FABRICATION OF A MEA FROM METAL-POLYMER NANOCOMPOSITE MEMBRANES FOR FUEL CELLS APPLICATIONS

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The synthesis and characterization of Metal NanoParticles (MNP) has attracted great interest of scientists and technologists within the last years due their unique physical and chemical properties [1]. These properties can be advantageous in various practical applications including catalysis- and electrocatalysis-based processes, which occur in, for example, fuel cells or sensing devices. In this sense, nanoparticles composed of, for example, gold, cobalt, palladium, copper, and cadmium selenide are of great interest due to their potential use in various nanotechnology applications [2].

At the same time, the main drawback of MNP, which still limits their wide application, is insufficient stability dealing with a high trend for aggregation. The coalescence of nanoparticles leads to the loose of their nanometric size and, as the result, of their unique properties. In order to overcome this drawback, stabilization of MNPs in polymeric matrices of different types has been proven to be one of the most promising strategies to prevent their aggregation and to stabilize their properties [3]. As a result, Polymer-Stabilized MNPs (PSMNPs) and Metal-Polymer Nanocomposites (MPNCs) on their base start to find different applications in various fields of science and technology [4].

The polymer used in this work was SPEEK that has been traditionally used for the development of Proton Exchange Membranes (PEM) and their application in both fuel cells and electrolysers. PEM fuel cells are regarded as a possible alternative power source for stationary and mobile applications [5]. Due to the catalyst costs, many

researchers have been studying the membrane and the electrode assembly (MEA) manufacturing processes that can reduce the content of Pt in the electrocatalyst layer while maintaining the performance. The MEA is the heart of the PEM fuel cells and catalyst plays an important role into the fuel cell operation.

In this paper the catalyst layer for a PEMFC-electrode was prepared from metal nanoparticles synthesized and stabilized on SPEEK (PSMNPs). These polymer composites were dissolved with dimethyl formamide to prepare inks that were dispersed with an aerograph on the gas diffusion layer (GDL). Finally, activated GDLs were glued to the membrane by hot pressing. The optimal conditions for this process were established in a previous work [6].

Once the MEA was assembled using MNP, it was mainly characterized by means of polarization curves (current density vs. voltage) obtained from a single hydrogen fuel cell of 5 cm^2. The activation drop and ohmic resistance that could be established through these curves are discussed along the whole paper comparing activity of PSMNP against standard PEMFC electrodes.

References

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