Ni-BASED BIMETALLIC CATALYSTS FOR SODIUM BOROHYDRIDE HYDROLYSIS

Zita Sukackienė[1], Gitana Valeckytė[1], Loreta Tamašauskaitė-Tamašiūnaitė[1], Jolanta Stupakova[2]

[1]Lithuania, Vilnius, Center for Physical Sciences and Technology, Department of Catalysis,
[2]Lithuania, Vilnius, Vilnius Gediminas Technical University
zita.sukackiene@ftmc.lt

The accelerated increase in global energy consumption, in conjunction with the gradual depletion of fossil fuel resources, has prompted an intensive search for clean, sustainable, and efficient energy alternatives. Among the proposed solutions, hydrogen has emerged as a particularly attractive energy carrier due to its high energy density and environmentally benign nature, producing only water as a by-product during use. Notwithstanding these advantages, the development of efficient and cost-effective hydrogen production technologies remains a significant challenge. In this context, the catalytic hydrolysis of sodium borohydride has garnered considerable interest, as it enables hydrogen generation under mild conditions with a high hydrogen yield.

In the present work, three nickel-based bimetallic catalysts $Ni_{96}Co_4$, $Ni_{95}Mo_5$ and $Ni_{93}W_7$ were synthesized and comparatively investigated for hydrogen generation via sodium borohydride hydrolysis. The catalysts were prepared using an electroless deposition method. The surface morphology and chemical composition of the samples were analyzed using scanning electron microscopy (SEM) and inductively coupled plasma optical emission spectroscopy (ICP-OES). A thorough examination through the use of scanning electron microscopy (SEM) revealed that all of the synthesized catalysts are composed of agglomerated particles with irregular, predominantly oval-shaped morphologies. These morphological features contribute to an increased surface area, which is favorable for catalytic activity.

Among the catalysts that were examined, $Ni_{93}W_7$ demonstrated the highest catalytic activity for the hydrogen generation reaction, achieving a hydrogen generation rate of 10.0 mL/min at 70°C. Furthermore, this catalyst exhibited the lowest activation energy (50.14 kJ/mol) in comparison to the $Ni_{95}Mo_5$ and $Ni_{96}Co_4$ catalysts. The enhanced catalytic performance of $Ni_{93}W_7$ is attributed to the synergistic effect between nickel and tungsten, which facilitates the sodium borohydride hydrolysis reaction.

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