Improving the Water Splitting Efficiency Using Nickel-based Catalysts: A Hydrogen Production Device Driven by Photovoltaic Cell

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Developing cost-efficient methods to store renewable energy is an essential part of satisfying the growing worldwide energy demands. The evolution of hydrogen from water splitting driven by solar energy is gaining popularity in recent years. In this project, electrochemical water splitting assisted by a silicon solar cell is used to convert solar energy to chemical en-ergy in the bonds of hydrogen and oxygen. Noble metals are very efficient but expensive cat-alysts for this reaction. Thus, cheap and abundant efficient catalysts, NiMo cathode and NiCo or NiCoFe anodes, are utilized for the electrolysis in this project. The electrochemical deposi-tion conditions were optimized to fabricate relatively large electrodes in a dimension of 5 cm × 5 cm to match the geometrical size of the solar cell and give more promising results by re-ducing the overpotential of the reaction. The optimization of NiMo was achieved by varying current from -20 to -77.5 mA and time from 1 second to 30 minutes. The optimized condi-tions were 25 minutes of deposition with a current of -200 mA. Electricity generated by a commercial photovoltaic cell of 30.25 cm2 was successfully utilized by the fabricated elec-trodes which produced a large quantity of hydrogen by the developed device. The solar-to-hydrogen (STH) efficiency of the device reached comparable results of 6.7% with economi-cally efficient catalysts in optimized conditions, making it available to use in a large scale. By industrializing this device, the future high energy demands can be supplied through hydrogen fuel instead of fossil fuel.

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