Hydrogen-Treated Semiconductor Metal Oxides For Photoelectrochemical (PEC) Water Splitting

Tech ID: 23228 / UC Case 2012-025-0

BACKGROUND

Photoelectrochemical (PEC) water splitting for solar hydrogen production has attracted extensive interest in the past few decades. In PEC water splitting, hydrogen is produced from water using sunlight and specialized semiconductors called photoelectrochemical materials. Moreover, Titanium dioxide (TiO_2) has been extensively investigated as a photoanode for PEC water splitting. TiO_2 photoanodes provide favorable band-edge positions, strong optical absorption, superior chemical stability and photocorrosion resistance, and are low cost. However, reported photocurrent densities and photoconversion efficiencies of TiO_2 photoanodes are substantially lower than projected. UC Santa Cruz researchers have developed a strategy which demonstrates that hydrogen treatment can significantly enhance the photoconversion efficiency of TiO_2 materials by improving their donor density and electrical conductivity.

TECHNOLOGY DESCRIPTION

UCSC researchers have demonstrated that hydrogen treatment can be used to fundamentally improve the performance of TiO_2 materials as photoanodes for PEC water splitting. Hydrogen-treated TiO_2 nanomaterials, in particular rutile nanowire and anatase nanotubes, yield substantially increased photocurrent densities and the photocurrents saturate at a very low applied bias. These hydrogen-treated TiO_2 nanowires and nanotubes open up new opportunities in various areas, including PEC water splitting, dye-sensitized solar cells, and photocatalysis. By replacing TiO_2 with new hydrogen-treated TiO_2 materials, the efficiencies of these processes and subsequent devices increase significantly.

APPLICATIONS

- PEC water splitting
- Dye-sensitized solar cells
- Photocatalysis

ADVANTAGES

- Substantially enhanced photocurrent densities
- Photocurrents saturated at a very low applied bias
- No greenhouse gas emissions

INTELLECTUAL PROPERTY INFORMATION

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,379,422	06/28/2016	2012-025

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OTHER INFORMATION

KEYWORDS

Photoelectrochemical, PEC, water splitting, photoconversion, photocatalysis, dye-sensitized solar cells, solar cells, titanium dioxide, photoanode, photocurrent, semiconductor, nanowire, nanotube, nanomaterials

CATEGORIZED AS

- **Energy**
  - Bioenergy
  - Solar
- **Environment**
  - Other
- **Semiconductors**
  - Design and Fabrication
  - Materials
  - Other
- **Engineering**
  - Other

RELATED CASES

2012-025-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Carbon-Doped NiO Catalyst For Hydrogen Evolution Reaction
- Zinc-Iodine Battery with improved Coulombic efficiency
- Z-Scheme Microbial Photoelectrochemical System (Mps) For Wastewater-To-Chemical Fuel Conversion
- Self-Biased and Sustainable Microbial Electrohydrogenesis Device
- Three-Dimensional Hierarchical Porous Carbon Foams For Supercapcitors

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