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### **Differentiating Left- and Right-handed Carbon Nanotubes by DNA**

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New structural characteristics emerge when solid-state crystals are constructed in lower dimensions. This is exemplified by single-wall carbon nanotubes, which exhibit a degree of freedom in handedness, and a multitude of helicity that gives rise to three distinct types of electronic structures - metals, quasi-metals, and semiconductors. Here, we report the use of intrinsically chiral single-stranded DNA to achieve simultaneous handedness and helicity control for all three types of nanotubes. We apply polymer aqueous two-phase systems to select special DNA-wrapped carbon nanotubes, each of which we argue must have an ordered DNA structure bound to a nanotube of defined handedness and helicity, resembling a well-folded biomacromolecule with innate stereo-selectivity. We have screened over 300 short single-stranded DNA sequences with palindrome symmetry, leading to the selection of more than 20 distinct carbon nanotube structures that have defined helicity and handedness and cover the entire chiral angle range and all three electronic types. The mechanism of handedness selection is illustrated by a DNA sequence that adopts two distinct folds on a pair of (6,5) nanotube enantiomers, respectively, rendering them large differences in fluorescence intensity and chemical reactivity. This result establishes a first example of functionally distinguishable left- and right-handed carbon nanotubes. Taken together, our work demonstrates highly efficient enantiomer differentiation by DNA, and offers a first comprehensive solution to achieve simultaneous handedness and helicity control for all three electronic types of carbon nanotubes. .