

Electronic Supplementary Material (ESI) for Analytical Methods

Quantitative Analysis of the Effect of Reabsorption on the Raman

Spectroscopy of Distinct (*n, m*) Carbon Nanotubes

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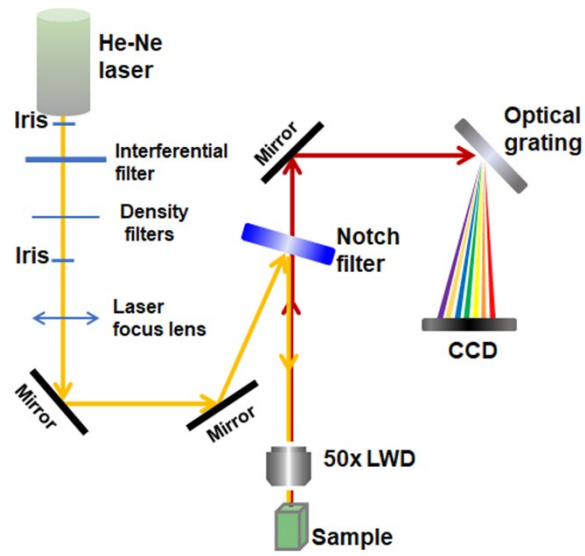


Fig. S1 Schematic diagram of full higher-resolution confocal micro-Raman measurement setup.

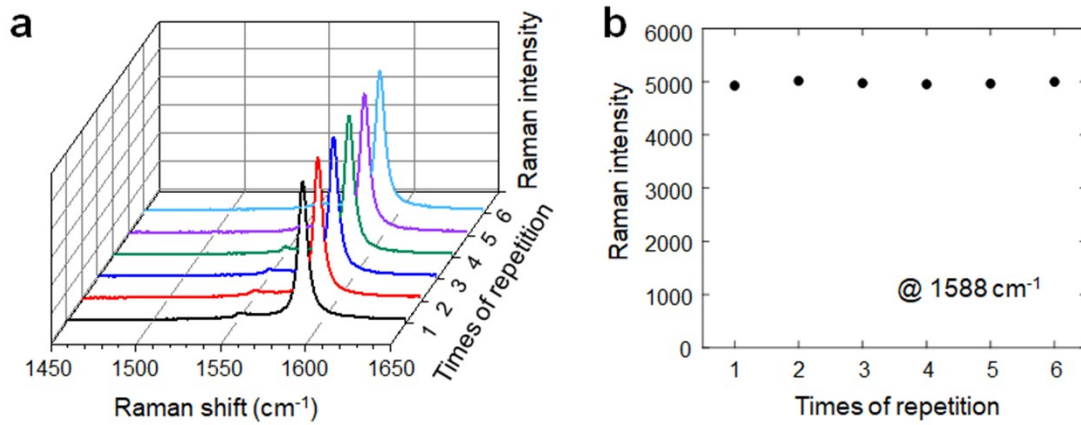


Fig. S2 (a) Raman spectra of (10, 3) SWCNT solution repeatedly measured six times with the same SWCNT solution and at the same depth excited by 633 nm laser. (b) Plot of G⁺ band intensities (1588 cm⁻¹) as a function of measurement repetitions, which shows a good stability for the detected Raman spectra of the SWCNT solution sealed in a cuvette.

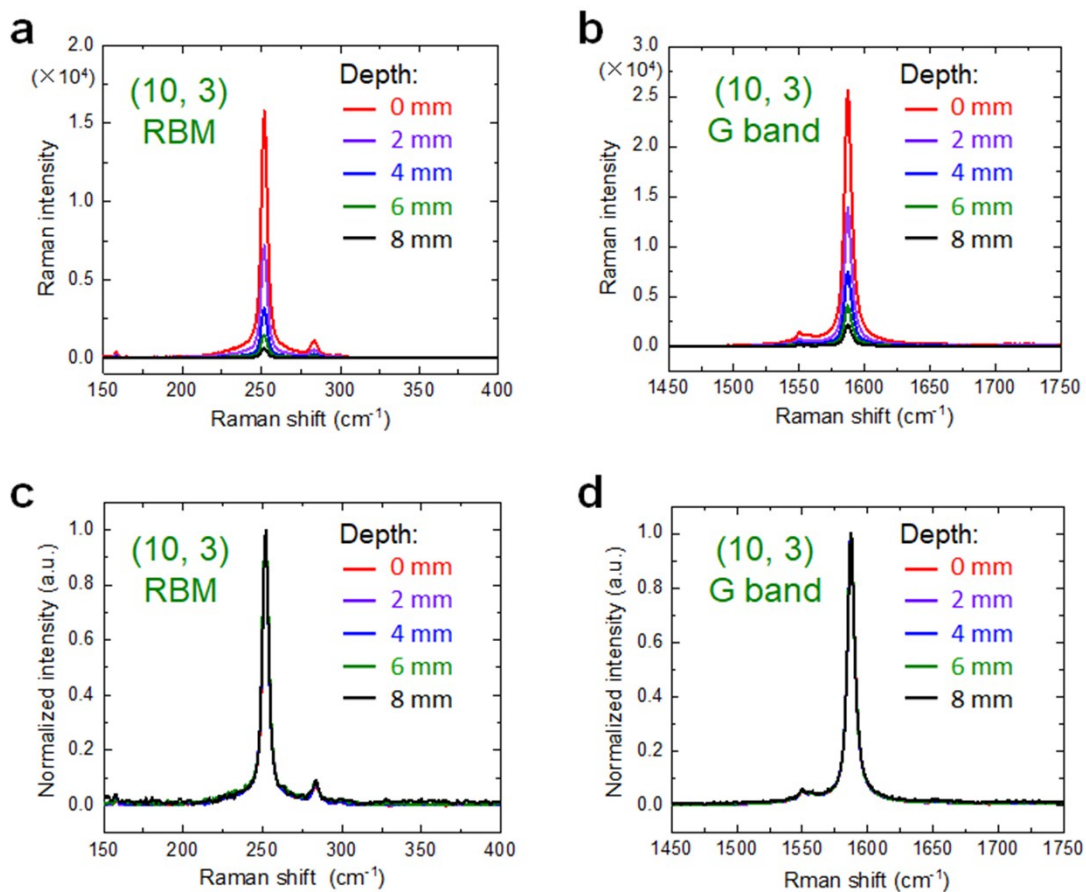


Fig. S3 (a, b) Raman spectra of RBM (a) and G band (b) of (10, 3) SWCNT solution measured under different focal depth (0, 2, 4, 6, and 8 mm). (c, d) Normalized Raman spectra of RBM (c) and G band (d) corresponding to (a) and (b) for observation of spectral shape. The normalized Raman spectra reveal the spectral shape did not change with varying the detection depth.

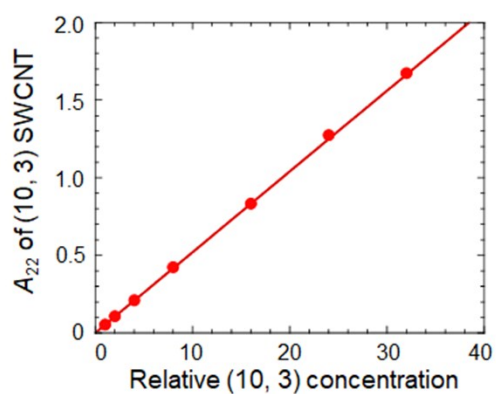


Fig. S4 Plot of absorbance at E_{22} (A_{22}) of (10, 3) SWCNT, as a function of the relative (10, 3) concentration converted from the dilution time, which reveal the optical absorbance have a linear relationship with the concentration of SWCNTs in solution. Red straight line indicates the fitting results.

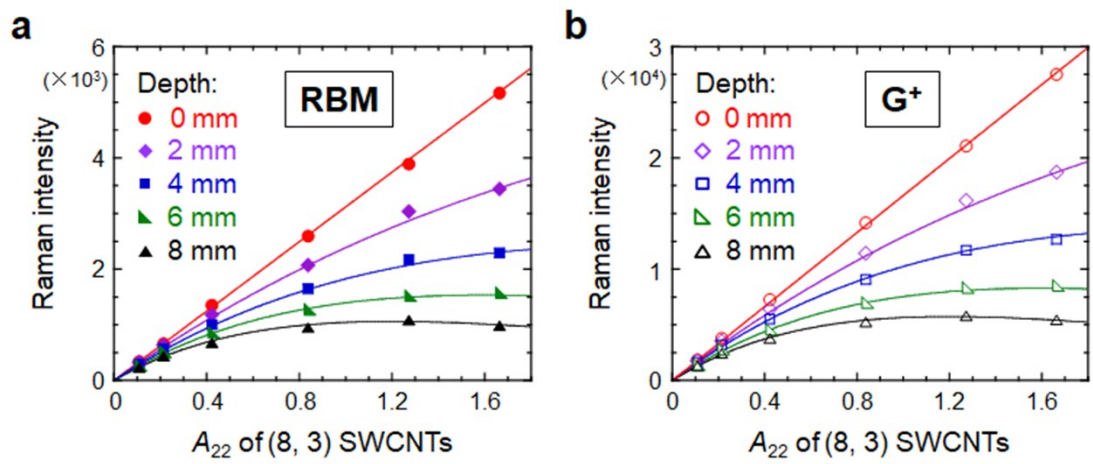


Fig. S5 (a, b) Plots of the observed maximum Raman intensities for RBM (a) and G^+ band (b), as a function of the concentration (A_{22}) of (8, 3) SWCNT solution under depth = 0, 2, 4, 6, and 8 mm. Color curves indicate the fitting results based on Eq. (11).

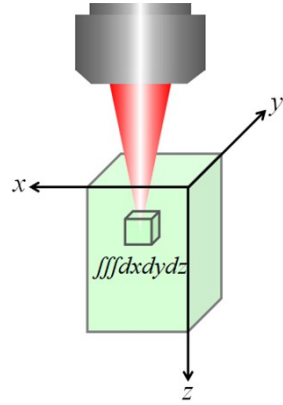


Fig. S6 Geometric model of the focusing volume (denoted as $\iiint dx dy dz$).

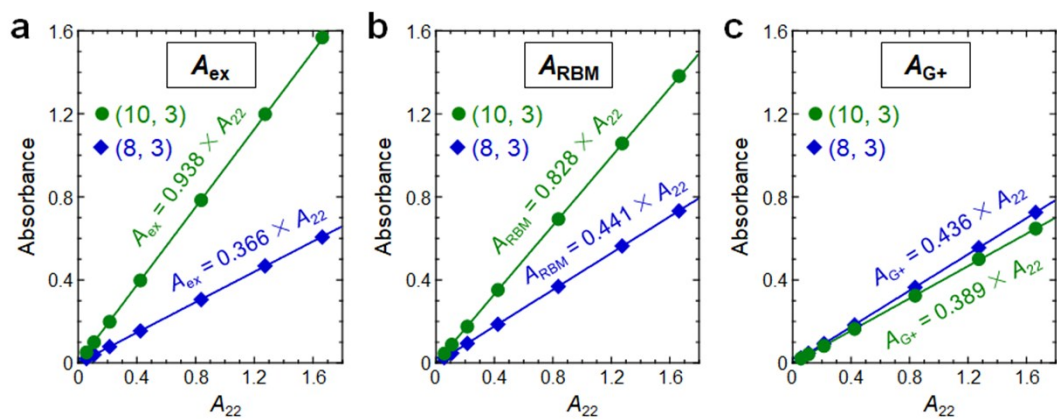


Fig. S7 (a-c) Plots of A_{ex} (a), A_{RBM} (b), and A_{G+} (c) as a function of A_{22} for (10, 3) (green dots) and (8, 3) (blue squares) SWCNT solutions. Green and blue straight lines indicate the fitting results.

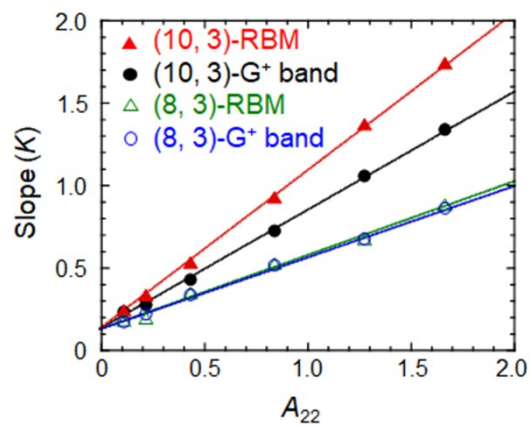


Fig. S8 Plots of slope for RBM and G⁺ band of (10, 3) and (8, 3) SWCNTs, as a function of the concentration (A_{22}) of SWCNTs, respectively.

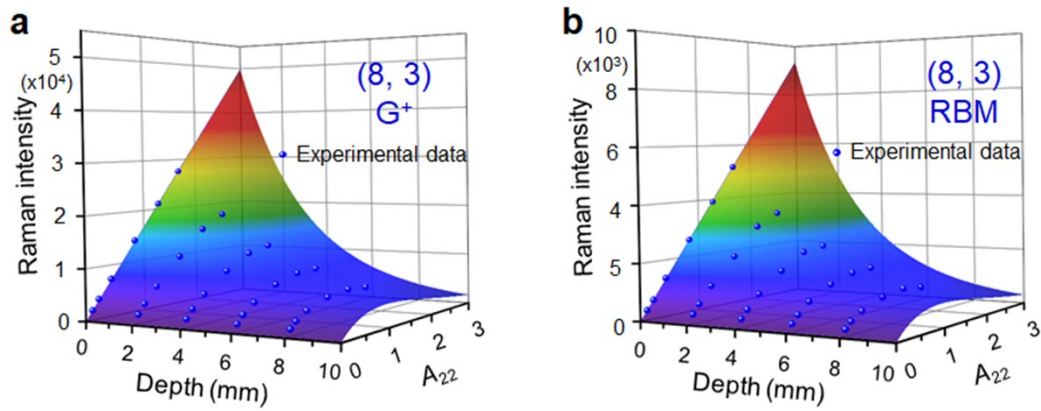


Fig. S9 (a, b) Simulated three-dimensional diagrams of G⁺ band (a) and RBM (b) intensities of (8, 3) SWCNTs as a function of the focal depth and SWCNT concentration (A₂₂). Blue dots indicate the experimental data for comparison.

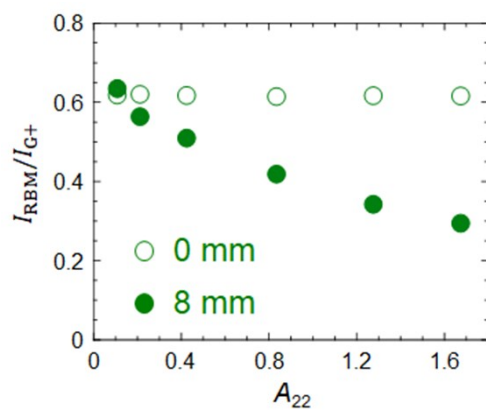


Fig. S10 Plots of the experimentally observed Raman intensity ratio of $I_{\text{RBM}}/I_{\text{G}^+}$ measured at depth = 0 mm (open circles) and 8 mm (solid circles), respectively, as a function of the concentration (A_{22}) for (10, 3) SWCNT solutions.

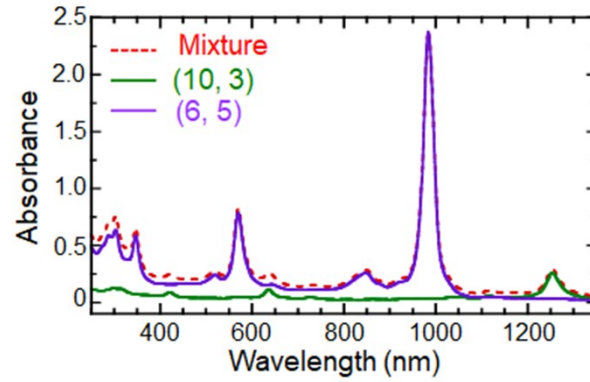


Fig. S11 Optical absorption spectra of (6, 5) SWCNT solution (purple curve), (10, 3) SWCNT solution (green curve) and their mixture solution (red dashed curve). The pure (6, 5) and (10, 3) SWCNT solutions were prepared by diluting the original (6, 5) and (10, 3) SWCNT solutions with DOC solution to the same concentration as the mixture solution.

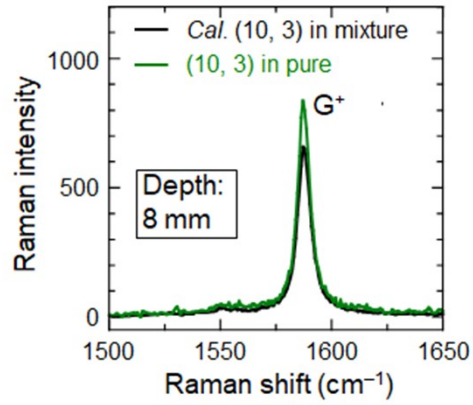


Fig. S12 Calculated Raman spectrum (black curve) corresponding to G band region contributed by (10, 3) SWCNTs in the mixture at the depth of 8 mm. Measured G-band spectrum (green curve) of pure single-chirality (10, 3) SWCNT solution with the same (10, 3) SWCNT concentration measured at the same depth.

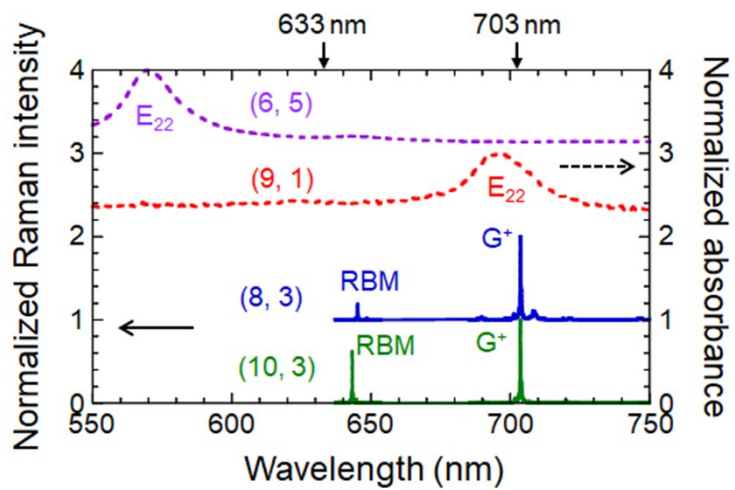


Fig. S13 Normalized Raman spectra of (8, 3) (blue solid curve) and (10, 3) (green solid curve) SWCNT solutions, and optical absorption spectra of (6, 5) (purple dashed curve) and (9, 1) (red dashed curve) SWCNT solutions.

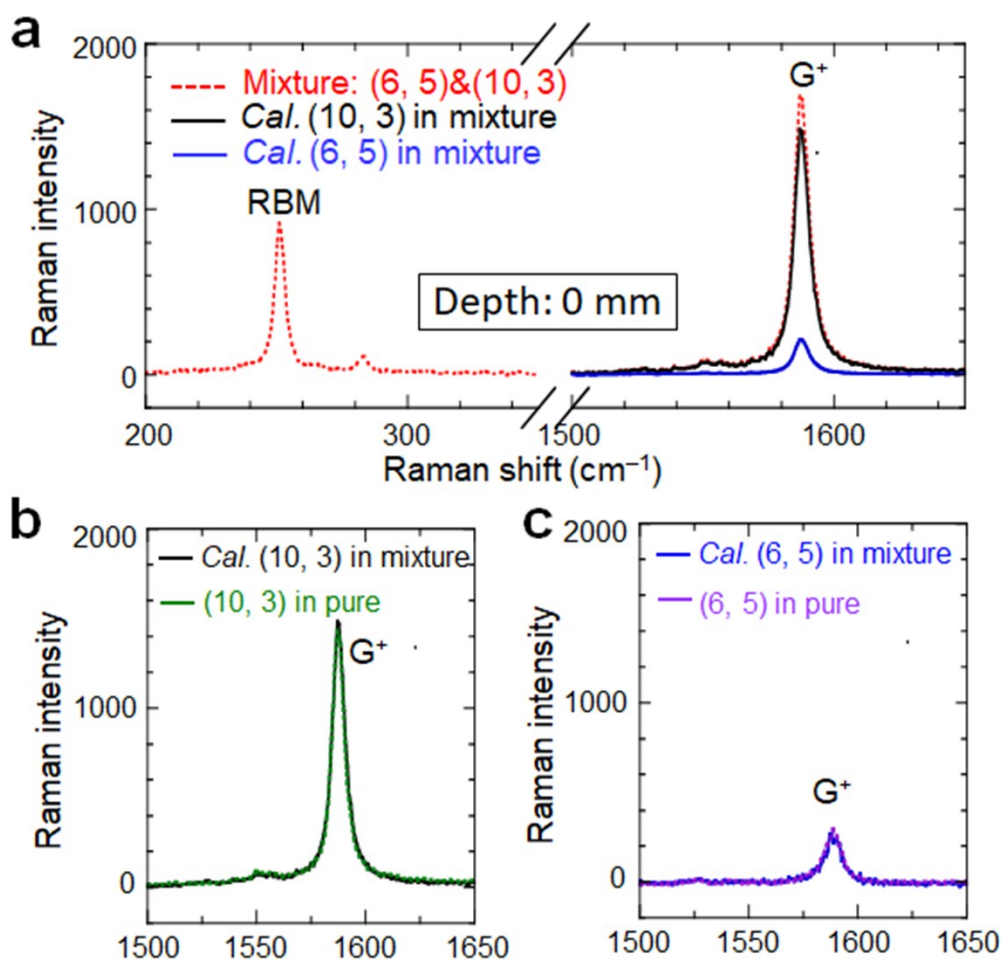


Fig. S14 (a) Analysis of Raman spectra of the mixture solution of (10, 3) and (6, 5) SWCNTs at an excitation wavelength of 633 nm under the focal depth of 0 mm. Red dashed curve represents the measured Raman spectrum of the mixture of (10, 3) and (6, 5) SWCNTs, black and blue solid curves represent the calculated Raman spectra corresponding to G band region contributed by (10, 3) and (6, 5) SWCNTs in the mixture, respectively. (b) Raman spectra corresponding to G band region contributed by (10, 3) SWCNTs in the mixture (black curve) and by (10, 3) SWCNTs in pure (10, 3) solution (green curve). (c) Raman spectra corresponding to G band region contributed by (6, 5) SWCNTs in the mixture (blue curve) and by (6, 5) SWCNTs in the pure single-chirality (6, 5) solution (purple curve).