SYNTHESIS, CHARACTERIZATION AND INVESTIGATION OF N-DOPED CARBON SUPPORTED Au-Co AND Au-Ni NANOCOMPOSITES

Danielė Kurlenskaitė, Aldona Balčiūnaitė, Daina Upskuvienė, Loreta Tamašauskaitė-Tamašiūnaitė, Eugenijus Norkus

Department of Catalysis, Center for Physical Sciences and Technology, Saulėtekio Ave. 3, LT-10257, Vilnius, Lithuania
daniele1kurlenskaite@gmail.com

The search and application of new efficient catalyst compositions for practical low temperature proton exchange membrane fuel elements (PEMFC), replacing well-known and expensive Pt or its alloy catalysts with base metals or reducing the amount of precious metals in catalysts, is a relevant research direction to improve and and reduce the price of fuel cells.

In this work, new nanocarbon material synthesized from bio-waste-alder chips was used to form an effective catalysts. Carbon powder from alder chips was chemically activated with NaOH at higher temperatures and then doped with nitrogen at a temperature of 800°C using dicyanodiamide (DCDA) as a nitrogen precursor. Then, gold-cobalt (Au-Co) and gold-nickel (Au-Ni) nanoparticles were precipitated on the nitrogen-doped carbon (N-doped carbon) using the microwave synthesis method.

For the synthesis, a reaction mixture consisting of N-doped carbon powder, 1.3 mM $HAuCl_4$, 0.06 M $CoCl_2$ or $NiCl_2$, 0.05 M NaOH and ethylene glycol was used. Microwave synthesis was performed using a Monowave 300 (Anton Paar) at a temperature of 150°C for 30 min. Synthesized Au-Co/N-doped carbon and Au-Ni/N-doped carbon nanocomposites were washed with acetone, distilled water and dried in a vacuum oven at a temperature of 80°C for 2 hours.

The surface morphology, structure, and composition of synthesized Au-Ni/N-doped carbon and Au-Co/N-doped carbon catalysts have been extensively investigated using transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES), and Raman Spectroscopy.

TEM and Raman analysis data confirmed that the carbon powder derived from alder chips and nitrogen doped has a graphene structure. It has been found that the N-doped carbon powder consists of 92.68 at.% carbon, 0.74 at. % of nitrogen and 6.59 at. % of oxygen.

The use of the N-doped carbon as a substrate for the deposition of Au-Co and Au-Ni nanoparticles allows to develop an efficient catalysts for fuel cells.