Plasma deposited platinum-containing nanocomposite films as catalysts for fuel cells

A. Milella[1], E. Dilonardo[1], F. Palumbo[2], S. Martin[3], R. d'Agostino[1], F. Fracassi[1]

[1] *University of Bari, Department of Chemistry, Via Orabona 4, 70126 Bari (Italy)*

[2] *Institute for Inorganic Methodologies and Plasmas (IMIP)- CNR; Department of Chemistry*

[3] CEA-G/ Leti, Grenoble (France)

In Proton Exchange Membrane Fuel Cells (PEMFC) the electrode reactions rely heavily on the use of platinum catalysts. Since cost of this precious metal is one of the main barriers for commercialization of fuel cells, many research efforts are addressed to obtaining higher catalytic activity than the standard carbon-supported platinum particle catalysts used in current PEM fuel cells, but using a reduced amount of catalyst. One strategy to increase the performance of platinum catalysts is to disperse it in form of nanoparticles, eventually embedded in a polymeric matrix. In the framework of limiting the amount of precious metal in the fuel cell assembly, plasma processes are particularly appealing since they allow control of the film thickness to the nanometer scale.

In this contribution we report on the deposition of nanocomposite thin films containing platinum nanoclusters (high specific area) with definite concentration and uniform in size. Thin films are obtained from a simultaneous plasma-enhanced chemical vapour deposition of ethylene (C_2H_4) / argon gas mixtures and RF sputtering of a platinum target. The main advantages of this approach consist in the reduced thickness (less then 1 micron), the possibility to coat complex shapes, and the easy scale up in a continuous process. Chemical and morphological characterization show that the platinum content in the coating can be finely controlled by varying the RF power and the monomer flow rate. Furthermore platinum is organized in crystalline nanoclusters uniformly distributed in the material. Ciclovoltammetry indicates that the catalytic activity of deposited films reaches a maximum correspondingly to a platinum load of about 60%. Preliminary results on device testing will be also presented.

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