Polymer-stabilized Palladium Nanoparticles for catalytic membranes: *ad hoc* polymer fabrication.

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Metal nanoparticles (MNPs) are especially effective catalysts because of their relatively large percentage of surface atoms [1,2]. Additionally, these materials often possess unusual electronic properties due to their unique size, which is between the bulk and molecular regimes [3]. For most practical catalytic applications, however, the nanoparticles must be immobilized on solid supports to prevent aggregation and facilitate catalyst recovery [4,5].

Encapsulation by polymers [6] seems advantageous because in addition to stabilizing and protecting the particles, polymers offer unique possibilities for modifying both the environment around catalytic sites and the access to these sites [7-9]. Including nanoparticles inside polymeric membrane would yield to a useful material for process intensification [10,11] since the combination of catalysis and membrane processes may, for instance, change and separate pollutants through a single step. Anyway, it is imperative to adequate the polymeric matrix to the MNPs synthesis and to their final application since the protective polymer not only influences particle size and morphology but can also have a tremendous influence on catalytic activity and/or selectivity.

In this presentation we report the development Pd-MNPs by Intermatrix Synthesis (IMS) [12,13] in asymmetric SPES-C (sulfonated polyethersulphone with Cardo group) membranes as synthetic media. The aim to use SPES-C is to improve of the final nanocomposite properties for catalytic applications such as microfiltration. Up to now, we have optimized the sulfonation degree of the polymer taking into account the following issues: (i) the needed of a high enough ion-exchange capacity (because sulfonic groups act as metal ion binders and nanoreactors) and (ii) the solubility properties of the polymer required for membrane formation by phase inversion procedure (a large degree of sulfonation would cause polymer dissolution).

In Figure 1 a Transmission Electron Microscopy image is shown, where the obtained Pd-MNPs in SPES-C membranes can be seen. Almost spherical small nanopaticles are found with a low degree of aggregation.

The characterization of the catalytic effect of the membrane samples was performed using a reaction model [14] widely used in the evaluation of new catalysts for reactions in aqueous phase: the reduction of p-nitrophenol in presence of sodium borohydride and metallic catalyst Figure 2.) Quick p-nitrophenol degradation has been observed in batch experiments.

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Figures

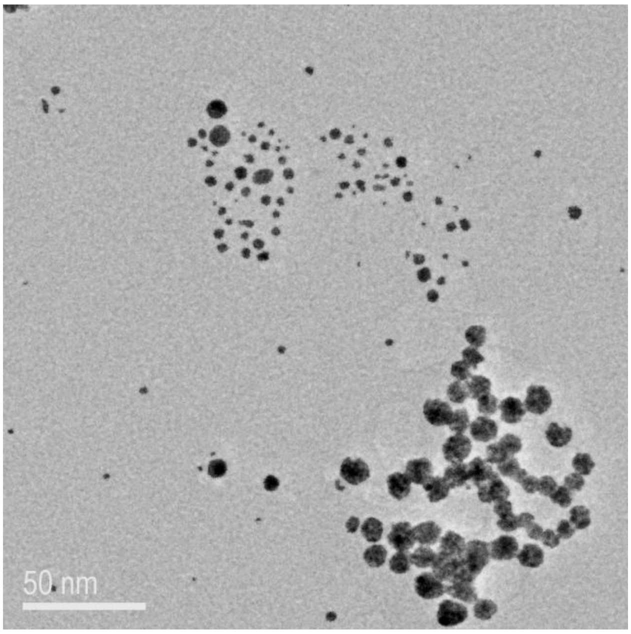

Figure 1: TEM image of Pd-MNPs obtained by IMS inside a SPES-C membrane.

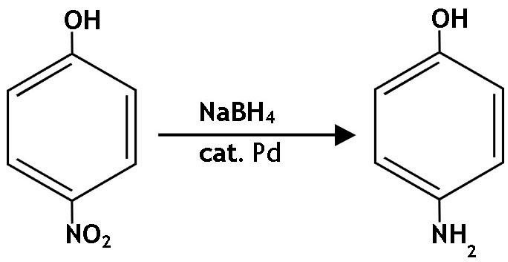

Figure 2: catalytic reduction of p-Nitrophenol in basic media with $NaBH_4$