB7 with fullerenes are coupled to significantly enhanced exciton dissociation, which consequently contribute to photocurrent, leading to the superior performance of PTB7:fullerene BHJ solar cells. New insights of performance-related structures afforded by the current study should aid in the rational design of even higher performance polymeric solar cells.

[1]W. Chen gratefully acknowledges financial support from Argonne Director's Postdoctoral Fellowship. This work is partially supported by a University of Chicago-Argonne Strategic Collaborative Initiative Seed Grant.

Wei Chen
Center for Nanoscale Materials, Argonne National Laboratory

Date submitted: 08 Dec 2011 Electronic form version 1.4