Synthesis of hydrophilic MWCNT-Fe composites as potential MRI contrast agents

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There is a considerable number of scientific reports stating that carbon nanotubes (CNTs) and magnetic nanoparticles have a potential for medical applications like contrast agents for Magnetic Resonance Imaging (MRI) or guided drug delivery. Functionalised, multi-walled carbon nanotubes are usually considered to be less toxic than the long and pristine ones. Such nanotubes would make a water-soluble shell for pure iron nanoparticles, or other magnetic material-based structures.

Multi-walled CNTs (MWCNTs) filled with three selected amounts of iron were synthesised by a floating catalyst chemical vapour deposition (FCCVD) route. Consecutively, three oxidation protocols were explored in order to select the most efficient route for the production of a highly soluble and biocompatible material. Ultracentrifugation was used to sort the resulting MWCNT-iron nanocomposite by length. The properties of these structures were characterised by several techniques i.e. scanning electron microscopy (SEM), high resolution transmission electron microscopy (HRTEM), thermogravimetric analysis, Raman spectroscopy, superconducting quantum interference device (SQUID), NMR and MRI.

A highly effective and simple MWCNT dispersion technique, resulting in particles that remained suspended for months, was developed. The MWCNTs filled with well-defined iron particles were successfully obtained as well as some magnetic properties of nanocomposite were shown. Significant enhancements in MRI contrast were observed. Moreover, the cytotoxicity of the MWCNT-Fe nanocomposites was studied in two cell lines.

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