Evaluation of biodistribution by Raman spectroscopy in rats exposed to single-walled carbon nanotubes functionalized with polyethylene glycol

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Introdução

The development of nanotechnology has enabled the creation of nanoscale materials with unique chemical and physical characteristics, evoking the interest of different scientific and technological areas for their potential applications. Polyethylene glycol-functionalized single-walled carbon nanotubes (SWNT-PEG) have been studied for many biomedical and pharmacological applications due to their potential biocompatibility, low immunogenicity and for their high stability in physiological media[1]. The aim of this study is to evaluate the biodistribution of this nanomaterial in rats, with a special attention to brain. For this, a commercial sample of SWNT-PEG (PEG Mw=600 gmol-1) obtained from Sigma-Aldrich was characterized and used in stable aqueous dispersions for biological studies. The experiments were performed by intravenous administration of 0.05, 0.25 and 1.25 mg/kg of SWNT-PEG dispersion in Wistar rats and the tissues were removed after 24h of exposure for analysis. All protocols were approved by the Institutional Animal Care Committee (process number 006/2014, CEUA-FURG). The Raman spectra were recorded using a FT-Raman spectrometer (RFS 100/S -Bruker Inc., Karlsruhe, Germany) with 1064 nm as source of excitation. The tissues Raman spectra show a characteristic peak of SWNT around 180, 1300 and 1600 cm^{-1} that corresponds to radial breathing mode (RBM), D and G band respectively. All the spectra were normalized with respect to the 1448 cm^{-1} band obtained from the control sample.

Resultados e Discussão

The biodistribution of SWNT-PEG was observed in the blood (data not show), spleen (data not show), liver and central nervous system (cortex) as shown as Raman signatures in Figure 1. With these results we can suggest that covalently functionalized PEG with the surface of carbon nanotubes has been an effective strategy to increase biocompatibility, decrease liver uptake and reduce possible toxicity. We propose SWNT-PEG can effectively be used for several other biological and nanobiotechnological applications.

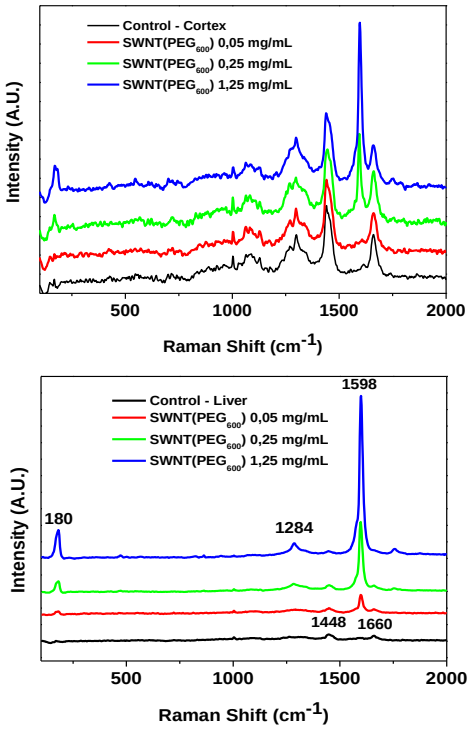

Figure 1. Raman spectra of cortex and liver tissue after the injections of SWNT-PEG dispersions at different concentrations.

Conclusões

The results show that the SWNT-PEG is a nanomaterial with a functionalization and a dispersion preparation that allows an effective biodistribution in the analyzed organs.

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[1] Z. Liu, C. Davis, W. Cai, L. He, X. Chen, H. Dai. Proceedings of the National Academy of Sciences, Vol.105(2008) 1410-1415.