# Enantiomeric Separation of Semiconducting Single-Walled Carbon Nanotubes by Acid Cleavable Chiral Polyfluorene

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Helical wrapping by conjugated polymer has been demonstrated as a powerful tool for the sorting of single-walled carbon nanotubes (SWCNTs) according to their electronic type, chiral index, and even handedness. However, a method of one-step extraction of left-handed (M) and right-handed (P) semiconducting SWCNTs (s-SWCNTs) with subsequent cleavage of the polymer has not yet been published. In this work, we designed and synthesized one pair of acid cleavable polyfluorenes with defined chirality for handedness separation of s-SWCNTs from as-produced nanotubes. Each monomer contains a chiral center on the fluorene backbone in the 9-position, and the amino and carbonyl groups in the 2- and 7-positions maintain the head-to-tail regioselective polymerization resulting in polyimines with strictly all-(R) or all-(S) configuration. The obtained chiral polymers exhibit a strong recognition ability toward left- or right-handed s-SWCNTs from commercially available CoMoCAT SWCNTs with a sorting process requiring only bath sonication and centrifugation. Interestingly, the remaining polymer on each single nanotube, which helps to prevent aggregation, does not interfere with the circular dichroism signals from the nanotube at all. Therefore, we observed all four interband transition peaks (E11, E22, E33, E44) in the circular dichroism (CD) spectra of the still wrapped optically enriched left-handed and right-handed (6,5) SWCNTs in toluene. Binding energies obtained from molecular dynamics simulations were consistent with our experimental results and showed a significant preference for one specific handedness from each chiral polymer. Moreover, the imine bonds along the polymer chains enable the release of the nanotubes upon acid treatment. After s-SWNT separation, the polymer can be decomposed into monomers and be cleanly removed under mild acidic conditions, yielding dispersant-free handedness sorted s-SWNTs. The monomers can be almost quantitatively recovered to resynthesize the chiral polymer. This approach enables high selective isolation of polymer-free s-SWNT enantiomers for their further applications in carbon nanotube (CNT) devices.
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