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ABSTRACTS

NANOPHASE METAL CATALYSTS IN ELECTRODES FOR POLYMER ELECTROLYTE FUEL CELLS

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The proton exchange fuel cells are one of the most promising candidates as power source for electrical vehicles, since they combine high energy conversion efficiency at relatively low temperatures with the absence of pollutants emission in the environment, the fuel being hydrogen. However a high power density and a very low noble metal catalyst loading are required to reduce weight, volume and cost of this power source, in order to obtain systems competitive with traditional combustion engines.

Since the very first years of the last century, when the catalysis technology based on nanoparticles started to develop, there has been an increasing need to establish a theoretical and practical framework, within which the performances of metal supported catalyst, as activity, selectivity and lifetime, could be correlated with different preparation procedure, physical and chemical properties.

Unfortunately an actual electrode for such kind of cells is a very complex system, far from the ideal one in which catalyst surface properties could be monitored at atomic level during the reactions. An electrode appears as a layered structure, with a carbon porous substrate, treated to allow gas and water flowing, covered by the Pt/C electrocatalyst layer, in turns facing the polymeric electrolyte. Electrode performances are influenced by the nature of all components, whose chemical, physical and structural properties should be studied.

In this work, besides a short comment on substrate characteristics, we focus on the electronic properties of Pt nanoparticles, resulting to be different from those of Pt bulk, due to size effect and cluster-support interactions. To enlighten the peculiar behaviour of Pt clusters, some XPS spectral features are determined, apt to provide useful correlation between the system performances and material physical and chemical characteristics. The variation of the intrinsic asymmetry of the Pt4f peak, the energetic shifts of the photoemission lines and the evolution of the relative intensities are studied before and after heat treatments and galvanostatic measurements. Moreover a correlation is guessed between XPS data and particles size distribution, obtained by non-conventional XRD measurements.