Catalytic Activity of Strontium Modified TiO₂ Nanotubes for Hydrogen Evolution Reaction

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A highly active electrochemical catalyst consisting of a strontium/titanium dioxide nanotubes (Sr-TNTs) composite was developed for the hydrogen evolution reaction (HER). The TNTs and Sr-TNTs were synthesized by direct hydrothermal synthesis. The morphology of the final product was characterized by SEM, EDX, X-ray diffraction (XRD) and Raman spectroscopy. The enriched Sr-TNT/Pd modified catalyst on Au electrode with highly dispersed nanoparticles and uniform Sr nanocrystallites provides an efficient electrocatalyst, leading to a superior HER activity with lower activation energy (5.56 kJ/mol) and optimum current density (1.393 mA/cm²) compared to undoped TNT/Pd in 0.1 mol L⁻¹ H₂SO₄ solution. The reaction is determined to follow the Volmer–Tafel mechanism. The exceptional performance of the Sr-TNT/Pd cathodes is due to the unique semiconducting properties of the Sr-TNTs structure, which provide abundant Pd active sites with optimized atomic hydrogen binding energies in acidic media for the hydrogen production. A mechanism for the HER on Sr-TNTs/ Pd has been proposed where both the hybrid metal (Sr) and the support metal (Pd) are involved in the charge transfer process.

Keywords: Electrocatalysts; Strontium-TiO₂ nanotubes; Hydrothermal; Hydrogen generation; Activation energy.

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