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Stability of Excitons in Carbon Nanotubes under High Laser Excitations G.N. OSTOJIC, S. ZARIC, J. KONO, Dept. of Elec. & Comp. Engineering, Rice Univ., V.C. MOORE, R.H. HAUGE, R.E. SMALLEY, Chemistry Dept., Rice Univ. — The behavior of excitons and free carriers strongly depends on the carrier density. In 3-D and 2-D solids, increasing the number of carriers reduces the exciton binding energy via screening, and when the average separation reaches the Bohr radius, a transition from an excitonic insulating state to a conducting electron-hole (e-h) plasma occurs (i.e., the Mott transition). However, the unique nature of 1-D Coulomb interaction may alter this scenario. We have used nondegenerate pump-probe spectroscopy with a widely tunable pump and a white light continuum probe to monitor the behavior of excitons in single-walled carbon nanotubes for different carrier densities. In addition to already known band filling effects, broadening of absorption peaks is identified from complex, spectrally dependent pump-probe signals including both photo-induced absorption and bleaching. From the excitation conditions, we estimate that the average 1-D density of the photo-excited e-h pairs is in the order of the Mott density. However, throughout the observed time range, covering both high and low density regimes, the positions of E_{11} absorption peaks are unchanged. This stability of excitons is similar to excitons in GaAs quantum wires and thus indicates a unique property of 1-D solids.

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