Wydział Chemiczny
Katedra Chemii Nieorganicznej, Analitycznej i Elektrochemii

ROZPRAWA DOKTORSKA

Opracowanie nowych tworzyw elektrokatalitycznych z wykorzystaniem nanotechnologii do utleniania wybranych związków organicznych

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Abstract

In the proposed thesis a simple method for composite catalyst synthesis is presented. The properties of such materials, including their activity toward oxidation of simple organic molecules, such as urea, methanol, and ethanol, were examined.

Proposed catalysts, in the form of powders, have been prepared using the electrodeposition technique. The electrolytic bath contained nickel and copper ions with the addition of a graphene oxide. During the experiments, the influence of current density used for the electrodeposition process and the presence of nanometric carbon particles in the electrolytic bath on the properties of the final materials have been examined.

The physicochemical properties of prepared catalysts have been examined using Scanning Electron Microscopy with X-ray Dispersive Spectroscopy, Raman Spectroscopy, X-ray photoelectron spectroscopy, and X-ray diffraction. Using these techniques, the chemical composition of the prepared materials has been examined. The electrochemical properties of proposed catalysts have been examined using cyclic voltammetry, linear sweep voltammetry, and chronoamperometry. The electroactivity of the proposed catalysts has been examined in KOH solutions and alkaline solutions of urea, methanol, and ethanol. The composite activity towards urea oxidation has been further examined during its electrolysis. Samples of the reaction mixture have been periodically collected and its composition has been examined using ionic chromatography and high-performance liquid chromatography.

It has been proven that the electrodeposition technique can be an effective tool for the preparation of composite catalysts. The influence of the current density, and the presence of carbon nanometric particles in the electrolytic bath, on the properties of the final material has been examined. The proposed materials have been proven to be active in KOH solutions and alkaline solutions of urea, methanol, and ethanol. It has been confirmed that the addition of nanometric carbon particles leads to the formation of a composite material, with an electroactive surface and thus activity, higher, than that of the corresponding NiCu material. During the urea electrolysis experiments, it has been proven, that the widely agreed mechanism of urea oxidation to N_2, CO_2 and H_2O might not be accurate in some cases, and thus the necessity to include reaction product analysis in the new catalyst activity assessment protocol has been proven.