Ni Microspheres as Electrocatalysts for Ethanol Oxidation in an Alkaline Medium

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We report the synthesis of nickel microspheres and their structural and electrochemical characterization. The materials were prepared by the microemulsion technique from $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ and NaOH, and using $\text{NaH}_2\text{PO}_2 \cdot \text{H}_2\text{O}$ as a reducing agent. Sodium dodecyl sulfate (SDS) was used as a surfactant. The following ternary formulations were used for their synthesis: N1 (90% H_2O -7.5% SDS-2.5% Pentanol), N2 (92.5% H_2O -5% SDS-2.5% Pentanol), N3 (95% H_2O -3.75% SDS-1.25% Pentanol) and N4 (99% H_2O -0.75% SDS-0.25% Pentanol). The catalysts were characterized by scanning electron microscopy (SEM) and X-ray diffraction (XRD). The catalytic activity for ethanol oxidation in an alkaline medium was evaluated by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The average diameters of the nickel microspheres ranged from 0.375 to 1.476 μm . On subjecting the materials to heat treatment in a nitrogen atmosphere at 300 °C for 4 h, mixtures of polycrystalline Ni and nickel phosphide (Ni_3P) were obtained. The best performance for the ethanol oxidation reaction (EOR) in an alkaline medium was recorded with non-heat-treated nickel microspheres, presenting a maximum peak potential at approximately 0.7 V vs. Hg/HgO with normalized currents between 10.774 and 18.198 $\text{mA}(\text{mgcat})^{-1}$. These results indicate that nickel microspheres are potential candidates for use as anodes in alkaline direct alcohol fuel cells (A-DAFCs).

Keywords: Nickel microspheres, microemulsion synthesis, electrocatalysts, anode, alkaline direct alcohol fuel cells.

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