Abstract Submitted
for the TSF15 Meeting of
The American Physical Society

Variation of optical properties of single-walled carbon nanotubes with length[1] ANTON NAUMOV, Texas Christian University, DMITRI TSYBOULSKI, SERGEI BACHILO, R. BRUCE WEISMAN, Rice University — The length dependence of the optical properties of single-walled carbon nanotubes (SWCNTs) was studied in bulk dispersions length-fractionated by electrophoretic separation or ultrasonication-induced scission. Fractions ranged from 120 to 760 nm in mean length. After shortening SWCNTs by timed ultrasonic treatment, their absorption was found constant within 11 percent as average nanotube length changed by a factor of 3.8. This indicates that the absorption cross-section per carbon atom is not length-dependent. By contrast, in length fractions prepared by both fractionation methods, the fluorescence efficiency and average quantum yield increased with average SWCNT length, approaching an asymptotic limit of 1 micrometer. This is interpreted as reflecting the combined contributions of exciton quenching by sidewall defects and by the ends of shorter nanotubes. Mathematical modeling of the quantum yield based on the experimentally found parameters and only nanotube end defects suggested a mean exciton excursion range of 50 nm. This is significantly below the 90-200 nm exciton excursion ranges found previously for individual, nearly-pristine SWCNTs that are expected to have lower defect density than typical processed SWCNTs.

[1]Variation of optical properties of single-walled carbon nanotubes with length

Anton Naumov
Texas Christian University

Date submitted: 05 Oct 2015 Electronic form version 1.4