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Self-assembly and characterization of two-component films of semiconducting nanoparticles YIPENG YANG, NAGARJUNA GAVVALAPALLI, HARIHARA VENKATRAMAN, MINA BAGHGAR, MICHAEL BARNES, DHANDAPANI VENKATARAMAN, ANTHONY DINSMORE, University of Massachusetts Amherst — Polymer-based semiconducting materials are promising candidates for large-scale, low-cost photovoltaic devices. To date, the efficiency of these devices has been low in part because of the challenge of optimizing molecular packing while also obtaining a bicontinuous structure with a length scale of approximately 10nm. Here we demonstrate an alternative approach to solving this problem by packing nanoparticles of electron- and hole-transporting semiconductors into a two-component film. We first make nanoparticles of semiconducting materials (P3HT, PCBM, CdSe, etc) suspended in liquid. Then a binary suspension of nanoparticles is dried onto a non-volatile liquid surface to form a solid, two-component film with uniform thickness. The absorbance, photoluminescence, structure, and charge mobility of the films are measured. For a range of stoichiometries, we obtain bicontinuous structures and significant luminescence quenching, indicating charge transfer. This study shows that two-component nanoparticulate films may be an effective route toward bulk heterojunctions with controlled morphology. We acknowledge support from the US Department of Energy, Office of Basic Energy Sciences, through grant DE-SC0001087.

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