

Analysis of Single Walled Carbon Nanotubes with the Dimension-P2, Laser Attenuation and Z-axis Positioning Modules

Single walled carbon nanotubes (SWNT) are allotropes of carbon, graphene, one-atom thick rolled up into a seamless cylinder with diameters of a nanometer. SWNT's have novel properties of strength and conductivity with applications ranging from material science to optics to microelectronics. The symmetry and unique electronic structure of graphene strongly affects its electrical properties that can be metallic or semiconducting. In fact metallic carbon nanotubes have a current density 1000 times that of silver or copper. A key issue in the production of SWNT's is the monitoring of the structural symmetries in order to control the various properties. Key measures of these structural elements are the radial breathing modes (RBM) that affect chirality and the C-C translation or G mode in the graphite plane

Raman spectroscopy is an effective means of analyzing single walled carbon nanotubes, however, much of the research has employed research grade instrumentation impractical and cost prohibitive for production and quality control purposes. Lambda Solutions has developed a low cost Raman system that gives rapid analysis of nanotube structure and permits the monitoring of nanotube production and purification.

Figure 1

**Dimension-P2 Spectrum of Single-Walled Nanotube
One Second Spectrum at 1mW 785nm Laser Power**

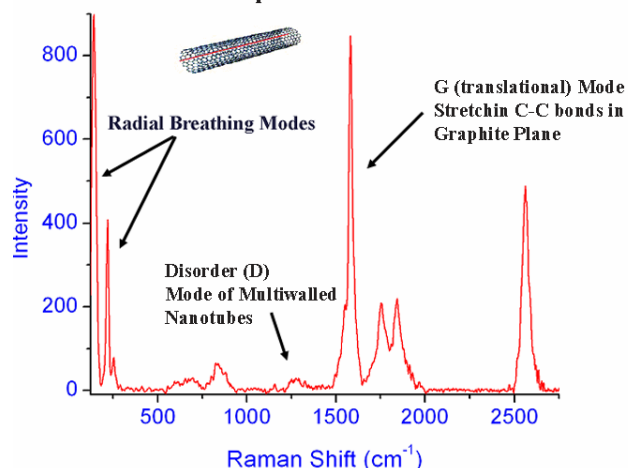


Figure 2 illustrates the power of this methodology for monitoring nanotube production and purification. As a result of the successive purification steps the nearly 5-fold enrichment of a nanotube preparation is clearly defined for the Raman peaks for RBM & G modes and even the much lower intensity D mode frequency.

Using the compact LSI Dimension-P2 equipped with 785nm laser, a micrometer-stage mountable LSI Raman Vector Probe for exact surface sampling and a customized laser beam attenuator, we demonstrate quality spectra of carbon nanotubes. Figure 1 illustrates one second spectrum of a purified SWNT at 1 mW laser power that delineates RBM's between 140-210 cm⁻¹ and the G mode near 1620 cm⁻¹.

Figure 2

**Crude SWNT Preparation
Partially Purified SWNT Preparation**

