Palm Leaf Waste-to-Hydrogen Conversion via Modified Graphene Oxide-Supported Ni–Co Electrocatalyst

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The transition to a clean energy is limited by the high cost of green hydrogen production, relying ?on expensive noble metals electrocatalysts. This creates supply chain risks and restricts large-?scale deployment. Also, large amounts of unused palm leaf waste posing an environmental ?challenge. Solving these two issues, this work aims to convert palm leaf carbon source to a cost-?effective and sustainable graphene oxide (GO) nanosheets loaded with Ni/Co as an ?electrocatalyst for hydrogen production via electrochemical water splitting. GO were synthesized ?from palm through pyrolysis and hydrothermal oxidation, then used as a conductive support for ?Ni/Co nanocomposites prepared at different ratios (2:1, 1:1, 1:2). The catalysts were evaluated ?for hydrogen evolution reaction (HER) in acidic (0.5 M H2SO4) and in alkaline (1 M KOH) ?media. Structural and morphological analyses (SEM, TEM, XRD, and FTIR) confirmed uniform ?dispersion of Ni/Co on GO. Electrochemical testing revealed that Ni/Co (1:1)-GO electrode ?exhibited superior performance with lowest overpotential, and charge transfer resistance. ?Quantifying the output, ˜1.5L of H2 was produced over 24h using small cell with 90% activity, ?demonstrating high stability. ? Enhanced performance is explained by synergistic Ni/Co-GO interactions, increasing active sites ?and accelerates electron transfer. With 1:1 optimal ratio, Ni is best at splitting water, and Co ?facilitates optimal hydrogen adsorption for hydrogen binding, that accelerates the overall ?hydrogen evolution kinetics. The work demonstrates a scalable waste-to-material strategy for ?efficient, low-cost H2 production, advancing sustainable energy technologies.? Keywords: Waste-to-value conversion, Green hydrogen, Prototype, Sustainability ?

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