Synthesis of Carbon Fiber Electrocatalysts Obtained by Pyrolysis of Polymeric Fiber

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ABSTRACT

One of main barriers to the production of fuel cells is the high price of platinum. Several studies propose solutions based on the decrease of platinum amount; e.g. enhance the support an dispersion, decreasing their particle size, mix with other metals, etc. Since 2009, Dai et al reported a different path to synthesize electrocatalysts, using nitrogen doped nanotubes, creating a branch of metal-free catalysts with activities very close to platinum for ORR. Recent studies are shifting towards to carbon derivatives with a graphitic lattice limited, such as activated carbon, carbon black, carbon fibers and amorphous graphite doped with nitrogen, which yields similar to compounds of highly ordered structures used as electrocatalysts, getting great economic advantages due to its simplicity in the synthesis of these materials. This study, proposes the synthesis of carbon fibers from pyrolysis of commercial polymeric fibers (Kevlar and Nylon). These fibers are aramids and polyamides, which contain nitrogen in its structure. According to studies made by Bradley et al (1997), the nitrogen bonds with carbon produce nitrogenated quaternary structures. The polymers fibers were subjected to heating in an argon gas atmosphere with a flow of 200cm^3/min during 2 h., then they were subjected to a carbon dioxide atmosphere by 1 h, as an activation process. Raman spectra show the typical Raman-active band D and G of carbonaceous materials. The samples were characterized by TGA and BET. SEM images show that fibers diameter were from 8 to 10µm. Catalytic activity was evaluated by electrochemistry techniques (cyclic voltammetry and rotated disk electrode). The obtained results show that the electrocatalysts have catalytic activities comparable to graphene and CNTs doped with nitrogen.

Keywords: Electrocatalysts, carbon, nitrogen

References:

1. - R.H. Bradley et al “Chemical transformations resulting from pyrolysis and carbon dioxide activation Kevlar” Carbon (1997).

2.-Marta E.G. Mosquera, Marielle Jamond, Amelia Martinez-Alonso and Juan M.D. Tasconi, “Thermal Transformations of Kevlar Aramid Fibers during Pyrolysis: Infrared and Thermal Analysis Studies “Chem. Mater (1994).