

Supplementary

Chirality control for predominant metallic or semiconducting single-walled carbon nanotubes prepared using a mild etchant

Sook Young Moon^{1,*} and Woo Sik Kim²

^aInstitute of Advanced Composite Materials, Korea Institute of Science and Technology (KIST), Chudong-ro 92, Bongdong-eup, Wanju-gun, Jeonbuk 55324, Republic of Korea

^bCeramic Fiber & Composite Center, Korea Institute of Ceramic Engineering & Technology, 101 Soho-ro, Jinju-si, Gyeongsangnam-do 52851, Republic of Korea

Experimental

SWCNTs were synthesized via the FC-CVD method using methane as a carbon source, ferrocene as a catalyst precursor, sulfur as a promoter, He and H₂ as carrier gases, and acetone as an etchant. The ferrocene and sulfur powders were mixed by ball milling for 24 h to obtain a homogeneous compound. We used a horizontal tube furnace with two hot zones. The mixed catalyst powder (5 wt%) was placed at the upstream hot zone of a quartz tube reactor, and the temperature was increased to 100 °C. The downstream hot zone was increased to 1100 °C simultaneously. The catalyst sublimated and was transported into the reaction zone by the He–H₂ carrier gas. At the same time, methane and acetone flow were introduced as a carbon source and an etchant. The as-synthesized SWCNTs were carried downstream in the quartz tube reactor. After 30 min of the SWCNT growth process, the furnace was allowed to cool naturally to room temperature under flowing He.

The morphologies of the CNTs were observed by field-emission scanning electron microscopy (FE-SEM, Verios 460, FEI, USA) and field-emission transmission electron microscopy (FE-TEM, Tecnai G2 F20, 200 kV, USA). The crystalline characteristics of the CNTs were analyzed by Raman spectroscopy (Renishaw, In Via, excited by a 514 nm, 785 nm laser; Horiba, LabRam Aramis, excited by a 633 nm laser).

For optical absorption measurements, 0.5 mg of SWCNTs were dispersed homogeneously into 5 ml of D₂O (99.9 atom%, Sigma-Aldrich) containing 1 wt% sodium dodecyl benzene sulfonate (SDBS, 99%, Sigma-Aldrich) as a surfactant under 20°C. The black suspension was centrifuged at 10,000 rpm for 20 min, and the upper supernatant was carefully decanted and analyzed by ultraviolet–visible–near-infrared (UV–vis–NIR) spectroscopy (UV 670, JASCO, Japan).

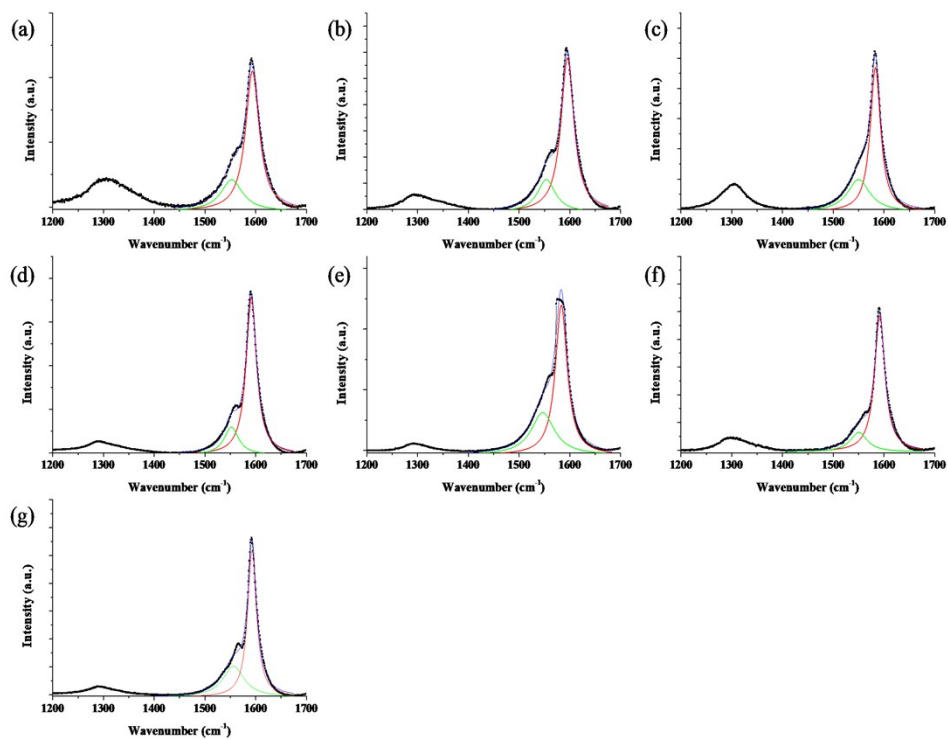


Fig. S1. Raman spectra of SWCNTs prepared with various amounts of acetone; (a) 0sccm, (b) 5sccm, (c) 10 sccm, (d) 20 sccm, (e) 50 sccm, (f) 70 sccm, and (g) 100 sccm.

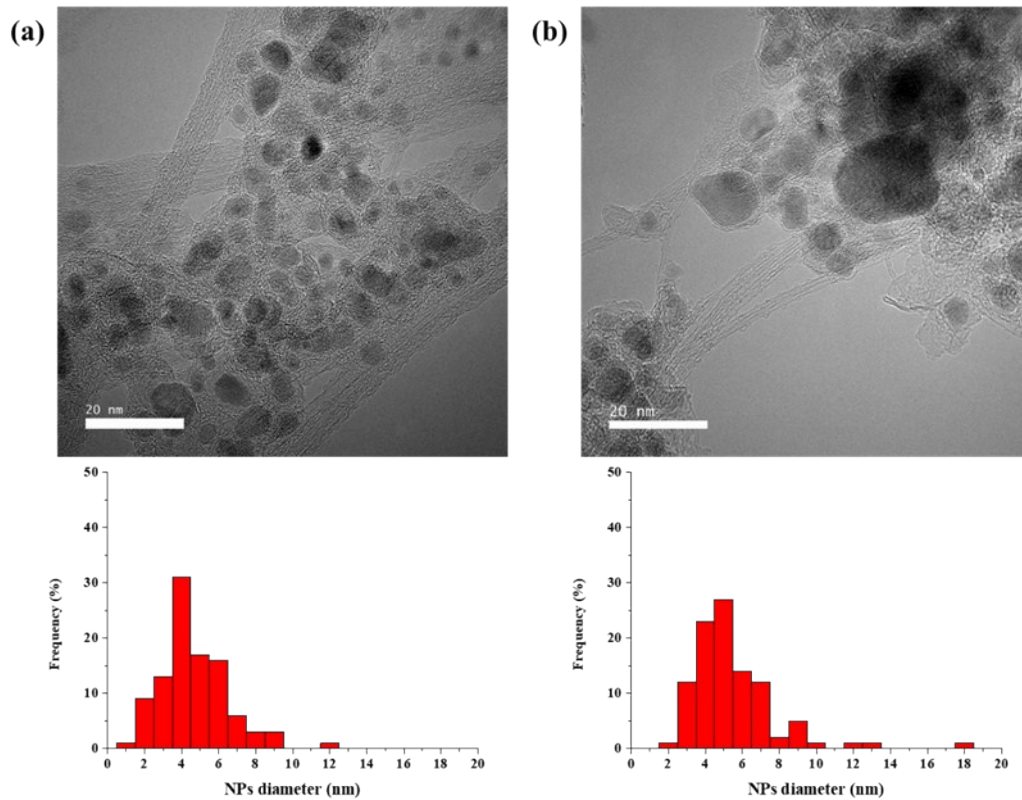


Figure S2. The diameters of the catalyst particles prepared with(a) and without(b) acetone

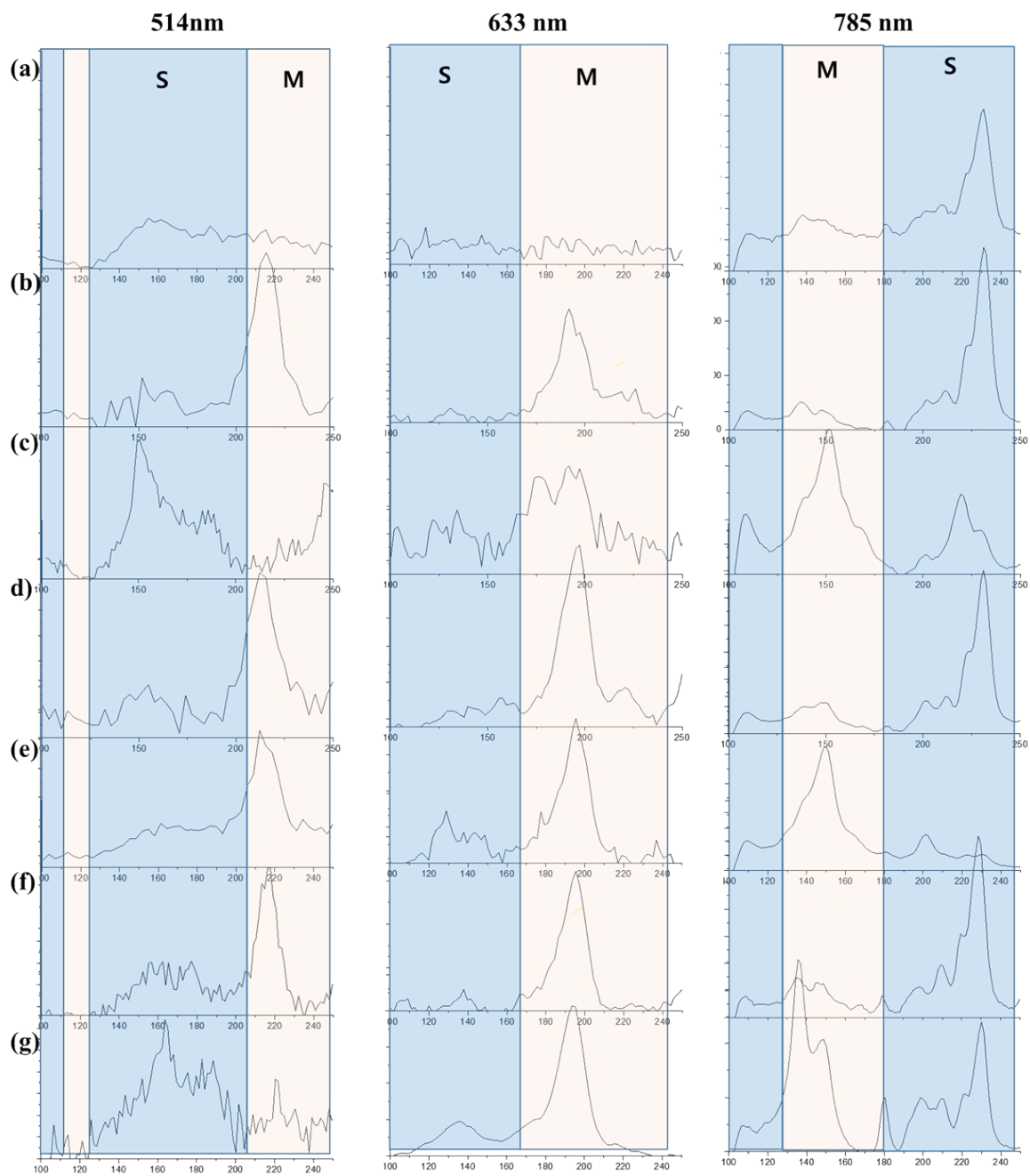


Figure S3. RBM spectra of SWCNTs prepared with various amounts of acetone; (a) 0sccm, (b) 5sccm, (c) 10 sccm, (d) 20 sccm, (e) 50 sccm, (f) 70 sccm, and (g) 100 sccm.