Preparation of platinum and non-platinum electrodes on stainless steel substrate and investigation of electrochemical performance in oxygen reduction reaction in acidic medium

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Fuel cells need to improve durability and stability. Therefore, to improve fuel cell performance, reduce corrosion, and reduce manufacturing costs, this research is an attempt to use stainless steel as an electrode substrate, and nickel-cobalt and FeNxC as electrocatalysts. Three samples of stainless steel with different mesh are considered as the electrocatalyst's substrate. To reduce the corrosion rate, a thin layer of titanium is placed on the meshes by a sputtering method. Then samples are placed in the electroplating solution with the aim of loading the platinum and non-platinum cobalt-nickel catalyst. So as to determine the optimal time and concentration of electroplating, the samples are taken in different times and concentrations. In addition, the FeNxC catalyst is placed on the electrocatalyst substrate using the painting method. The structure of the electrocatalysts has been evaluated by SEM, XRD, and EDS imaging methods. The performance of the electrocatalysts for oxygen reduction reaction in an acidic medium has been evaluated by electrochemical tests such as line scan voltammetry, chronoamperometry, and impedance electrochemical spectroscopy. The results of comparing the plating time for the non-platinum nickel-cobalt electrocatalyst shows that the optimal plating time is 20 minutes. Changing the concentration of the plating solution has no significant effect on the results. In the case of the platinum electrocatalyst with three different plating times, the optimal plating time is 7.5 minutes. The performance of the FeNxC electrocatalyst has been promising according to the obtained results and is comparable to the results obtained from the platinum sample.