CONTROL OF COVALENT FUNCTIONALIZATION OF SWCNT THROUGH REDUCTION

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Covalent functionalization of carbon nanotubes (CNTs), either single or multi-walled, is used extensively to solubilize or disperse and therefore manipulate these exceptional materials. In addition, it is necessary to connect strongly nanotubes between them, for example to increase CNTs composites mechanical properties, or to give the nanotubes additional physical and/or optical properties, such as possible photo-induced electron transfer, through the grafting of functional groups. Both are of interest for the CNTs fibers developed in our laboratory.[1] Although many reported functionalization routes are known,[2] most involving highly reactive intermediates, the functionalized ratio is not controlled, while this latter point is fundamental for most applications using the extended π-system of CNTs.

To this aim, we focused on the reaction of various halogenated species with SWCNTs-alkali metals salts[3] with varying stoechiometries. Indeed, chemical analyses and XPS data of these salts show that the stoechiometry of alkali metal with respect to carbon can be varied and controled. Furthermore, spectroscopic, chemical and thermogravimetric analysis of the reaction products indicate functionalization has indeed taken place. TGA, photoelectron and Raman spectroscopy are corroborating each other and prove that the functionalization of the carbon nantubes follows the stoechiometry of the SWNTC-alkali metal salts. Additionnaly, an anomaly is reproducibly observed for a specific salt stoechiometry. We will discuss its origin.

The functionalization of CNTs through their reduction into salts represents a convenient way to control the functionalization ratio. Functionalized carbon nanotubes are soluble in different organic solvents. Application of these results to various functions and therefore various applications such as photo-voltaics can be envisionned.

Current projects and activities:

- PhD student under the direction of Alain Pénicaud and Olivier Roubeau : Functionalization of carbon nanotubes with organic dyes or inorganic complexes
- Member involved in the ANR project NATALI about the incorporation of carbon nanotubes into a liquid crystal

Figures:

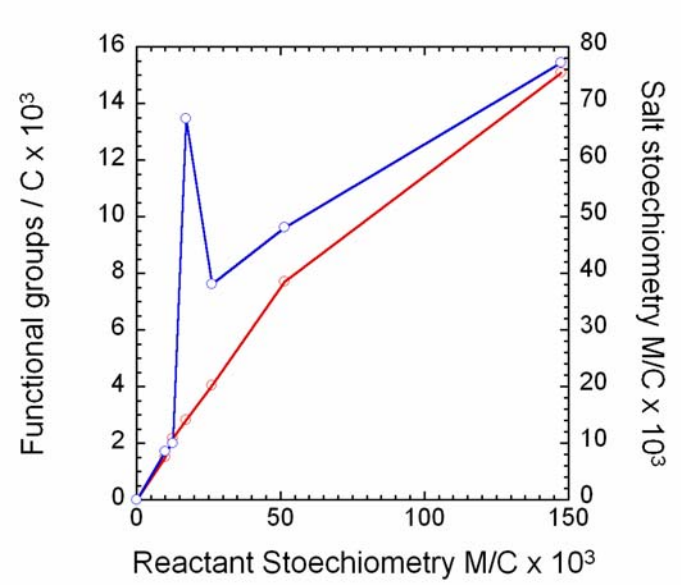

Figure 1. Number of functional groups vs. reactant stoechiometry. Blue: Functional groups of decylcarboxylic acid per 1000 carbons measured by TGA under Ar at 800ºC, Red : Salt stoechiometry measured by elemental analyses as function of the reactant stoechiometry M/C (x10^3)

References:

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