USING TIME-RESOLVED THZ SPECTROSCOPY TO STUDY CARRIER INJECTION AND DYNAMICS IN TIO_2 AND SNO_2 NANOMATERIALS

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Charge injection from a variety of porphyrin-based dyes bound to TiO_2 and SnO_2 has been measured. The time scales and efficiencies are interpreted in terms of the identities (singlet vs. triplet) and energetics of excited electronic states. In addition, we have characterized the time-dependent conductivity after photoexcitation of dye-sensitized TiO_2 nanotubes. It had been hoped that nanotubes would overcome low electron mobilities found in TiO_2 nanoparticle films because the nanotubes can be many tens of microns long. However, recent macroscopic measurements found electron transport through nanotube and nanoparticle films to be comparable. Here we show that low electron mobility in polycrystalline TiO_2 nanotubes is not due to scattering from grain boundaries but instead due to traps that manifest themselves in a single sharp resonance in the THz spectrum. The TiO_2 nanotube spectra are fundamentally and qualitatively different than that for nanoparticles or the bulk material.

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