Knowledge Transfer Office
香港城市大學
City University of Hong Kong

Solar-Electrocatalytic System for Hydrogen Generation

Energy & Environment

Energy Conservation/Generation/Management/Storage (Battery)

Nanotechnology and New Materials

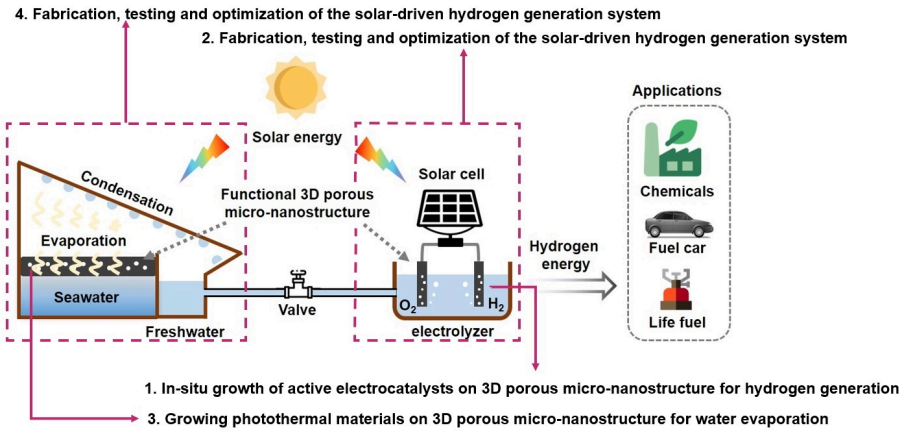

Figure 1. The synergistic solar-driven seawater evaporation and hydrogen production system.

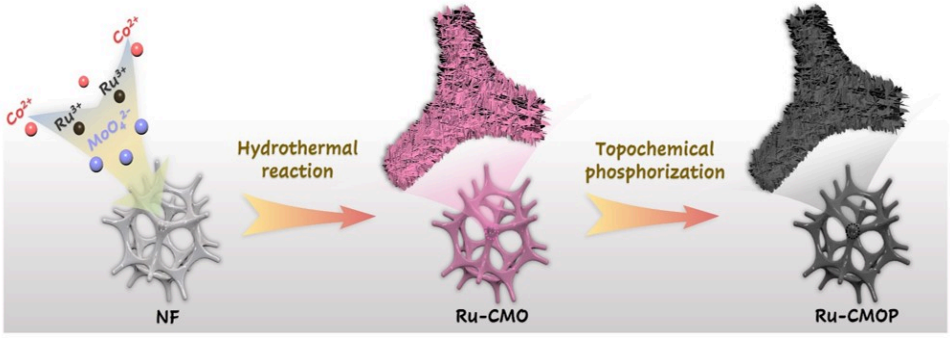

Figure 2. A large number of open micron-sized pores are generated because of the vertically interconnected nanosheets.

Remarks

1. 48th International Exhibition of Inventions Geneva (IEIG) (2023) - Gold Medal
2. 3rd Asia Exhibition of Innovations & Inventions Hong Kong (AEII) (2023) - Silver Award
3. Silicon Valley International Invention Festival (SVIIF) 2024 - Semi-Grand Prix
4. Silicon Valley International Invention Festival (SVIIF) 2024 - Gold Medal

IP Status

Patent filed

Technology Readiness Level (TRL) ? 6

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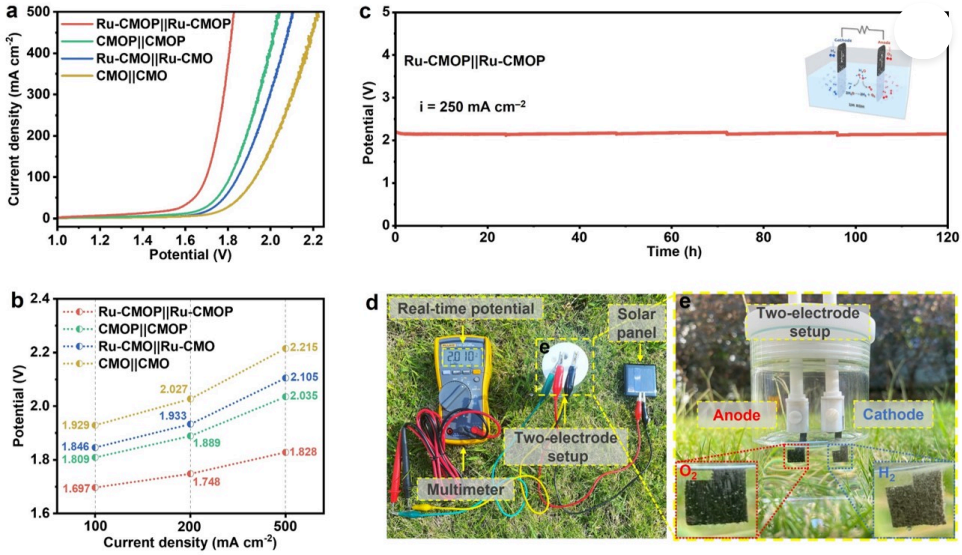

Figure 3. Using the Ru-CMOP as anode and cathode simultaneously delivers cell voltages of 1.697 V and 1.828 V to achieve 100 mA cm−2 and 500 mA cm−2.

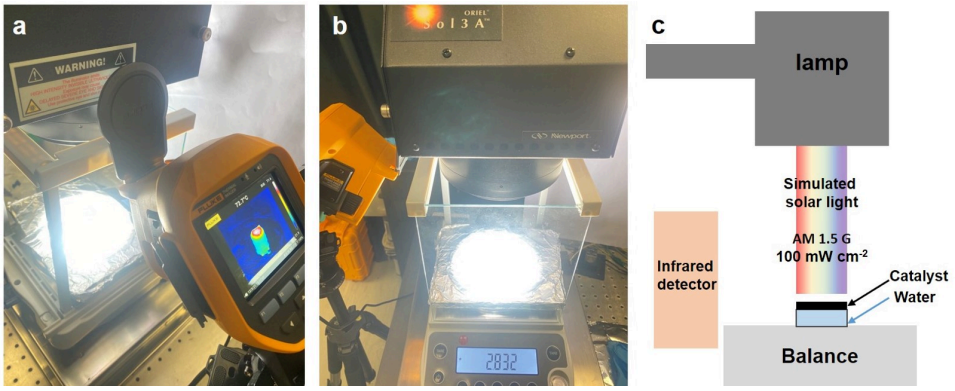

Figure 4. Fabrication, testing and optimization of the solar-driven hydrogen generation system.

Opportunity

Utilization of carbon-rich fossil fuels (e.g., coal, oil, and natural gas) in our society has led to a significant increase in CO_2 emissions, resulting in the climate changes due to the "greenhouse effect". Different government policy and clean energy technologies have been introduced to address the increasingly serious energy and environmental issues. Diversification of energy sources and development of alternatives to fossil fuels such as hydrogen-powered and electric vehicles are not only highly desirable, but some of them are currently technologically feasible and cost-competitive in different countries. Lately, there is a new concept, known as hydrogen economy, which utilizes hydrogen, generated by renewable energies, as high-density energy carriers instead of electricity. This way, instead of the centralized generation of hydrogen at power plants, hydrogen fuels can be produced on-demand on the spot for the delocalized energy generation by different schemes without using any energy storage technologies, power grid and transportation systems.

Technology

This technology aims for the efficient and delocalized generation of energy resources to achieve the cost-effective distributed renewable energy utilization. In specific, the surface of large-size 3D porous micro-nanostructure (e.g., nickel foam, carbon cloth) is engineered to reach a dual function: (i) solar-driven evaporation of seawater to freshwater and (ii) solar-driven electrocatalytic hydrogen production from the pre-evaporated seawater, which can enable the large-scale deployment for eco-friendly and low-cost solar-driven hydrogen fuel production from local seawater as an alternative clean energy carrier. Since there is not be any electricity grid system involved, there would not be any grid related problems encountered in the distribution of this renewable energy. This way, the hydrogen fuel can be generated on-demand in the local regions when it is needed, while there is no need to have a centralized generation as well as a large-scale storage and transportation of hydrogen fuels.

Advantages

- On-demand generation of large-scale and low-cost hydrogen fuels
- Multi-functionality and high-performance of micro-nanostructure electrocatalysts
- Solar-driven (e.g., photovoltaic and photothermal) water splitting

Applications

- Water splitting
- Hydrogen fuel generation