Nanocomposites and nanomaterials

Optical properties of ultrashort carbon nanotubes

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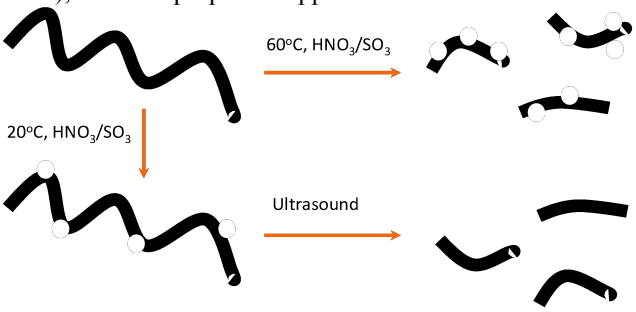
Single wall carbon nanotubes (SWNTs) are extensively studied during last two decades. They demonstrate unique physical properties, particularly, narrow optical absorbance and PL peaks in the NIR range caused by excitonic transitions as well as electronic properties, close to metals or semiconductors in depend on the NTs chirality (n, m values). These properties make the SWNTs promising as bioimaging and theranostic tool. However the NTs are not biocompatible due to their hydrophobicity and long length (up to microns).

To make the NTs biocompatible, we perform their oxidation in a mixture of HNO_3 and oleum at 60°C according to [1]. Alternatively, the oxidation was performed at 20°C followed by powerful ultrasound treatment according to [2]. Both procedures resulted in NTs cutting into 50-200 nm fragments (ultra-short nanotubes, US-NTs), but their properties appeared rather different.



The US-NTs prepared at 60 °C are strongly hydrophilic, but no excitonic peaks were seen in absorbance and PL spectra. The US-NTs done at 20°C are more hydrophobic and the excitonic peaks are clearly seen. These differences are caused by high concentration of lateral defects in the NTs after oxidation at 60°C, while the defects formed at 20°C mainly serve as the break-points for NTs cutting by the ultra sound.

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1. *Z. Chen, K. Kobashi, U. Rauwald, R. Booker [et all]* Soluble Ultra-Short Single-Walled Carbon Nanotubes // JACS.-2006.-**128**, N 32.-P.10568-10571.

2. *Gao Zh., Oudjedi L., Faes R [et al]* Optical detection of individual ultra-short carbon nanotubes enables their length characterization down to 10nm // Sci.rep.-2015.-**5**, .-N. 17093.