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Study of free carrier recombination in carbon nanotubes photovoltaic materials MENG-YIN WU, THOMAS MCDONOUGH, MATTHEW SHEA, YUMIN YE, MARTIN ZANNI, MICHAEL ARNOLD, Univ of Wisconsin, Madison — Semiconducting single-walled carbon nanotubes are promising photoabsorbers for future solar cells and photodetectors. Previously, we have put nanotubes in contact with electronegative accepting semiconductors such as C60-fullerenes, which spontaneously drive photoexcited electron transfer from the nanotubes to the C60. One important part of making efficient CNT/C60 photovoltaics is that the free carrier lifetime has to be longer than the charge collection time. Here, we analyze CNT/C60 planar heterojunction devices for simplicity to study the free carrier recombination lifetime. We use three measurements: photocurrent-voltage characteristics, photovoltage decay following transient optical excitation, and simple charge extraction to determine how charge density and lifetime are interrelated and how they vary under different illumination intensities. These dependencies also allow us to uncover recombination mechanisms. The results showed the free carrier lifetime decays from 130 us to 280 ns as the free carrier density increases from 3.4E13 cm^{-3} to 1.3E17 cm^{-3}, with a power law dependence. These measurements of free carrier lifetime and concentration will help us in future investigations and modeling of the C60-nanotube heterointerface.

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