Purification of SWNT Suspensions and Formation of 2-D Networks of Single-Walled Carbon Nanotubes

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As energy conversion and conservation become more important, nanoscale electronic materials will play an essential role in development of enhanced electronic device structures. Single-walled carbon nanotubes (SWNTs), in particular, show great technological promise because of their nanometer-scale dimensions, enhanced electrical properties and mechanical flexibility. Yet, several major obstacles prevent the ability to control and predict the properties of SWNT electronic materials. As produced, SWNTs are a mixture of metallic (1/3rd) and semiconducting (2/3rd) molecular wires, as well as soot and residual catalyst nanoparticles. Because SWNT soot contains up to 40 wt.% impurities (such as amorphous carbon and residual metal catalyst), and SWNTs tend to form large bundles in suspension, due to their hydrophobicity, purification is of great importance. The Lay research group has developed an effective non-oxidizing purification method using probe sonication, followed by repeated centrifugation cycles at low centrifugal force (~18,000 G) that results in suspensions of unbundled, high-aspect ratio SWNTs. We have developed an SWNT network deposition method that allows formation of arbitrary densities of unmodified, high-aspect ratio SWNT networks at room temperature. As the density of SWNTs is strictly controlled, the electronic properties of these transparent and flexible networks are tunable from metallic to semiconductive. Therefore, this deposition method greatly improves the reproducibility of SWNT electronic materials.