Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Tailored exciton diffusion in organic photovoltaic cells for enhanced power conversion efficiency RUSSELL J. HOLMES, University of Minnesota — Organic photovoltaic cells (OPVs) have the potential to become a low-cost source of renewable energy due to their compatibility with high throughput processing techniques and the demonstration of power conversion efficiencies exceeding 10%. In the simplest planar heterojunction OPVs, photoconversion is limited by a short exciton diffusion length (L_D) that restricts migration to the dissociating electron donor-acceptor (D-A) interface. Consequently, bulk heterojunctions are often used to realize high efficiency as these structures reduce the distance an exciton must travel to be dissociated. Here, we present an alternate approach that seeks to directly engineer L_D by optimizing the intermolecular separation and consequently, the photophysical parameters responsible for excitonic energy transfer. By diluting the electron donor boron subphthalocyanine chloride (SubPc) into a wide energy gap host material, we optimize the degree of interaction between donor molecules and observe a nearly 50% increase in L_D. Using this approach, we construct planar heterojunction OPVs with a power conversion efficiency of 4.4%, >30% larger than the case of optimized devices containing an undiluted donor layer. It is worth noting that this efficiency also rivals those realized in optimized, bulk heterojunction OPVs based on SubPc and C_{60}. The underlying correlation between L_D and the degree of molecular interaction has wide implications for the design of both OPV active materials and device architectures.

Russell Holmes
University of Minnesota

Date submitted: 07 Nov 2012 Electronic form version 1.4