Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Investigation of Different Organic Solar Cell Active Region Structures Deposited by Resonant Infrared Matrix-Assisted Pulsed Laser Evaporation (RIR-MAPLE)[1] ADRIENNE STIFF-ROBERTS, RYAN MCCORMICK, AYOMIDE ATEWOLOGUN, Department of Electrical and Computer Engineering, Duke University, STIFF-ROBERTS RESEARCH GROUP TEAM — In this work, we use RIR-MAPLE to investigate organic solar cells (OSCs) featuring different P3HT:$PC_{61}BM$ active region structures: bulk heterojunction (BHJ), bilayer, and gradient composition. Two deposition capabilities of RIR-MAPLE, nanoscale domains in blended polymeric films and multi-layer polymeric films regardless of constituent solubility, enable the deposition of these structures. While the BHJ yields better exciton dissociation due to large donor/acceptor interfacial area, the bilayer provides better charge transport due to reduced interfacial recombination. In contrast, the gradient structure could optimize both exciton dissociation and charge transport. P3HT materials characterization includes UV-Vis absorbance for Spano analysis and grazing-incidence, wide angle X-ray scattering (GIWAXS) for structural information. The OSC device characterization includes external quantum efficiency (EQE) and current-density voltage measurements. In addition, a Dynamic Monte Carlo model is used to simulate the different structures in order to generate EQE spectra for comparison to the measured device performance. This work was supported, in part, by the Office of Naval Research under Grant N00014-10-1-0481 and the National Science Foundation Triangle MRSEC on Soft Matter.

[1]This work supported in part by ONR and NSF.

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Date submitted: 14 Nov 2014 Electronic form version 1.4