Aerosol-based directed assembly of single walled carbon nanotubes

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Thermophoresis, or the force exerted on aerosols by a temperature gradient, provides a continuous, dry and clean way of depositing nanosized aerosols such as nanoparticles, nanowires, and single-walled carbon nanotubes (SWCNTs) grown using the floating catalyst CVD (FC-CVD) process. Using a purpose-built thermophoretic precipitator, we have deposited clean, as-synthesized SWCNTs uniformly on centimeter-sized substrates with a high efficiency approaching unity and controllable densities, ranging from individual separated nanotubes to thin films. Based on aerosol loss measurements, the thermophoretic terminal velocity of SWCNTs is lower than that of nanoparticles and nanoparticle agglomerates with a similar mobility and electrical mobility diameter.[1]

By depositing sub-monolayers of SWCNTs and investigating their morphology using atomic force microscopy, we have established that gas-phase bundling in the FC-CVD process can be described by aerosol agglomeration caused by Brownian motion[2,3]. We have also fabricated network channel TFTs with high charge carrier mobilities and I_{ON}/I_{OFF} ratios comparable to previously published devices fabricated using filter dissolution[1,4]. We have also carried out photoluminescence spectroscopy of FC-CVD SWCNTs for the first time by directly depositing air-suspended nanotubes on trenches[5]. Finally, we discuss the fabrication of aligned, high density arrays of SWCNTs, applicable to field effect transistors, by introducing electrostatic and dielectrophoretic forces.[6]

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