Improved Electrolytic Hydrogen Peroxide Generator

Energy efficiency exceeds that of a prior electrolytic H$_2$O$_2$ generator.

Lyndon B. Johnson Space Center, Houston, Texas

An improved apparatus for the electrolytic generation of hydrogen peroxide dissolved in water has been developed. The apparatus is a prototype of H$_2$O$_2$ generators for the safe and effective sterilization of water, sterilization of equipment in contact with water, and other applications in which there is need for hydrogen peroxide at low concentration as an oxidant. Potential applications for electrolytic H$_2$O$_2$ generators include purification of water for drinking and for use in industrial processes, sanitation for hospitals and biotechnological industries, inhibition and removal of biofouling in heat exchangers, cooling towers, filtration units, and the treatment of wastewater by use of advanced oxidation processes that are promoted by H$_2$O$_2$.

The apparatus is an electrochemical cell in which the electrodes are located on opposite sides of a commercially available polymeric membrane, which separates the electrolytes of the two electrolytic half-reactions. One of the half-cells produces the biocidal aqueous H$_2$O$_2$ product; the product of the other half-cell restores the biocidal solution to potability. The apparatus is designed to process water that is neutral (in the sense of neither acidic nor alkaline) or nearly neutral, to consume minimal energy, and to operate without need to supply nonregenerable material(s) other than the small proportion of water that is electrolyzed.

The energy efficiency of the cell is increased through improved microscopic mixing of the electrolytes near the electrodes without need for large bulk electrolyte flow rates: this is accomplished by rotating the electrodes relative to the rest of the cell (in contradistinction to forcing electrolyte flow over stationary electrodes). Even though the design of this prototype cell is unoptimized, the total energy consumption per unit of product was found to be 60 percent less than that of a common planar H$_2$O$_2$-generating cell in operation at similar Faradaic and production rates.

This work was done by Yekta Gursel of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

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High-Power Fiber Lasers Using Photonic Band Gap Materials

PBG materials would be exploited to increase power levels and efficiencies.

NASA’s Jet Propulsion Laboratory, Pasadena, California

High-power fiber lasers (HPFLs) would be made from photonic band gap (PBG) materials, according to the proposal. Such lasers would be scalable in the sense that a large number of fiber lasers could be arranged in an array or bundle and then operated in phase-locked condition to generate a superposition and highly directed high-power laser beam. It has been estimated that an average power level as high as 1,000 W per fiber could be achieved in such an array.

Examples of potential applications for the proposed single-fiber lasers include welding and laser surgery. Additionally, the bundled fibers have applications in beaming power through free space for autonomous vehicles, laser weapons, free-space communications, and inducing photochemical reactions in large-scale industrial processes.