Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Controlling the Morphology of TiO2 Nanorods/Polythiophene Composites for Bulk Heterojunction Solar Cells Using H-Bonding[1] YING LIN, QINGSHUO WEI, JAMES J. WATKINS, Department of Polymer Science and Engineering, University of Massachusetts Amherst — We demonstrate how the morphology of solution-processable hybrid bulk heterojunction solar cells, within an active layer consisting of modified poly(3-hexylthiophene) (P3HT) and TiO2 nanorods, can be controlled by H-Bonding. The hybrid bulk heterojunction solar cells suffer from the problems of the aggregation of inorganic nanocrystals and the interface between nanocrystals and the polymer matrix. To address these issues, we utilize P3HT-based block copolymer (BCP), in which one block is P3HT and the other block is a P3HT derivative containing a poly(ethylene glycol) (PEG) oligomer side chain. In the mean time, we functionalized the TiO2 nanorods with dyes having multiple COOH groups. This design both enables self-assembly of the devices via micophase segregation into well-defined morphologies and provides a means for establishing strong preferential interaction between TiO2 nanorods and the PEG side chain. This strong, preferential H-bonding limits the aggregation of the TiO2 nanorods and modifies the interfacial properties between donor and acceptor. TEM showed the self-assembly structure of the TiO2 nanorods in polymer matrix. Using this modified thiophene copolymer, hybrid devices are made with power conversion efficiencies 50% higher than that of conventional P3HT homopolymer.

[1]Funding from the NSF Center for Hierarchical Manufacturing (CMMI-0531171) and the Department of Energy supported Energy Frontier Research Center at the University of Massachusetts (DOE DE-PS02-08ER15944) are gratefully acknowledged.

Ying Lin
Department of Polymer Science and Engineering,
University of Massachusetts Amherst

Date submitted: 26 Nov 2011 Electronic form version 1.4