

Ultrafast Localization of Photo-injected Charges by Alkyl Side Chains in Organic Semiconductors

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Organic electronics and photovoltaics suffer from low charge mobilities and an inability to disentangle morphological and molecular effects on charge transport. Specific chemical groups such as alkyl side chains are often added to enable spin casting and to improve over all power efficiency and morphologies, but their exact influence on mobility is poorly understood.

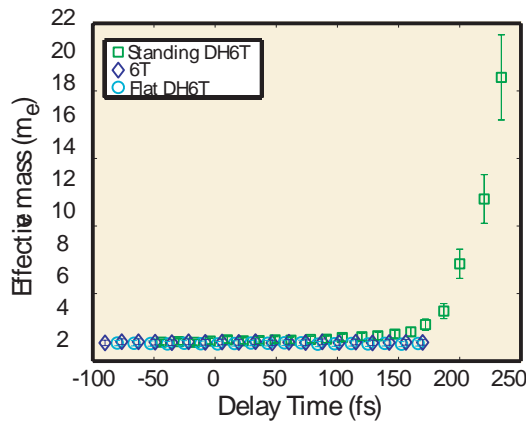


Figure 1: The effective mass of an electron is shown as a function of time in three systems. The standing layer of dihexyl-sexithiophene is found to affect a rapid increase in effective mass.

Here we use two photon photoemission spectroscopy to study the charge transport properties of the image potential state in two organic semiconductors, both with and without alkyl substituents (sexithiophene and dihexyl-sexithiophene). We show that the hydrocarbon side chains are responsible for localizing electrons within 220 fs. The localization is measured directly by following the dynamic increase in effective mass of a free electron (see Fig. 1). This implies that charge transport in alkyl containing organic semiconductors will be fundamentally limited by their side chains. We suggest that molecules which are solution processable without alkyl units may make more efficient transistors and photovoltaics.