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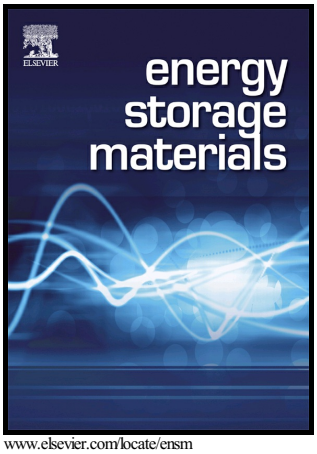

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Combining Water Reduction and Liquid Fuel Oxidization by Nickel Hydroxide for Flexible Hydrogen Production

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Abstract:

Electrochemical water splitting, which depends on the simultaneous hydrogen and oxygen evolution, is being considered as a sustainable hydrogen production approach, but where oxygen is generally an unconsidered by-product because of its rich existence in ambient (except some specific applications). The oxygen evolution related issues, including gas separation, sluggish kinetics, over-potential and noble catalyst, also limit the application of this technology. Herein, using nickel hydroxide as a solid-state redox mediator, we combine the water reduction and the oxidization of liquid fuel (e.g. ethanol, methanol, formate, isopropanol or hypophosphite solution) to form a new electrolysis architecture for hydrogen production without above issues. The hydrogen production involves the cathodic water reduction and the anodic oxidization of $Ni(OH)_2 \rightarrow NiOOH$, and consequently the cathodic reduction of $NiOOH \rightarrow Ni(OH)_2$ is coupled with the anodic oxidization of liquid fuel to form a hybrid system for delivering stable electricity energy and recycling $Ni(OH)_2$.

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