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Revisiting length-dependent Raman spectroscopy of single-wall carbon nanotubes using single chirality, length-refined populations YANMEI PIAO, STEPHANIE LAM, ANGELA HIGHT WALKER, JEFFREY FAGAN, National Institute of Standards and Technology (NIST) — As-synthesized, single-wall carbon nanotube (SWCNT) populations contain a wide variety of diameter and length nanotubes. This structural diversity with its accompanying property variation, especially in optical properties, provides a great challenge to application and characterization for these materials. Given the tremendous effort to understand the diameter-dependent optical properties of SWCNTs, it is perhaps surprising that little recent work has re-examined the consequences of length, a correspondingly important factor in terms of characterization, to our understanding of the science. Early work demonstrated that for SWCNTs of mixed chirality, the variation in length drove a degradation at short lengths in the optical responses. Since then, identification that morphological impurities and defect density were highly correlated with length in singly sorted samples prompted a reexamination of those results. In this work we probe the length-dependent optical properties of SWCNTs using extremely high-quality SWCNT populations based on multiple aqueous-two-phase separations followed by size exclusion chromatography length-separations. Our results reveal significant and varying dependencies on properties including the G peak intensity and D/G ratio as measured by resonant Raman spectroscopy with the length of single species SWCNT populations, and in other optical properties including absorption and fluorescence.

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