Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Monitoring Residual Solvent Additives and Their Effects in Solution Processed Solar Cells DEREK M. FOGEL, Wake Forest University, JAMES I. BASHAM, NIST and Penn State University, SEBASTIAN ENGMANN, SUJITRA J. POOKPANRATANA, EMILY G. BITTLE, NIST, OANA D. JURCHESCU, Wake Forest University, DAVID J. GUNDLACH, NIST — High boiling point solvent additives are a widely adopted approach for increasing bulk heterojunction (BHJ) solar cell efficiency. However, experiments show residual solvent can persist for hours after film deposition, and certain common additives are unstable or reactive. We report here on the effects of residual 1,8-diiodooctane on the electrical performance of poly(3-hexylthiophene-2,5-diyl) (P3HT): phenyl-C71-butyric acid methyl ester (PC[71]BM) BHJ photovoltaic cells. We optimized our fabrication process for efficiency at an active layer thickness of 220 nm, and all devices were processed in parallel to minimize unintentional variations between test structures. The one variable in this study is the active layer post spin drying time. Immediately following the cathode deposition, we measured the current-voltage characteristics at one sun equivalent illumination intensity, and performed impedance spectroscopy to quantify charge density, lifetime, and recombination process. Spectroscopic ellipsometry, FTIR, and XPS are also used to monitor residual solvent and correlated with electrical performance. We find that residual additive degrades performance by increasing the series resistance and lowering efficiency, fill factor, and free carrier lifetime.

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Date submitted: 14 Nov 2014 Electronic form version 1.4