Intermatrix synthesis: easy technique permitting preparation of polymer-stabilized nanoparticles with desired composition and structure.

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Synthesis and Characterization of Metal nanoparticles (MNPs) attract great interest of scientists and technologists due to their special physical and chemical properties. A high trend for aggregation is considered to be the main drawback of MNPs, as their coalescence results in the loss of their special shape and properties. The development of Polymer-Stabilized MNPs (PSMNPs) is considered to be one of the most promising solutions to the MNPs stability problem [1, 2].
The synthesis of PSMNPs can be successfully carried out by using InterMatrix Synthesis (IMS) technique, which consists in sequential loading of the functional groups of the polymer (sulfonated poly(etherether ketone), SPEEK in our case) with the desired metal ions followed by their reduction to MNPs inside the membrane, what results in the formation of PSMNPs.

In many instances the electrochemical applications of MNPs are based on the use of Platinum Group Metals (PGM) nanoparticles (Pd, Pt, etc.) due to their well-known unique electrocatalytic properties [3]. The synthesis of core-shell MNPs, where the shell is composed of PGM and the core consists of a cheap metal gives a possibility of decreasing their costs making them more affordable.

The scheme shown in **Figure 1** demonstrates four main parameters, which determine the variety of applications of IMS technique: the nature of the ion-exchange matrix [4-5], the type of MNP precursor (metal ions or metal complexes), the reaction which forms the MNPs (reduction, oxidation, precipitation) and the MNP structure (monometallic and polymetallic) [6-8]. This sort of network permits to estimate number of different combinations of PSMNPs and nanocomposites on their base which can be obtained.

In this presentation we report the results obtained in our group on the development of this technique for the synthesis of a wide spectrum of MNPs by using different metals with various structures and also by using different synthetic routs for the MNPs formation (e.g. reduction, precipitation).

We also report the results obtained by the development of PSMNP-based amperometric sensors, which can be easily prepared by using “in situ” version of IMS technique (formation of MNPs directly on the surface of modified electrode), what gives a possibility to substantially enhance some working parameters of the sensors, such as the response time and the sensitivity [8].

References

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Figures

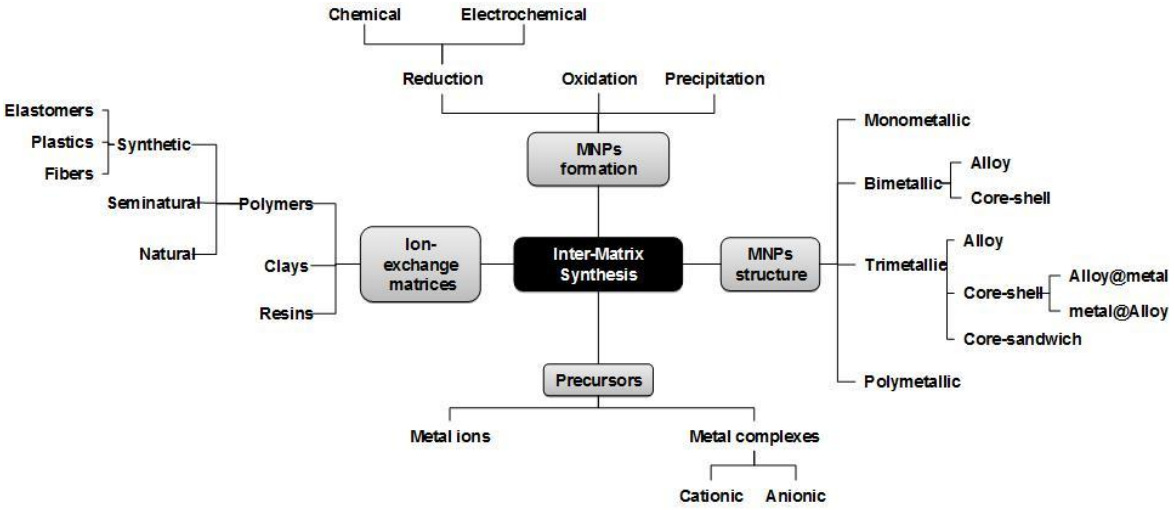

Figure 1: Inter-matrix synthesis (IMS) possibilities for different ion exchange matrices.