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Membraneless Fuel Cell with Self-Pumped Fuel and Oxidant

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OTHER INFORMATION

KEYWORDS

Fuel cell, miniature power source,
membraneless fuel cell, cleantech

CATEGORIZED AS

▶ [Energy](#)
▶ [Storage/Battery](#)

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SUMMARY

Researchers at UCLA have developed a miniaturized membraneless fuel-cell system where the whole system can be reduced down to the millimeter scale without sacrificing output power.

BACKGROUND

Fuel cells are promising energy sources with higher theoretical energy densities than batteries. Despite the significant effort invested in the development of micro-scale fuel cells by numerous institutes and companies, active fuel-cell systems below a few centimeters in size have not been reported. Most existing miniature fuel cells are passive systems with poor fuel utilization. The challenges in miniaturizing whole active fuel-cell systems are largely due to difficulties in miniaturizing ancillary subsystems such as pumps, gas separators, and electrode assemblies on the charge-exchange membrane between the fuel and oxidant.

INNOVATION

This invention incorporates an innovative membraneless design with other specialized ancillary technologies that simplify the device and enable that the whole fuel-cell system to be miniaturized to the millimeter scale. Where most fuel cells require ancillary fuel and oxidant pumps, this invention incorporates a previously developed self-pumping mechanism that uses bubbles to move these fluids through its channels. The self-regulating nature of the system enhances fuel utilization, since the pumping rate of the fuel is automatically adjusted according to the applied electrical load. The pumping stops when the external electric load is removed. Additionally, lack of ancillary parts keeps the fuel cell efficient by not consuming the produced energy to run the ancillary parts. Because the system was essentially designed like a solid-state device, it is scalable to large systems and mass production.

The capability to simplify the device (and reduce conventional problems with fuel cells) without sacrificing the output power of existing fuel cells is attractive because it solves the main drawbacks of fuel cells when compared against batteries as miniature power sources.

APPLICATIONS

- ▶ Portable power source for miniature devices
- ▶ Long-lasting portable power source for larger devices

ADVANTAGES

- ▶ Simple design
- ▶ Size can be reduced to the millimeter scale
- ▶ Power output equivalent to existing larger devices
- ▶ Easily scalable to larger systems
- ▶ Amenable to mass production

STATE OF DEVELOPMENT

The invention has been designed, fabricated and tested in proof-of-concept device in centimeter scale. It has been proven experimentally with fuel of formic acid (HCOOH) and acidic oxidant (1M H₂SO₄) that the device produces power output (peak current density: ~80 mA/cm²) comparable to the existing technique that forces the fuel with an external pump.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,601,789	03/21/2017	2010-309

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