Supplementary Information

Ethanol-Assisted Gel Chromatography for Single-Chirality

Separation of Carbon Nanotubes

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Figure S1. Normalized optical absorption spectra corresponding to the spectra in Figure 1a. All spectra are normalized at S_{11} peaks (800-1300 nm) in near infrared region and offset vertically for comparison.



Figure S2. Photoluminescence (PL) contours of the fractions corresponding to those in Figure 1.



Figure S3. Optical absorption spectra of the nanotube fractions adsorbed onto the gel by loading a SWCNT/2 wt % SDS dispersion to a gel column under different ethanol contents ranging from 7 to 15% (v/v). The spectra shift vertically for comparison. We can observe that the optical absorption peaks in S_{11} (800-1300 nm) and S_{22} (500-800 nm) regions disappeared with increasing the ethanol content to higher than 10% (v/v). The colour of the gel column did not change after loading the SWCNT dispersion. These results indicate that most of the loaded SWCNTs lost their adsorbability onto the gel and passed directly through the gel column under high-concentration ethanol in the SWCNT dispersion.



Figure S4a. Purity evaluation of nanotubes using absorption spectra and spectral simulations. Line color: (6, 5): olive; (7, 5): violet; (7, 6) and (8, 4): orange.



Figure S4b. The relative abundances of the (6, 5); (7, 5); and (7, 6) + (8, 4) species in the adsorbed SWCNT fractions as a function of ethanol contents, which were calculated based on the spectra in Figure 1a and S4a. The relative abundance of each kind of SWCNTs was expressed as the ratio of their absorption peak area to the sum of all the absorption peak areas in near-IR optical absorption spectra. Notably, since the absorption peak positions of the (7, 6) and (8, 4) nanotubes are very close, it is difficult to accurately perform the peak fitting to isolate them and thus we used the area of their superposed peak at about 1119 nm to calculate their relative abundance.



Figure S5. Optical absorption analysis of the adsorbability of SWCNTs onto a gel column under different ethanol contents in a SWCNT solution by loading 2.5-ml aliquots of the SWCNT/1 wt % SDS dispersion with various ethanol contents to a gel column packed with 6 ml of gel beads, respectively. (a) The adsorbed fractions, and (b) the corresponding flow-through fractions. The spectra shift vertically for comparison. The SWCNT/1 wt % SDS dispersion with various ethanol contents was prepared by adding pure ethanol to 0.25-ml parent SWCNT dispersion while maintaining a constant SDS concentration at 1 wt %. As shown in (a), with increasing the ethanol content, the adsorbability of the nanotubes onto the gel decreases gradually in the sequence of diameters from larger to smaller, which could be observed clearly from their normalized spectra in Figure S6. Moreover, through a comparison between panels a and b, we uncover that those nanotubes losing the adsorbability are present in the flow-through fractions, barring the quantity of the irreversibly adsorbed nanotubes.



Figure S6. Normalized absorption spectra correspond to the spectra in Figure S5a. All spectra are normalized at S_{11} peaks and shift vertically for comparison. Comparing with the data in Figure S1, the selectivity in diameters here is weaker, which might be attributed to a stronger interaction of each (*n*, *m*) SWCNTs with the gel at a lower SDS concentration.



Figure S7. Schematic diagram of the ethanol-assisted gel chromatography.





Figure S8. Photoluminescence (PL) spectral analysis of the separated nanotubes by stepwise elution. (a) Pristine HiPco-SWCNTs; (b-e) several separated nanotube fractions corresponding to those in Figure 2 under different SDS concentrations. The SDS concentrations and ethanol contents in the eluents are (b) 2 wt % SDS, 6% (v/v) ethanol; (c) 2 wt % SDS, 7.5% (v/v) ethanol; (d) 1.5 wt % SDS, 6% (v/v) ethanol; and (e) 1 wt % SDS, 8% (v/v) ethanol, respectively.



Figure S9. The original absorption spectra correspond to those in Figure 2. All spectra shift vertically for comparison.



Figure S10. Photoluminescence (PL) contours of the adsorbed nanotubes under different SDS concentrations. (a) 2.5 wt % SDS, (b) 2 wt % SDS.



Figure S11. The original absorption spectra correspond to those in Figure 5a and b, shifting vertically for comparison.



Figure S12. Absorption spectra of the nanotube fractions eluted by an ethanol-contained SDS eluent (red line) and a 5-wt % SDS eluent (black line), respectively. The components of each eluent are indicated. The loaded nanotube solution was prepared by dispersing HiPco-SWCNTs in an aqueous solution of 1 wt % SDS. It is visible that the two spectra of the nanotube fractions eluted by the ethanol-contained SDS eluent and the 5-wt % SDS eluent well overlap, indicating the desorption ability of the ethanol-contained eluent is comparable to that of the 5-wt % SDS eluent.



Figure S13. Optical absorption spectra of supernatants of the nanotube fractions collected by the ethanolcontained eluent and 5-wt % SDS solution after staying for 60 days and subsequently centrifuging at 210 000 × g for 30 min. The supernatants in panel (a) are obtained from the fractions in Figure 6(a), while the supernatants in panel (b) are from the fractions in Figure S12. The components of each eluent are indicated. Centrifugation is used to remove the bundles in the fractions. From the two panels, it is clear that the intensities of the optical absorption spectra for the nanotube fractions eluted by the ethanol-contained SDS eluents are higher than those eluted by the 5-wt % SDS eluent, indicating that fewer SWCNT bundles are present in the fractions collected by the ethanol-contained eluents after staying for 60 days.