*n*UMALAB: An interdisciplinary laboratory on nanotechnology

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***n*UMALAB** includes a set of researchers of different scientific and technological fields from the University and Enterprise areas, with common objectives in the field of nanotechnology: preparation, development and applications of materials on nanometric scale. This paper presents the different research topics we are dealing with. The common targets include preparation, characterization and modification of different materials, especially carbon and ceramics nanotubes and nanofibers functionalized to be applied in quite interesting technologies, as catalysis, hydrogen storage, biosensors, biocompatible systems, drug encapsulation, etc. There exist also close cooperation with the firms *YFLOW-Sistemas y Desarrollo SL and ICON-Nanotech SL* which are companies of nanotechnology operating in Malaga. Amongst the goals obtained up to date the following ones are to be stressed.

- **Preparation of carbon nanotubes and nanofibers and ceramics.**

Electrohydrodynamic technics have been used to obtain nanofibers in liquid simple jets and in turn nanotubes in jets of two concentric liquids. Starting with different precursors, different carbon nanofibers and ceramics can be obtained. For example, in Figure 1, hollow fibers obtained from PVP and lignin can be seen.

- **Use of nanotubes in catalysis.**

Co-electroespining technics have been used to obtain ceramic micro and nanoparticles, both hollow spheres and nanotubes to be used in catalysis. An example is shown in Figure 2a where the fiber has been prepared starting with a sol-gel precursor of silicon oxide containing scattered Pt. Figure 2b shows its catalytic activity in the NO reduction reaction. High conversion factors in the range 60-70% are reached at rather low temperatures.

- **Preparation of carbon nanoparticles**

Figure 3 shows a SEM micrography of carbon nanoparticles of some 400 nm. The kinetics of infiltration with pirolytic carbon of carbonaceous and ceramic substrates has been studied in order to prepare composite materials, and very highly pure carbon nanoparticles have been obtained.

- **Metal nanoparticles in homogeneous phase or supported on porous materials.**

Colloidal suspensions of silver nanoparticles of some 20 nm diameter (Figure 4) have been used to record the Raman spectra of molecules adsorbed on such metallic nanostructures from very diluted solutions. This so called SERS phenomenon (Surface-Enhanced Raman Scattering) allows to monitor adsorption and catalytic processes going on surfaces as occurs in electrochemistry or heterogeneous catalysis.

- **Funcionalization of nanotubes and nanofibers.**

We are synthesizing oligo-p-phenylenes (OPP) with side chains of oligoethylenglycol (OEG) in order to modify the raw material and to make it biocompatible. Another aim is to build a tripod shaped macromolecular structure by coupling several molecular components to a central nucleus (Figure 5). The size of the tripod will determine the size and the arrangement of the terminal functional groups.

Selected References:

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Figures:

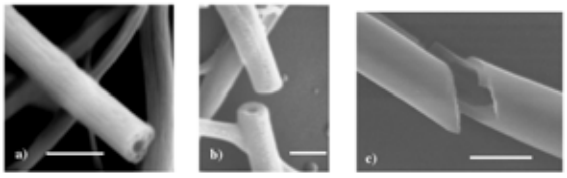

Figure 1.- Hollow nanofibers from PVP, a) stabilized, b) carbonized, and c) stabilized fiber of lignin. Scale a) 1 b) 0.5 and c) 2 μm.

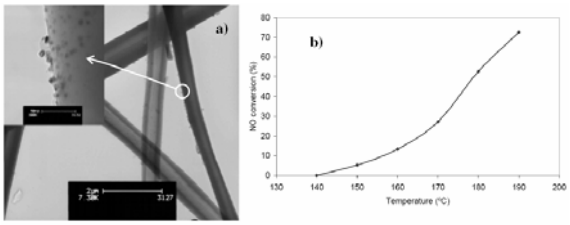

Figure 2.- a) Silica nanotube with Pt (scale: 2μm). Top: detail of Pt nanoparticles (scale: 50nm); b) conversion of NO vs temperature.

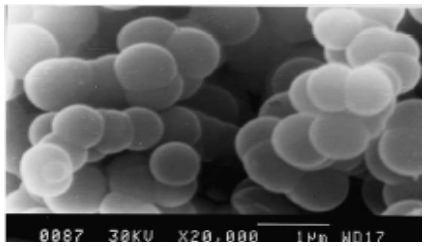

Figure 3.- SEM micrography of carbon nanospheres (scale: 1μm).

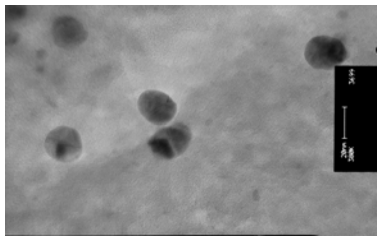

Figure 4.- TEM micrography of activated carbon with silver nanoparticles.

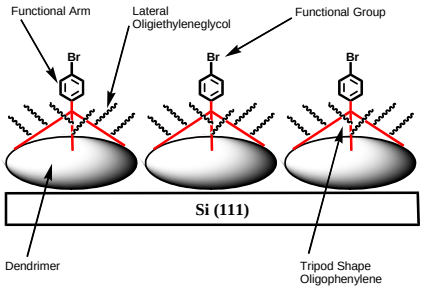

Figure 5.- Scheme of the structure of molecular tripods and functionalization of a silica surface to be used as biosensor.