Carbon nanotubes interaction with macrophages: chemical imaging by synchrotron X-ray fluorescence microscopy

C. Bussy [1,2], J. Cambedouzou[1], S. Lanone[2], E. Leccia[1], M. Pinault[3], M. Mayne-l'Hermite[3], M. Cotte[4], J. Doucet[1], J. Boczkowski[2], P. Launois[1]

[1] *Université Paris-Sud, Laboratoire de Physique des Solides, CNRS, Orsay, France*
[2] *Université Paris Val de Marne, Institut Mondor de Recherche Biomédicale,Créteil, France*
[3] *CEA-CNRS, Laboratoire Francis Perrin, Gif-sur-Yvette, France*
[4] *European Synchrotron Radiation Facility, ID21, Grenoble, France*

The human health impact associated with carbon nanotubes (CNT) is a topical issue considering their numerous potential applications. Analysis of CNT-cell interactions is needed, but it is an experimental challenge due in particular to the low contrast of carbon-based nanomaterials in biological environment. We show that such interactions can be well studied using synchrotron-based micro X-ray fluorescence [1], used here for the first time for CNT.

Experiments have been performed on murine macrophages exposed to single-walled or multi-walled CNT, the choice of macrophage cells being dictated by their crucial role in inflammation and respiratory responses to exogenous agents. Investigating chemical element distributions allows one: (i) to image nanotube localization within a cell, with a spatial resolution m, by imaging the catalyst metal particles bound to nanotubes, (ii) toμof 1 detect chemical modifications of the cell after CNT internalization. An excess of calcium is detected in exposed cells. Pharmacological assays with calcium antagonists further demonstrate that calcium plays a key role in the cytotoxicity and the inflammation induced by exposure to CNT. These outcomes show the importance of a calcium pathway response in CNT toxicity.

[1] C. Bussy et al., Nano Letters 8 (9), 2659 (2008)