Novel polymer-metal based nanostructures.

Jon Maiz*, Helmut Schäfer[&], Javier Sacristán*, Brigitte Hartmann[&], Martin Steinhart[&], Markus Haase[&], Carmen Mijangos*

* Instituto de Ciencia y Tecnología de Polímeros, CSIC, c/ Juan de la Cierva 3, 28006 Madrid, Spain
[&] Institut für Chemie, Universität Osnabrück, Barbarastr. 7, D-46069 Osnabrück, Germany
jon@ictp.csic.es

During the last few years there has been tremendous interest in template-based synthesis of nanomaterials for numerous nanotechnology applications. Anodic Aluminium Oxide (AAO) is a suitable template for the preparation of 1D polymeric nanostructure by "template synthesis" due to its relatively low cost, good quality architecture with long-range order, adjustable length and diameter and uniform nanopores with hexagonal symmetry. Tailored polymer-metal nanotubes and nanofibers can be prepared by choosing the suitable AAO template, and the appropriate infiltration method and conditions [1-4].

Moreover, the extraordinary mechanical properties of SWCNT make them suitable additives for a new generation of polymer nanocomposites. Incorporating SWCNT into polymers has the potential to radically improve the properties of the polymer matrix in terms of strength, toughness, electrical conductivity, thermal conductivity and/or flame retardancy [5]. In addition, the Brust-Schiffrin method for Au nanoparticles synthesis has had a considerable impact on the overall field in less than a decade, because it allowed the facile synthesis of thermally stable and air-stable Au nanoparticles of reduced dispersity and controlled size for the first time (ranging in diameter between 1.5 and 5.2 nm). Indeed, these Au nanoparticles can be repeatedly isolated and redissolved in common organic solvents without irreversible aggregation or decomposition, and they can be easily handled and functionalized just as stable organic and molecular compounds (Fig.1). Gold presents advantages mainly on the basis of more robust chemical stability, which guarantees a long-term preservation of the optical features [6].

In relation with this, the aim of the present work is to prepare novel nanostructured polymer based composites. For that, we will embed single-wall carbon nanotubes (SWCNT) and gold (Au) nanoparticles in different polymers.

In the present work we have prepared new polymer-metal based nanostructures, in particular polyvinylidene fluoride (PVDF) – SWCNTs and polyethylene – Au nanoparticles. In order to achieve these composites we have developed; (i) different infiltration methods, either for polymeric fluids or polymer based composites fluids into the alumina template cavities; (ii) different anodization conditions in order to obtain both hollow and solid one dimensional nanostructures with tailored dimensions; (iii) characterization process by Raman Confocal Spectroscopy of the SWCNTs all along PVDF nanorods (Fig. 2) [7]; (iv) finally, we have studied the crystallization process of PE and PE/Au nanorods under confinement conditions, by differential scanning calorimetry (DSC) and X-ray diffraction (XRD) [8].

References

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Figures

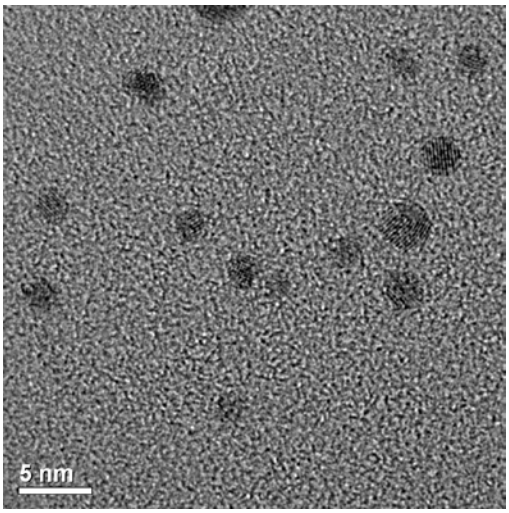

Figure 1. TEM picture of the thiol derivatised gold nanoparticles.

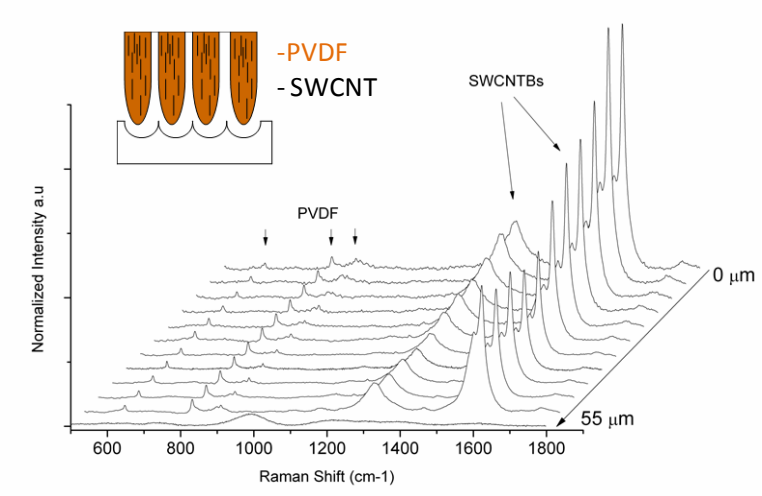

Figure 2. Depth profile Raman spectra of PVDF/SWCNT nanorods.