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Characterization of films Ni-electrodeposited on carbon flexible and stainless steel mesh for electrodes in Alkaline Membrane Fuel Cell (AMFC)

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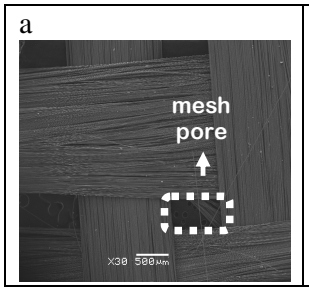
Abstract – In order to replace Pt in electrodes of the AMFC, Ni was electrodeposited on carbon flexible mesh and stainless steel mesh in a bath containing boric acid. Through the technique of electrodeposition, it was possible to control the pore size of the carbon and steel flexible meshes. Within 20 min of deposition, it was possible to decrease the mesh pore (Fig.1) from 100 microns to 80 microns, i.e., about 80% of original size. These materials presented compact and adherent structure and also showed globular morphology of high roughness. The film of the Ni deposited on carbon showed morphology more globular that the film Ni deposited on stainless steel.

Fuel cells are one of the alternatives clean and efficient for the generation of electricity, one of the reasons for which the fuel cells are not used extensively it is that, economically, they not yet are competitive. An important factor is the development of alternative components of low cost and that they provide to densities of higher power [1]. This present work to the electrodeposition of films of Ni on carbon flexible substrate (CF) and stainless steel mesh substrate (SSM) for electroplating in acid bath, therefore in alkaline bath for these substrates smooth and irregular films are deposited. As these materials can support high densities of current and low coast can be used in substitution the Pt in Alkaline Membrane Fuel Cell (AMFC). However a challenge to use these materials is lower the size of the pores of the CF and SSM (fig 1a and 2a) that measure 100 µm on average. The films were electrodeposited on substrate of the CF and SSM measuring 12x12 cm, from an electrolyte composes by $NiSO_4.6H_2O$, $NiCl_2.7H_2O$, H_3BO_2 [2], for a current density of 60 mA /cm^2 during 20 minutes.

Through the SEM Morphologic Analysis an overlap fiber structure was observed formed by several carbon wire of diameter of 5 µm (Fig. 1a), while the SSM presents structure of interlaced massive steel wire with 80 µm of diameter (Fig. 2a). The images obtained for the films deposited on carbon showed a globular morphology (Fig. 1b) such as for the deposited on steel (Fig 2b). The deposits on steel had presented size of smaller grain that the deposits of Ni on carbon, the two films are thick and presents metallic aspects of Ni (gray). The film of Ni on CF has thickness of 15 mm and film on SSM has thickness of 10 mm. The EDS analyses show to film on SSM, 11.6 % atomic of O and 88.4 % atomic of Ni and for film on CF 94, 9 % atomic of Ni and 5,1 % atomic of O, what indicate lower percentage of oxide. Through the technique of electrodeposition was possible control the pore size of the carbon and steel flexible mesh, with time of 20 min of deposition was possible to decrease the pore of mesh from 100 microns to 80 microns.



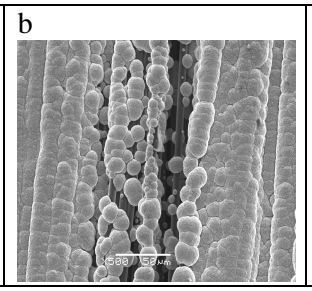
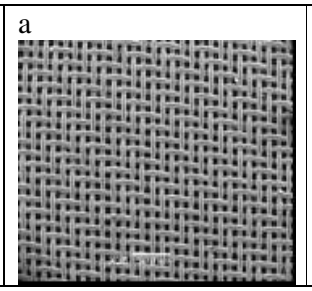


Figure 1: SEM image of **a)** carbon flexible mesh (30X) and **b)** Ni deposited on carbon flexible mesh (500X).



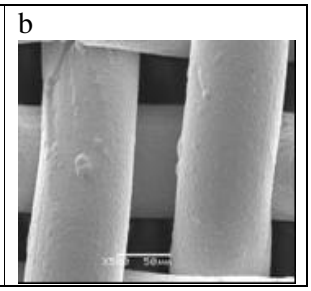


Figure 2: SEM image of **a)** stainless steel flexible mesh (30X) and **b)** Ni deposited on stainless steel flexible mesh (500X).

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