Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Roll-to-Roll printed large-area all-polymer solar cells with 5% efficiency based on a low crystallinity conjugated polymer blend[1] XIAODAN GU, Univ of Southern Mississippi, YAN ZHOU, KEVIN GU, TADANORI KUROSAWA, Stanford University, HONGPING YAN, CHENG WANG, MICHEAL TONEY, Stanford synchrotron radiation lightsource, ZHENAN BAO, Stanford University — The challenge of continuous printing in high efficiency large-area organic solar cells is a key limiting factor for their widespread adoption. We present a materials design concept for achieving large-area, solution coated all-polymer bulk heterojunction (BHJ) solar cells with stable phase separation morphology between the donor and acceptor. The key concept lies in inhibiting strong crystallization of donor and acceptor polymers, thus forming intermixed, low crystallinity and mostly amorphous blends. Based on experiments using donors and acceptors with different degree of crystallinity, our results showed that microphase separated donor and acceptor domain sizes are inversely proportional to the crystallinity of the conjugated polymers. This methodology of using low crystallinity donors and acceptors has the added benefit of forming a consistent and robust morphology that is insensitive to different processing conditions, allowing one to easily scale up the printing process from a small scale solution shearing coater to a large-scale continuous roll-to-roll (R2R) printer. We were able to continuously roll-to-roll slot die print large area all-polymer solar cells with power conversion efficiencies of 5%, with combined cell area up to 10 cm2. This is among the highest efficiencies realized with R2R coated active layer organic materials on flexible substrate.

[1]DOE BRIDGE sunshot program. Office of Naval Research

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Date submitted: 11 Nov 2016 Electronic form version 1.4