MAR16-2015-009494

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Morphology-insensitive Performance Facilitates Transition from Spin-Coating to Roll-to-Roll Coating For High-Performance, Solution-Processed Solar Cells

DEAN DELONGCHAMP, National Institute of Standards and Technology

Solution processing via roll-to-roll (R2R) coating promises a low cost, low thermal-budget, sustainable revolution for the production of solar cells. Yet virtually all high efficiency solution processed research cells have been demonstrated by spin-coating, a low-volume deposition process. We present detailed device and morphology studies of an organic photovoltaic (OPV) system deposited by a high volume manufacturing technique, blade-coating, that achieves greater than 9.5 % power conversion efficiency (PCE). The average crystal domain orientation and characteristic phase separation length distribution are markedly different when deposited by blade-coating rather than spin-coating,. This result allows us to determine which aspects of morphology are not relevant to the PCE of this system. Whether the crystallites are "face on" or "edge on" does not appear to impact the PCE of system, nor does the length scale or "hierarchical" nature of the phase length scale. Persistent morphological qualities that may be associated with high PCE in this system are relatively pure phases and relatively strong diffraction. We posit that OPV systems in which the PCE is less sensitive to morphology may also be less sensitive to film thickness, enabling some to maintain high PCE in active layers thicker than greater than ≈200 nm. We confirm that blade-coating is a suitable prototyping technique for R2R coating by demonstrating nominally identical morphologies for both piece blade-coating and continuous-web, slot-die coating.