Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Free Carrier Auger Relaxation of Excitons in Carbon Nanotubes

JESSE KINDER, EUGENE MELE, University of Pennsylvania — We study a relaxation pathway in doped carbon nanotubes in which optically pumped excitonic states interact with free electrons or holes through an Auger process. The exciton recombines nonradiatively, transferring its energy and momentum to a free carrier. The calculated decay rate depends on temperature, exciton density, and the amount of doping. For optically excited bright excitons, conservation of energy and momentum forbid this decay below a critical doping density. For the heavier dark excitons, recombination is allowed for any nonzero doping density. By studying the phase space for this Auger process and exciton-exciton annihilation, we find that the free carrier interaction can dominate the relaxation rate at low exciton densities.

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Date submitted: 27 Nov 2007 Electronic form version 1.4