STRATEGIES FOR THE SELECTIVE CONFINEMENT OF NANOPARTICLES IN THE INNER CAVITY OF MULTI-WALLED CARBON NANOTUBES

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Carbons nanotubes (CNTs) have a well-defined hollow structure and exhibit unusual chemical, mechanical and thermal properties as well as high electron conductivity. They can be employed as catalyst supports since they present a very open macrostructure with large mesoporosity allowing to avoid mass transfer limitations [1].

The shape of these carbons nano-objects allows to explore the effect of confinement on the catalytic activity and selectivity of CNT based catalysts. The introduction of foreign elements inside CNTs may modify the physical and chemical properties of the encapsulated material and also of the support itself, thanks to the electron transfer between the graphite structure and the metal particles [2]**.** The presence of relatively well-defined inner cavities can also induce differences of reactivity between the external and internal surfaces. It is expected that specific properties will be observed with these encapsulated nanomaterials, particulalry in the heterogeneous catalysis field, compared to those usually encountered with traditional catalysts [3,4]. Up to date, the selective confinement of discrete nanoparticles (NPs) in the inner cavity of CNTs is a rather difficult task and unexplored field [5,6].

We have developed an effective strategy to selectively deposit PtRu NPs either on the whole surface of multi-walled carbon nanotubes, either in their inner cavity (Figure 1).

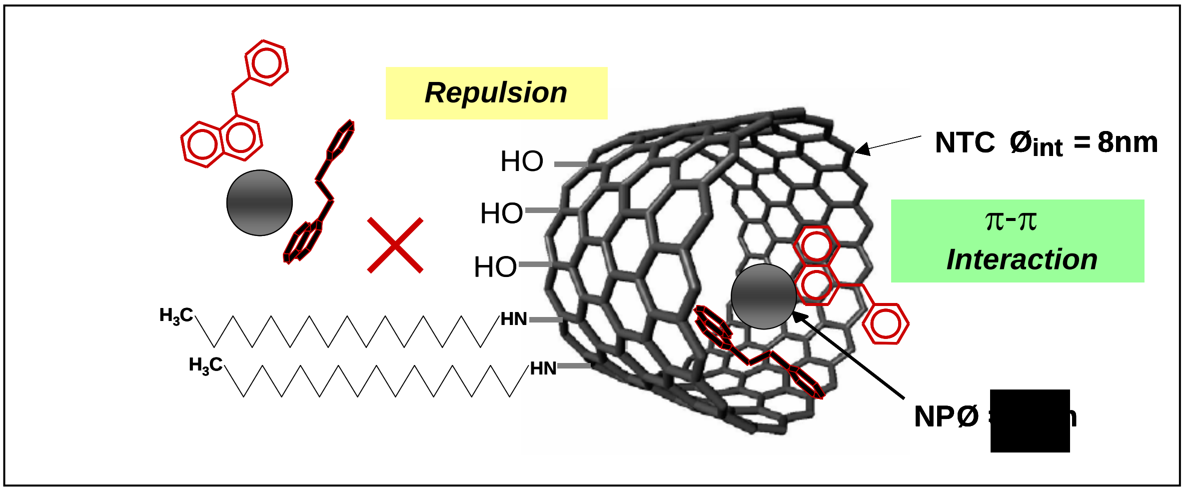

Figure 1. Strategy to confine NP in the inner cavity of CNTs.

The first step consists in the controlled preparation (chimie douce approach) of NPs stabilized by a ligand presenting two functionalities: one having an affinity for the surface of the NP and the other presenting an affinity for the grapheme layers (π-π interaction). The second step requires the external surface functionalization of CNTs to introduce for example long chain amine groups, which should induce repulsion between the NPs and CNT external surface.

In this contribution we will present results on NP preparation, CNT functionalization and NP deposition in (NP@CNT) or onto CNTs (NP/CNT). The different materials (Figure 2) have been characterized by Transmission electronic microscopy, EDX, infrared spectroscopy, X-ray photoelectron spectroscopy, acid-base titrations and elemental micro-analyze.

References:

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Figures:

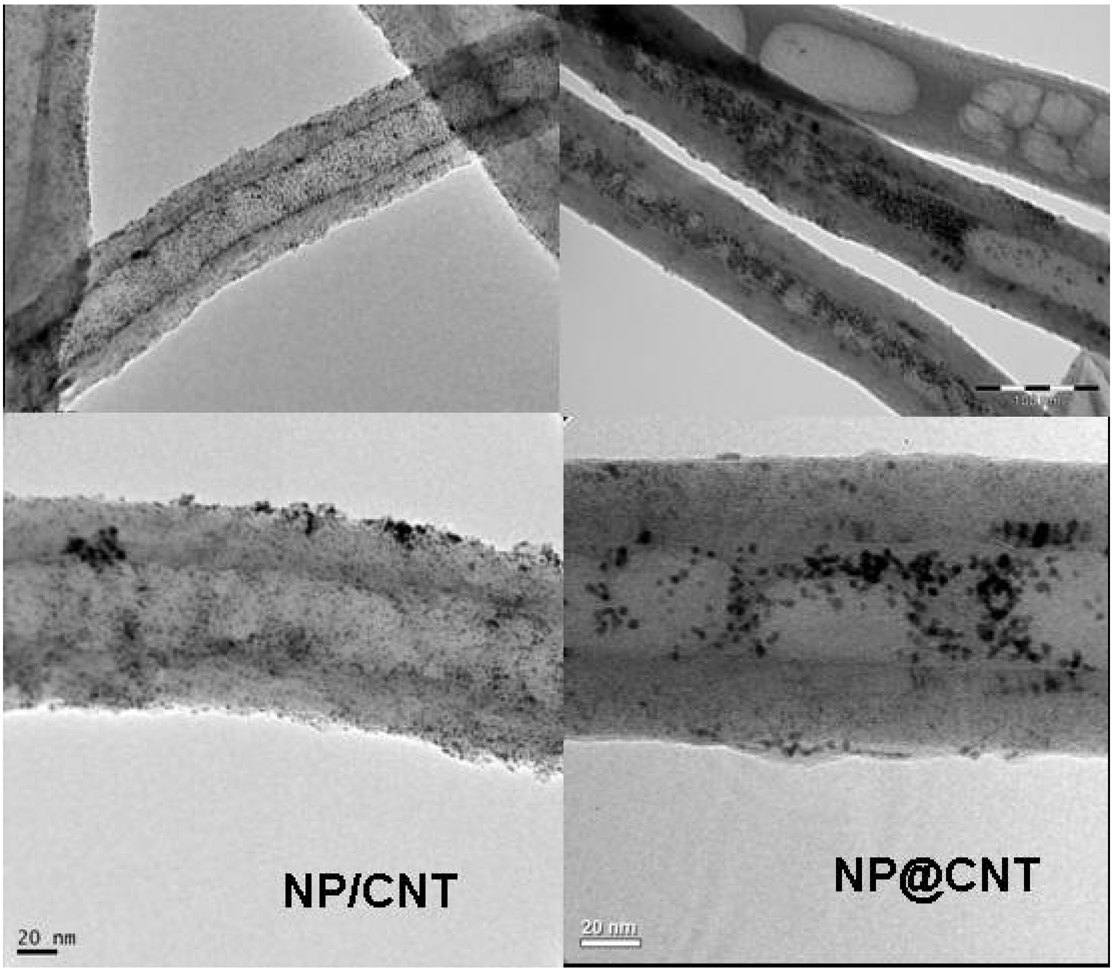

Figure 2. TEM micrographs of NP/CNT and NP@CNT.