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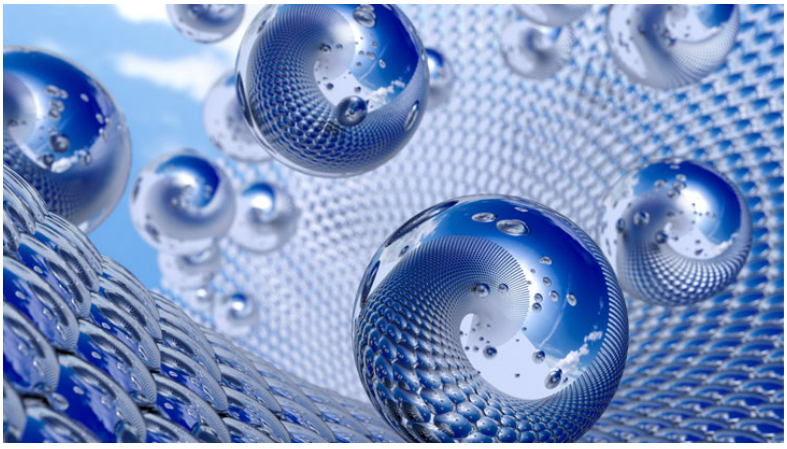
BARCELONA RECERCA I INNOVACIÓ

15/06/2015

Modification of Materials with Silver Nanoparticles



Nanomaterials, with a size one hundred million times smaller than an apple, are an alternative to conventional materials and have useful applications in fields such as electronics and biochemical sensors. However, one must prevent the risk of uncontrollable release and problems with stability in these materials, for example by incorporating them into bulk components. This article reports the results obtained by the modification of a polymeric matrix with silver nanoparticles having biocide activity.

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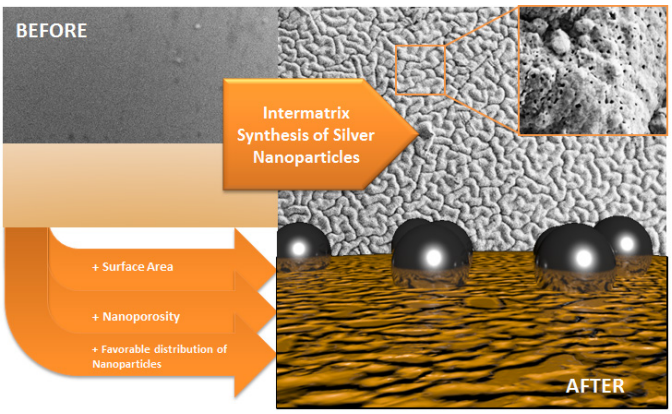
Life in the twenty-first century is dependent on an unlimited variety of advanced materials. The design of materials depends on the current necessities of the society, the availability of resources and the investment required for an appropriate scale up production.

The main aim of material scientists is to design new efficient and low cost methodologies for the preparation of novel materials such as nanomaterials. The nanomaterials (carbon nanotubes, nanoparticles, quantum dots) represent an alternative to conventional materials and have useful applications in fields like electronics, biochemical sensors, catalysis and energy. The size of a nanomaterial is consider to be in the range from 1-100nm (one hundred million times smaller than an apple).

At this scale, there is an increase of the exposed surface area of the nanoparticles, making them more reactive. Consequently, the nanoparticles present enhanced features for conductivity and catalytic activity.

Due to their extended incorporation in common use products, it has become a priority to evaluate the possible environmental risks of nanomaterials. In this regard, one way to prevent the risk of uncontrollable release and further stability issues of nanomaterials is by their incorporation into bulk components; such as polymeric matrices. The resulting hybrid material is called nanocomposite.

This publication reports the results obtained by the modification of ion exchange polymers with silver nanoparticles having biocide activity. The preparation of these materials is carried out by using the Intermatrix Synthesis technique (IMS).



IMS takes advantage of the ion exchange properties of the matrix and the electrostatic equilibrium (Donnan Effect) caused by the attraction of the silver cations (positively charged) and the functional groups of the polymeric matrix (negatively charged) during the first stage of synthesis. Later on, the reducing agent (negatively charged) is repelled by the matrix functional groups and cannot penetrate deeply. This equilibrium results in the most favorable distribution of the silver nanoparticles near the surface of the final material.

Moreover, some morphology changes are observed on the surface of the polymer (worm-like structures) due to the interaction of silver nanoparticles with the matrix. This interaction leads to the appearance of nanoporosity and therefore an enhancement of the mass-transfer features.

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References

Bastos-Arrieta, J.; Muñoz, M.; Muraviev, D. N. Bi-Functional Polymer-Metal Nanocomposites: Modification of Ion-Exchange Materials with Silver Nanoparticles. Solvent Extraction and Ion Exchange. 2015, vol. 33, no. 2, p. 152–165. doi: 10.1080/07366299.2014.974445.

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