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# Hydrogen Battery Using Neutralization Energy

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## Abstract

Low-cost, non-toxic and environment-friendly electrochemistry is highly needed for clean energy storage technologies. Here we propose a most simple rechargeable *pH* differential hydrogen battery using neutralization energy as an efficient energy storage system to utilize renewable energy and waste acid/base. The overall battery reaction can be simplified as follow:  $2\text{H}^+ + 2\text{OH}^- \xrightleftharpoons[\text{charge}]{\text{discharge}} 2\text{H}_2\text{O}$ . This proposed hydrogen battery can deliver a theoretical specific energy of up to  $250 \text{ Wh kg}^{-1}$  and a maximum energy density of up to  $355 \text{ Wh L}^{-1}$ , very high values among aqueous battery systems. We show adding excessive amount of  $\text{NaClO}_4$  can lead to effective *pH* maintenance, higher coulombic efficiency, higher power and more stable cyclic performance at  $9 \text{ mA cm}^{-2}$ . This work offers new opportunities to

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