Physical Chemistry Seminar

Tuesday, September 14, 2010 | **11:00 a.m.** | **Room 1315 Chemistry Building**

Pathways to More Efficient Organic Solar Cells: What We Can Learn by Watching Electrons Move in Real Time

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Organic solar cells are promising candidates for inexpensive photovoltaics for large area applications because they can be processed from solution using roll-to-roll technology. The efficiencies of current organic solar cells are limited by partial overlap with the solar spectrum and sub-optimal open-circuit voltage characteristics. Efforts to extend the absorption spectrum of organic solar cells into the near-infrared have produced many low band-gap polymers, but only certain 'magic' materials seem to produce more efficient devices. New understanding of the photophysics of many low band-gap polymers suggests that the efficiencies of the corresponding devices are limited by incomplete charge separation at electron donor/acceptor interfaces. To elucidate the origin of this limitation, we undertook a study of the dynamics of charge separation in a photovoltaic polymer blend consisting of the conjugated polymer, CN-MEH-PPV, blended with the electron accepting functionalized fullerene, PCBM, using ultrafast vibrational spectroscopy. We take advantage of a solvatochromic shift of the vibrational frequency of the carbonyl (C=O) stretch of PCBM to directly measure the rate of escape of electrons from their Coulombically bound charge transfer states. Our findings demonstrate that the efficiency of charge separation is determined by dynamic competition between electron propagation from charge separated states versus dissipation of excess energy in electronic/vibronic coordinates that results from donor-acceptor LUMO level offsets. These observations suggest that efforts to develop new low band-gap polymers for organic solar cells should target electron donor and acceptor pairs capable of advantageously redistributing excess energy to efficiently separate charge with minimal donor-acceptor LUMO level offsets.

Refreshments will be available prior to the seminar at 10:45 a.m. outside room 1315

Graduate Students and Post Docs may meet with the speaker at 1:00 p.m. in Room 8335