# Optical Spectroscopy of (6,5) Carbon Nanotubes Sorted by Density Gradient Ultracentrifugation

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We present a protocol to selectively isolate single-walled carbon nanotubes (SWNTs) with a chirality of (6,5) using density gradient ultracentrifugation (DGU)[1]. Starting with SWNTs synthesized by the alcohol catalytic chemical vapor deposition (ACCVD) method, we used sodium deoxycholate (DOC), sodium dodecyl sulfate (SDS) and sodium cholate (SC) as co-surfactant encapsulating agents[2] to isolate (6,5) SWNTs. In addition to observation by transmission electron microscopy (TEM), the high purity of (6,5) SWNTs was shown by various spectroscopic methods, such as optical absorbance, photoluminescence excitation (PLE), and resonance Raman spectra (RRS, 488 nm laser excitation) . Evaluation before and after DGU process revealed that the resulting sample contained a high concentration of (6,5) SWNTs, but other chiralities were also present at low concentrations. Unlike previous studies[1] using CoMoCAT SWNTs—of which (6,5) SWNTs are known to be one of the dominant chiral species—this effective extraction of a minority fraction of the pristine sample clearly shows the efficient chirality-selection by this dispersion process, without the existence of metallic nanotubes. This illustrates the potential for complete isolation, which we hope to achieve by further refinement of this process.

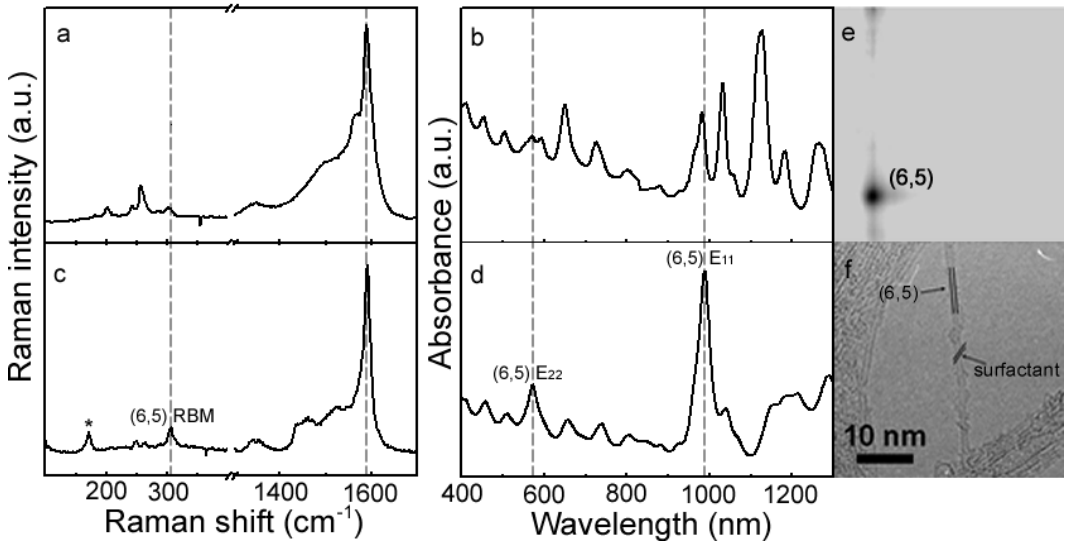


Figure 1: Optical spectroscopy showing the selective isolation of (6,5) SWNTs from ACCVD SWNTs by density gradient ultracentrifugation. (a) Resonance Raman spectra (b) Optical absorbance of pristine ACCVD SWNTs; (c) Resonance Raman spectra (d) Optical absorbance (e) Photoluminescence excitation map (f) TEM image of isolated (6,5) SWNTs after DGU process.

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[2] K.Yanagi, Y. Miyata and H.Kataura, *Appl. Phys. Express* **1**, 034003 (2008)

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