3D STRUCTURES COPPER-NICKEL FOAMS DECORATED WITH PLATINUM PARTICLES FOR THE ELECTROOXIDATION OF SODIUM BOROHYDRIDE

Žana Činčienė, Aldona Balčiūnaitė, Loreta Tamašauskaitė-Tamašiūnaitė, Jūratė Vaičiūnienė, Eugenijus Norkus

Department of Catalysis, Center for Physical Sciences and T echnology, Sauletekio Ave. 3, LT-10257, Vilnius, Lithuania

zana.cinciene@ftmc.lt

Currently, one of the renewable energy sources is fuel cells, namely chemical energy is directly converted into electricity. Designing new or enhancing the existing fuel cells, much attention is devoted to the search of new effective catalysts, which would allow increasing the effectiveness of fuel cells and creating the background for designing new technologies for catalysts formation. Everyone knows that precious metal and their alloys effectively catalyze the oxidation reaction of sodium borohydride. The cost of using such catalysts alone is very expensive, so an alternative is being sought.

The aim of the work is to form efficient and inexpensive nanostructured catalysts by electroplating 3D metal copper-nickel (Cu-Ni) foams with further their decorating with small amounts of platinum nanoparticles (PtNPs) for the electrooxidation of sodium borohydride ($NaBH_4$). Cu-Ni foam was prepared by electrochemical deposition ($I_{deposition}$=1.5 Acm^{-2}, $t_{deposition}$= 3,6 and 9 min) on titanium (Ti) surface. The electrolyte was containing 0.5 M Ni^{2+} ions and 0.01 M Cu^{2+} ions.

PtNPs were deposited by galvanic displacement on Cu-Ni foam (noted (Pt (Cu-Ni)/Ti)) by its immersion into the 1 mM H_2PtCl_6 solution at 25 °C for 1 min. The morphology and composition of the prepared catalysts were investigated using scanning electron microscopy (SEM), X-ray diffraction (XRD), and inductively coupled plasma optical emission spectroscopy (ICP-OES). The electrocatalytic activity of the prepared catalysts was evaluated towards the electrooxidation of sodium borohydride using the cyclic voltammetry method. The cyclic voltammograms were recorded on the prepared Cu-Ni foams and Pt(Cu-Ni)/Ti catalysts in a 0.05 M $NaBH_4$ solution in an alkaline medium in the potential range from -1.2 to 0.6 V (vs. Ag/AgCl) and with an electrode potential scan rate of 10 mVs^{-1}.

The study showed that the prepared 3D metal Cu-Ni foam and Pt(Cu-Ni)/Ti have good electrochemical stability in an alkaline $NaBH_4$ solution. It was also observed that immersion of Cu-Ni foam in a platinum-containing solution for 1 min increased the electrocatalytic activity of the prepared Pt(Cu-Ni)/Ti catalyst for $NaBH_4$ oxidation compared to Cu-Ni foam.

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