

MAR10-2009-020296

Abstract for an Invited Paper
for the MAR10 Meeting of
the American Physical Society

Transient Microwave Studies of Organic Photovoltaics

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Certified power conversion efficiencies of excitonic solar cells based on the polymer:fullerene (donor:acceptor) bulk heterojunction have increased from 2.5% back in 2001, to 7.7% in 2009. This impressive increase can be attributed to new polymer designs, combined with improved device engineering. As impressive as this increase is, it is the push towards a 15% efficient device that will have the impact required for the effective harvesting of solar energy. This increase will still require a continued effort towards new polymers, which act as the primary donor, but will also need a step towards new acceptors too. However, our knowledge of how the bulk heterojunction works is still in its infancy creating hurdles that we must overcome. It is this basic understanding that motivates the work that will be described. Few acceptors have proven to be as good as C60 or C70, and therefore this presentation will examine a number of new systems that will include molecules, quantum dots and single-walled carbon nanotubes. To examine their effectiveness as acceptors, results from studies using the electrodeless technique of transient microwave conductivity will be discussed and, where appropriate, a comparison with device performance will be examined.