Transparent SWNT and MWNT mixture films

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In most cases by synthesis of single and double walled carbon nanotubes, the bundles are formed. There need a special treatment to separation them into individual nanotubes.

We found the experimental conditions permitting to grow the films of individual nanotubes situated in substrate plane. The thickness of the film depend on sputtered layers and process time.

We synthesized thin films consisted of long carbon nanotubes and others nanostructures in HF CVD reactor using various gas mixtures and temperature up to 1100°C. This method allows to grow carbon films of different thickness.

TEM investigations and Raman spectroscopy investigations shown that the films consist of single- and double walled carbon nanotubes with several quantity of thin multiwalled nanotubes and small quantity of disordered graphite (peak D at 1345 cm^{-1}). Rough estimate of nanotubes diameter by radial breathing mode frequency (empirical formula from [1]) says that diameter of multiwalled nanotubes is approx 10-20 nm and the one of single- and double walled carbon nanotubes 0.8-0.9 nm

[1] J. Kurti, V. Zolyomi, M. Kertesz, and G. Sun. *New Journal of Physics* **5**, 125 (2003).