Polymer/metal hybrid membranes : from in situ nanostructuration process to modulated functional properties

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During the last few years, the preparation of hybrid organic-inorganic nanocomposite membranes by in situ methods has been a subject of growing interest. Indeed it generally allows to obtain homogeneous dispersions of nanometer size fillers within the membrane and to achieve functional properties [1, 2, 3]. The aim of this work is to prepare palladium/polymer nanocomposites membranes with different morphologies and modulated functional properties.

Dense films were prepared by cast process from palladium acetate and polyetherimide. The films were annealed according to different cure cycles. A nanostructuration process leading to the formation of crystalline palladium nanoparticles within the film occurred during the thermal treatments. The particles were homogeneously dispersed for Pd amount lower than 15 wt%. For higher palladium content, a surface layer composed of Pd particles was obtained in addition to an homogeneous dispersion of nanoparticles in the bulk for some curing conditions. The effects of the nanoparticle dispersion state were studied on gas permeation. Specific interactions with hydrogen were evidenced. Enhanced effects were observed as the total amount of particles increased and particularly as the particles were mainly located at the film surface.

In order to promote the palladium particles accessibility, asymmetric porous hybrid films were prepared. As for dense films, palladium crystalline nanoparticles were formed after thermal annealing. These particles were mainly located at the film surface of the dense polymer layer and on the walls of the pores (Figure 1).

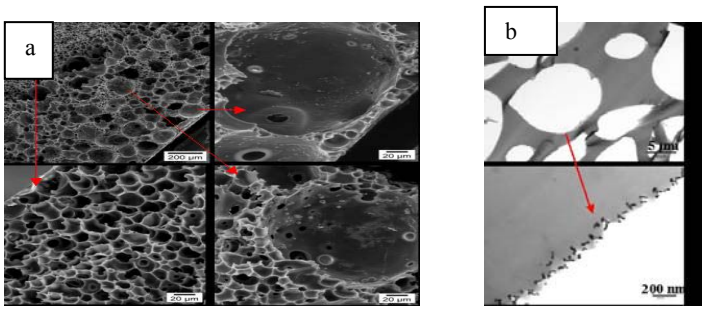

Figure 1: porous nanocomposite films
a) at the SEM scale and
b) at the TEM scale on an ultra-microtomed slice.

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