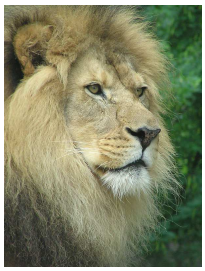
Séminaire LIONS



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Surface properties and thermal stability of Single-Walled Nanotubes of the Imogolite type

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Imogolite is a hydrous alumino-silicate with chemical formula $(OH)_3Al_2O_3SiOH$ forming nanotubes (NTs) with an inner surface lined by SiOH, outer Al(OH)Al groups, an inner diameter of 1.0 nm and variable length (from several nm to several microns). It is a very hydrophilic material, especially as far as the inner surface is concerned: the latter becomes accessible to probe molecules only after prolonged dehydration at high temperatures (above 150°C), whereas at T above 270°C surface dehydroxylation starts, with the eventual formation of a lamellar phase. The nature of the (dehydrated) inner surface may be studied by adsorption of probe molecules, like CO (at nominal 77 K), NH_3 and CO_2 (at room temperature), showing the presence of acidic functionalities (inner silanols) and of some acid/base sites at the outer surface, which has indeed a amphoteric nature.

By direct synthesis, a inorganic/organic hybrid material may be obtained, with chemical formula $(OH)_3Al_2O_3SiCH_3$ (Me-IMO), in which inner silanols are replaced by methyl groups, giving rise to an inner hydrophobic surface, as studied by volumetric adsorption of methane at 273 K, in the 0 – 10 bar range. Also, Me-IMO has larger pores, the inner NTs diameter being 2.0 nm: this has consequences also on NTs arrangement and on accessibility of the outer surface groups, which may interact with probe molecules. As to thermal stability, it is improved with respect to proper IMO and the thermal degradation mechanism occurs via an alternative pathway.

Finally, it is possible to tailor the surface properties of the outer surface by grafting organic functionalities, like aminopropyl groups, for instance: in the present work, the results obtained by grafting 3-APS at the outer surface of Me-IMO will be reported: a material named Me-IMO-NH_2 is obtained, with inner $SiCH_3$ groups and outer amino functionalities. The reactivity, thermal stability and accessibility of Me-IMO-NH_2 NTs is also studied and compared to that of proper IMO and of Me-IMO parent material.