Dynamical Effects of Doping in Single Wall Carbon Nanotube Solutions and Films

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We report a transient absorption (TA) study of doping in single-walled carbon nanotube (SWNT) films and solutions. An aqueous solution of pulsed laser vaporization SWNTs were spray-deposited to form films; the films were soaked in a solution of nitric acid, which collapsed them through removal of the surfactant. The nitric acid treatment induces p-type doping by protonation, and suppresses the lowest energy semiconducting (E1) optical absorption. Photo-exciting at 1215 nm and probing at the E1 peak yielded a strong photoinduced absorption (PA). De-doping the film by heating to 250°C for 30 minutes recovered the E1 linear absorption feature and converted the transient PA to a photoinduced bleach (PB). Films heated in air re-dope within a day in laboratory air, while films heated in nitrogen resisted re-doping under ambient laboratory air. Solution measurements involving oxygenated and deoxygenated solutions and different surfactants indicate the doping depends strongly on adsorbed molecular oxygen.

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