

APPLICATION OF Co_3O_4 AND Cr_2O_3 PARTICLES SUPPORTED ON NITROGEN-DOPED CARBON FOR HYDROGEN EVOLUTION REACTION

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The hydrogen evolution reaction (HER) is one of the key half-reactions in the process of electrochemical water splitting. It is responsible for generating hydrogen at the cathode. Efficient HER electrocatalysts are essential for reducing energy losses and enabling sustainable hydrogen production. Non-noble metal-based electrocatalysts offer an effective and low-cost alternative for HER, providing promising route towards green hydrogen production. In this study, Co_3O_4 , Cr_2O_3 , and $\text{Co}_3\text{O}_4\text{-Cr}_2\text{O}_3$ particles were prepared using a hydrothermal method and examined for their potential as non-noble metal electrocatalysts. Their structural and morphological properties were characterized using scanning electron microscopy (SEM). Additionally, the synthesized particles were supported on nitrogen-doped carbon (NC) with high surface area to enhance electrocatalytic activity. HER electrocatalytic activity was studied using linear sweep voltammetry (LSV) in an Ar-saturated 1 M KOH solution. The electrocatalytic activity for HER was found to be markedly increased when the Co_3O_4 and $\text{Co}_3\text{O}_4\text{-Cr}_2\text{O}_3$ particles were supported on NC, compared to the unsupported materials. Notably, Cr_2O_3 particles and the $\text{Cr}_2\text{O}_3/\text{NC}$ electrocatalyst exhibited no activity towards HER, demonstrating the positive influence of cobalt-containing oxides on HER performance. The $\text{Co}_3\text{O}_4/\text{NC}$ electrocatalyst demonstrated an onset potential (E_{onset}) of -0.189 V and an overpotential of 0.350 V at a current density of 10 mA cm^{-2} , compared to E_{onset} of -0.360 V and an overpotential of 0.476 V for $\text{Co}_3\text{O}_4\text{-Cr}_2\text{O}_3/\text{NC}$ under the same conditions. Thus, hydrogen produced through this process can serve as a clean fuel for fuel cells, enabling efficient energy conversion with zero carbon emissions. These results demonstrate the potential of cobalt-containing non-noble metal oxides as efficient, low-cost electrocatalysts for hydrogen production, supporting their application in fuel cells.