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Intermatrix synthesis of metal nanoparticles

Meta nanoparticles (MNPs) have interesting applications due to their special chemical and physical properties. This work describes the development of a polymer stabilized with MNPs (PSMNPs), using the membranes of ionic exchange as a nanoreactor.

The physical and chemical properties of metal nanoparticles (MNPs) are distinct from those of both bulk metal and isolated atoms. The main drawback of MNP is their instability and high trend for aggregation. Without stabilization they fuse together, losing their special shape and properties. The development of polymer-stabilized MNPs (PSMNPs) is one of the most promising solutions to MNP stability problem.

In this paper we report in situ synthesis and characterization of PSMNPs, using the ion-exchange membranes as a nanoreactor. The membranes were prepared by using sulfonated poly(etherether ketone) of desired sulfonation degree (SD). The optimal SD provided a sufficiently high ion-exchange capacity and insolubility of the polymer in water and solubility in organic solvents (DMF). The membrane was loaded with metal ions (e.g., Cu2+) or complexes (e.g., [Pt(NH3)4]2+) followed by metal reduction inside the polymer matrix resulting in formation of either monometallic or bimetallic PSMNPs with core-shell structure. The MNP-containing membranes were characterized by electron microscopy to evaluate the morphological changes of the membranes and to estimate the MNPs size. The same membranes were also deposited on the surface of graphite-epoxy composite electrodes to study the electrochemical properties of polymer-PSMNP composites and to estimate their applicability in sensor designs. The presence of both Cu- and Pt/Cu-PSMNPs inside the membrane not only substantially improves the electric conductivity of the polymer, but also testifies to the clearly pronounced strong electrocatalytic activity of PSMNPs towards analyte under study (H2O2).

Amanda Alonso
Unitat de Química Analítica
Universitat Autònoma de Barcelona

References

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