Enhancing Hydrogen Evolution Reaction Activity through Optimal Reaction Time in Synthesizing Platinum Single-Atom TiO_2 Catalyst

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Titanium dioxide (TiO_2) has garnered significant attention as a promising photocatalyst for clean and sustainable hydrogen production through photocatalysis. However, its potential is hindered by challenges such as high recombination rates of photoexcited charge carriers and limited absorption of the visible spectrum due to its high band gap energy. To overcome these limitations, researchers have investigated the approach of decorating TiO_2 with noble metals to enhance hydrogen (H_2) production via water splitting. In this study, we first synthesized one-dimensional (1D) TiO_2 nanotubes, followed by etching off the initiation layer on the top of the tubes. This structural configuration combines the advantages of nanoparticles with unique properties, including a direct pathway for accelerated electron transportation. Additionally, we explored the controlled loading of noble metals, notably platinum (Pt), onto TiO_2 nanotubes to enhance photocatalytic H_2 production. Various characterization techniques such as SEM, TEM, XRD, and UV-vis DRS were employed to elucidate the synthesized TiO_2 composite nanostructures. The optimized Pt, structured as single-atom photocatalysts, exhibited exceptional performance in photocatalytic water splitting and hydrogen evolution under one sun solar-simulated light conditions.

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