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Editorial

Composite Nanoparticles

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Composite nanoparticles are advanced materials having recently gained increasing attention due to their scientific and technological importance. They find a wide variety of applications such as catalysts with huge activity and specificity, metal semiconductor junctions, optical sensors, and modifiers of polymeric films for packaging.

From a scientific point of view the composition and the atomic order of the aggregates, in addition to size, are pivotal factors in determining their properties and functionalities, while the nanoscale regime confers to them structural and electronic degrees of freedom which are inaccessible to bulk materials.

The first indispensable stage to develop novel nanotechnologies is the preparation of tailored composite nanostructures. Virtually all the possible physicochemical phenomena have been employed to reach this objective allowing to set up a huge number of protocols each one with its specific advantages and disadvantages. The aspects of novel preparation methods are addressed in two manuscripts.

S. Bagheri et al. describe a novel synthesis of anatase titanium dioxide nanoparticles using egg white solution via sol-gel method and characterized them through a high number of techniques. The main advantage of using egg white proteins as a gelling agent is that it can provide long-term stability for nanoparticles by preventing particles agglomeration. They demonstrated that egg white solution is a reliable and cheap

green gelling agent that can be used as a matrix in the sol-gel method to synthesise tiny size TNPs.

V. Ovchinnikov and A. Shevchenko describe a cost-effective fabrication of random noble-metal nanostructures with a feature size of the order of 10 nm on a large-area dielectric substrate. The technique allows to create metal nanoislands on a nanopatterned dielectric template with an enhanced adhesion between the metal and the dielectric. The use of the adhesion layer (that makes the structures stable) is important in view of variety of optical and other potential applications of the structures. The results of their work can be of interest in regard to the development of new approaches to self-organization based nanofabrication of extremely small metal and metal-dielectric nanostructures on large-area substrates.

Due to their peculiarities, the production of nanomaterials is a promising strategy to fuel novel technological applications. Two manuscripts, highlighting enhanced properties for applicative purposes, are good examples of the potentialities of these materials.

M. C. Carrera et al. studied the permeation of CO₂ in films of high density polyethylene (HDPE) and organoclay modified with polyvinylalcohol (MMT_{HDTMA/PVA}) obtained from melt blending. They showed that the incorporation of the modified organoclay generated an exfoliated nanocomposite structure with a significant effect on the barrier

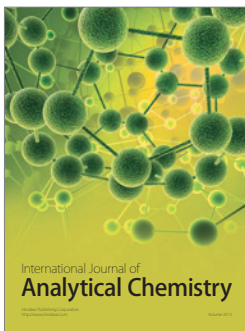
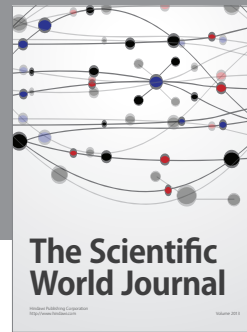
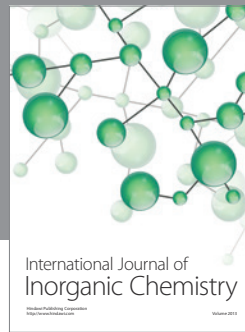
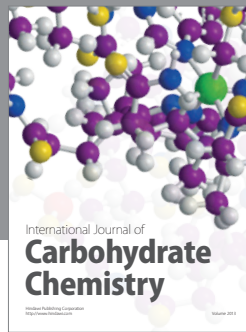
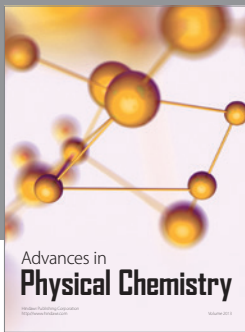
properties of HDPE. Notably the mechanical properties remain equal to those of pure polyethylene, but with an increase in barrier properties to CO₂ allowing to obtain nanocomposites of HDPE competitively used in packaging.

Q. X. Li et al. prepared a novel Pd/C catalyst with enhanced performance for direct ethanol fuel cell. They characterized the catalysts by XRD and TEM showing that they are spherical and homogeneously dispersed on carbon.

Finally, the theoretical/computational approach has been faced by P. Shabanzadeh et al. In their investigation, they applied the accuracy of artificial neural network training algorithm to study the effects of different parameters on the synthesis of Ag nanoparticles performed in the interlamellar space of montmorillonite (MMT) by chemical reduction technique. Using the best performing artificial neural network, they predicted the optimum conditions of AgNO₃ concentration, MMT d-spacing, and reaction temperature.

By compiling these papers, we hope to enrich our readers and researchers with respect to the most recent progresses in the field of nanoscale multicomponent particles.

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