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Correlating Free-Carrier production in P3HT with Solid-State Microstructure using Time-Resolved Microwave Conductivity[1]

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The nature of the primary photoexcitation in conjugated polymers has been a subject of interest for a number of years, and two models have emerged: neutral excitons and free charge carriers. While excitons are recognized as the dominant of the two species, there are a small fraction of carriers that appear directly upon photoexcitation that have been detected experimentally either spectroscopically or through conductivity measurements. The fraction of near-instantaneous free charge carriers produced depends both on the chemical structure of the polymer and on the time-scale on which the study is performed. For example, poly(3-hexylthiophene) (P3HT) thin films have been reported to have free carrier yields as high as 15%, when measured on a fast time scale, but as low as 3% when measured on a slow time scale. It is unclear why these numbers are so different, and from where these carriers originate. This presentation will report studies using flash photolysis, time-resolved microwave conductivity (fp-TRMC) to probe carriers produced in a number of thin films of P3HT of differing molecular weights. By correlating the free carrier yield with the solid-state microstructure of the polymer, and the corresponding electronic absorption spectra, we will propose a model that explains the origins of these carriers.

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