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Advanced Study on Hydrogen Evolution Reaction based on Nickel sulfide Catalyst

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Abstract : A potential pathway for efficient hydrogen production from water splitting electrolysis involves catalysis or electrocatalysis, which plays a crucial role in energy conversion and storage. Hydrogen generated by electrocatalytic water splitting requires active, stable, and low-cost catalysts or electrocatalysts to be developed for practical applications. In this study, we evaluated combination of 2D materials of NiS nanoparticle catalysts for hydrogen evolution reactions. The photocatalytic H_2 production rate of this nanoparticle is high and exceeds that obtained on components alone. Nanoparticles serve as electron collectors and transporters, which explains this improvement. Moreover, a current density was recorded at reduced working potential by 0.393 mA. Calculations based on density functional theory indicate that the nanoparticle's hydrogen evolution reaction catalytic activity is caused by strong interaction between its components at the interface. The samples were analyzed by XPS and morphologically by FESEM for the best outcome, depending on their structural shapes. Use XPS and morphologically by FESEM for the best results. This nanocomposite demonstrated higher electro-catalytic activity, and a low tafel slope of 60 mV/dec. Additionally, despite 1000 cycles into a durability test, the electrocatalyst still displays excellent stability with minimal current loss. The produced catalyst has shown considerable potential for use in the evolution of hydrogen due to its robust synthesis. According to these findings, the combination of 2D materials of nickel sulfide sample functions as good electocatalyst for H_2 evolution. Additionally, the research being done in this fascinating field will surely push nickel sulfide-based technology closer to becoming an industrial reality and revolutionize existing energy issues in a sustainable and clean manner.

Keywords : electrochemical hydrogenation, nickel sulfide, electrocatalysts, energy conversion, catalyst
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