

Abstract for an Invited Paper
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The Physics of Organic Solar Cells

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The best polymer bulk heterojunction solar cells now have efficiency exceeding 7%. Attaining even higher efficiency will require a detailed understanding of how the cells operate and what limits their performance. There is controversy regarding what limits the performance of one of the most studied systems, P3HT-PCBM. The primary limitation has been attributed to geminate recombination, bimolecular recombination, recombination near electrodes, formation of a region in the film with no electric field due to the semiconductors being doped, and series resistance. We will compare these different theories and demonstrate cases in which each one can be correct. We will show that some of the loss is a result of excitons in the PCBM recombining before they reach the interface with the polymer. Finally we will examine the nanostructures that form when various polymers are mixed with fullerenes and other electron acceptors, highlighting the important consequences of the acceptor molecules intercalate in between the sidechains of the polymer.