Back-Illuminated Photoelectrochemical Cell for Hydrogen Production

Tech ID: 33004 / UC Case 2019-188-0

BACKGROUND

Hydrogen from sustainable/renewable inputs shows promise as a decarbonized energy source. Hydrogen can be produced from a liquid electrolyte (e.g., water) through a variety of sunlight-based processes, including low/high-temperature electrolysis (e.g., steam electrolysis), photoelectrochemical (PEC), and solar thermochemical (STC). Temperature-based electrolysis systems using solar electricity are generally more complex and less solar-to-hydrogen efficient than PEC and STC. Water-splitting by PEC uses functional materials and leverages sunlight-driven electron-hole pairs to produce hydrogen and oxygen in two half reactions. STC water-splitting uses a series of consecutive chemical reactions and absorbed heat from sunlight to generate hydrogen and oxygen in two full reactions. Generation of hydrogen bubbles at the electrode-electrolyte interface obstruct the propagation of sunlight to functional or catalytic interfaces which limits the cell performance.

TECHNOLOGY DESCRIPTION

To address this problem, researchers at UC Santa Cruz (UCSC) have developed a PEC cell which spatially and temporally decouples generation of sunlight-driven electron-hole pairs from the transfer of electrical charges from/to liquid electrolyte (e.g., water) to produce hydrogen. In contrast with conventional PEC designs where these two processes occur simultaneously on the same surface of a photoelectrode, UCSC's PEC design has these processes take place on opposite surfaces of the electrode. As a result, the hydrogen bubbles form on one side of the electrode and do not interfere with the propagation of the sunlight to the other side of the electrode. Moreover, this design allows sunlight to be concentrated prior to reaching the electrode surface, which enables higher photon flux than non-concentrated cells.

APPLICATIONS

Photoelectrochemical hydrogen production

FEATURES/BENEFITS

- Eliminates sunlight interference from hydrogen bubbles.
- Allows for diversification of PEC electrode materials.
- Permits use of electrolytes with a wide range of pH.
- Compatible and enhanced by standard solar concentrator.

INTELLECTUAL PROPERTY INFORMATION

Country	Type	Number	Dated	Case
United States Of America	Published Application	20200291533	09/17/2020	2019-188

RELATED MATERIALS

- U.S. Patent Application Number 16/818923 filed 03/13/2020 - 03/13/2020

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OTHER INFORMATION

KEYWORDS

hydrogen, H2, solar, photoelectrochemical, electrolysis, thermochemical, electrolytic, photoelectric, decarbonization, clean energy, water-splitting, renewable, renewables

CATEGORIZED AS

- **Energy**
  - Hydrogen
  - Solar

RELATED CASES

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