Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

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High-Efficiency Photocatalytic H2O2 Production

Background

Hydrogen peroxide (H2O2) is widely used for industrial synthesis of organic chemicals, advanced oxidation of drinking or wastewater, and surface disinfection of pathogens. Currently, ~95% of H2O2 production employs the energy- and chemical-intensive anthraquinone-oxidation process. Photocatalytic H2O2 production is an emerging alternative process. While material discovery has been a primary focus of research on photocatalysis, breakthroughs in reactor designs capable of supporting the novel materials are lacking.

Today, most photocatalytic processes are carried out in slurry systems, but slurry photocatalytic production has inherent limitations: poor light penetration and utilization due to its scattering when delivered from an external source, and difficulty to recover and recycle the photocatalysts. Overcoming these limitations could revolutionize this industry, minimizing environmental impact and resource dependency while enhancing process efficiency and safety.

Invention Description

Researchers at Arizona State University have developed a novel method to enable low-energy and chemical-free photocatalytic production of H2O2 by integrating visible light-emitting diodes, optical fibers, and O2-delivering hollow-fiber membranes. A stable iron-basis metal–organic framework photocatalyst that is activated by visible light is permanently affixed to the optical fiber, resulting in a uniform and high-specific-surface-area coating on the optical fiber. With O2 delivered from the hollow-fiber membranes and visible-light irradiation of the coated optical fiber, rapid H2O2 production in pure water was observed during initial tests: 60-fold faster than the best reported values using photocatalytic slurries. The system is scalable for small portable or large stationary applications that can use LED or solar light.

Potential Applications

- Chemical manufacturing
- Water treatment and purification
- Renewable energy and sustainability

Benefits and Advantages

- Increased energy efficiency
- Greater cost savings
- Improved process efficiency and safety
- Lightweight and portable
- Environmentally friendly and free of platinum-group metals