Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Optical Properties of Empty and Water-Filled Single-Wall Carbon Nanotubes J.R. SIMPSON, Towson University, J.A. FAGAN, J.Y. HUH, A.R. HIGHT WALKER, National Institute of Standards and Technology, J.L. BLACKBURN, B.A. LARSEN, J. HOLT, National Renewable Energy Laboratory — The necessity for separation of single-wall carbon nanotube (SWCNT) populations to achieve desired properties presents a major technical barrier for the development of SWCNT-based applications, and has been the focus of significant academic and industrial research. Recent advances include the separation of SWCNT populations by diameter through buoyancy differences. Here we report on the optical spectroscopic properties of large diameter SWCNTs synthesized by laser ablation and electric arc methods and then separated by centrifugation to produced isolated bands of empty and water-filled nanotubes. This separation is consistent across multiple nanotube populations dispersed from different source material. Optical absorption, near-infrared fluorescence, and Raman spectroscopic measurements of the resulting empty and filled fractions reveal that water filling leads to systematic changes in the optical properties. Specifically, the peak locations in absorbance and fluorescence display red-shifts with the presence of water in the nanotube cavity and a hardening of the Raman radial breathing modes. The presence of water in the SWCNT interior is found to facilitate the subsequent separation into sub-populations of metallic and semiconducting SWCNTs.

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Date submitted: 29 Nov 2010 Electronic form version 1.4