PREPARATION AND CHARACTERIZATION OF POLYMER-METAL NANOCOMPOSITES FOR MOLECULAR RECOGNITION DEVICES

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The use of nanometer-sized metal particles (MNPs) in design of molecular recognition devices (MRD), such as sensors and biosensors can substantially improve their performance. MNPs exhibit properties (electrical, magnetic, optical, ionization potentials, etc.), which are distinct from those of the bulk metal and isolated atoms. To save their unique properties, MNPs require stabilization as they are usually so unstable that if their surfaces touch, they fuse together, and hence lose their special size and properties The development of Polymer-Stabilized MNPs (PSMNPs) is one of the most promising solutions to the MNPs stability problem [1-3].

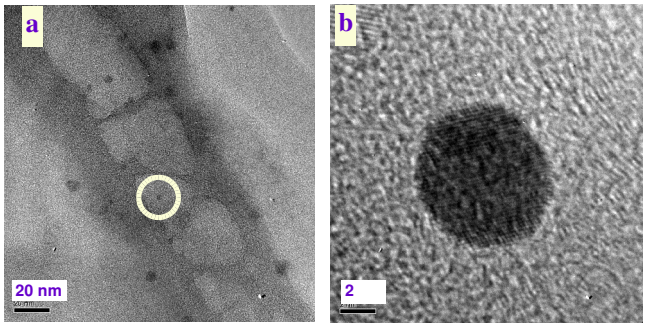
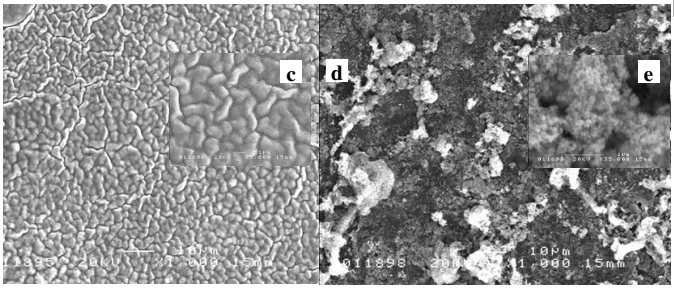


Fig 1. Typical TEM of SPEEK-Cu-PSMNP composite (a) and Single SPEEK-Cu-PSMNP (b).

In this presentation we report a novel approach for the inter-matrix synthesis of PSMNP, which is based on the use of functionalized polymeric membranes as a nanoreactor for both to synthesize and to characterize the properties of PSMNPs. The functional groups of the polymer are able to fix metal ions inside the matrix prior to their reduction resulting in the formation of PSMNPs.

The proposed approach is illustrated by the results obtained by studying the intermatrix synthesis of Cu and Pt PSMNPs in sulfonated poly (etherether ketone) (SPEEK).



PSMNPs-containing membranes surface was characterized by SEM and AFM techniques to evaluate the morphological changes of its structure whereas TEM was used to estimate the MNPs size. The MNPs loaded membranes were also deposited on the surface of graphite epoxy composite electrodes to study the electrochemical properties of polymer-PSMNP nanocomposites and to estimate their applicability in

Fig. 2 SEM images of surface morphology of SPEEK-CuPSMNP membranes loaded with Cu in different cycles: bare SPEEK (a, 1000X), Cu-SPEEK 6.8% Cu (b, 1000X; c, 5000X), Cu-SPEEK 10.2 % Cu (e, 1000X; f, 5000X).

MRD constructions.

The results of BET measurements show that the loading of polymers with PSMNPs leads to the appearance of nanoroporous structure what substantially improves the mass-transfer characteristics of the membrane. The electrical conductivity of membranes increases by several orders of magnitude in comparison with metal-free polymer. Certain PSMNPs demonstrate a very high electrocatalytic activity permitting to directly use them in MRD.

References

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