

Growth of gold nanostructures inside carbon nanotubes

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Abstract – Gold nanostructures encapsulated in carbon nanotubes were synthesized by impregnation-reduction of a gold salt using as support a hybrid CNT-AAO membrane. This membrane was prepared by decomposition of acetylene using anodic aluminum oxide (AAO) as template. Through the fine-tuning of experimental parameters it is possible to obtain gold nanorods and gold nanoparticles inside the channels of carbon nanotubes.

We have synthesized CNTs by chemical vapor deposition (CVD) using anodic aluminum oxide (AAO) as templates and acetylene as a carbon source. The AAO membranes were prepared by a double anodization procedure of high purity aluminum foils. Catalysts are not required if AAO membranes are used instead in the CNTs synthesis process, since the decomposed acetylene fractions condensate inside the pores, adopting the tubular geometry. The resulting diameter distribution of the tubes is very sharp and the inner diameters of the CNTs can be controlled through the synthesis time. The average wall thickness of the CNTs was varied from 7 to 24 nm, while the outer diameter remains constant due to the AAO template. We have explored the use of these CNT/AAO membranes (figure 1) to fabricate gold nanostructures encapsulated inside them. For this purpose we have impregnated the CNT/AAO membranes with a gold salt. In a posterior calcination-reduction process, the Au ions aggregate into metallic nanostructures. After the reduction the CNTs can be retrieved from the supporting matrix by dissolving AAO in NaOH. With this method we have successfully synthesized gold nanorods (figure 2a) and nanoparticles (figure 2b) encapsulated in the tubes.

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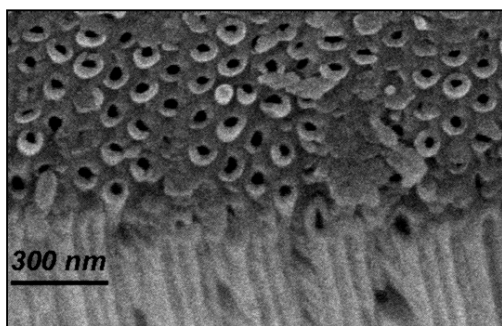


Figure 1: Carbon Nanotubes inside AAO membranes were prepared by decomposition of acetylene.

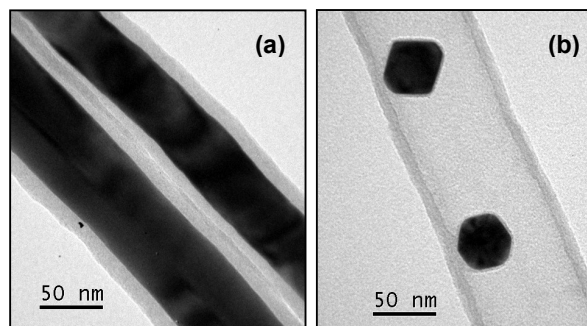


Figure 2: Gold nanorods (a) and gold nanoparticles (b) encapsulated inside carbon nanotubes were synthesized by a impregnation-reduction process.