Improved Fuel Cell with Flow-Based Anode and Cathode

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WARF: P170232US02

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing fuel cells in which the catalyst is removed from the electrode, enabling cheaper and/or more flexible systems.

Overview

Fuel cells hold promise for flexible, highly efficient power generation with low emissions. Two of the major issues hindering widespread adoption of fuel cells are the reliance on costly platinum cathodes to drive oxygen reduction and a lack of hydrogen infrastructure or alternative fuels.

In traditional polymer electrolyte membrane fuel cells (PEMFCs) or direct methanol fuel cells (DMFCs), the fuel is oxidized on a platinum or platinum-alloy catalyst that is deposited directly on the anode, and oxygen is reduced on the cathode by platinum catalysts. Both reactions occur directly on the respective electrodes. However, this configuration requires co-optimization of fuel oxidation, oxygen reduction and electrochemistry – severely limiting efficiency and output.

The Invention

UW-Madison researchers have developed a fuel cell with the catalyst removed from the electrode, offering several advantages that enable cheaper fuel cells and/or more flexible systems.

In the fuel cell, the anode includes an electrolyte solution and carbon-containing redox mediator, as well as a heterogeneous redox catalyst that is separated from the anode. The anode is also separated from the cathode by a permeable barrier. The anodic mediator is oxidized at the electrode and reduced by reaction with the fuel and the catalyst.

The cathode contains a redox mediator paired with a platinum- or non-platinum-based catalyst attached to a support (e.g., carbon, silica or metal-oxide), as described in P140274US02. The cathode is supplied with oxygen. The cathodic mediator is reduced at the electrode and reoxidized by reacting with the oxygen and the catalyst.

Applications

- Fuel cells for portable power generation, stationary power generation and power for transportation

Key Benefits

- Allows cheaper fuel cells or more flexible systems
- Non-conductive supports can be used for the catalyst.
- Enables higher loading of less active catalysts
- Reduces catalyst poisoning by using non-platinum catalysts
- Decreases plant complexity

- Increases device modularity

Stage of Development

Actual – the researchers have demonstrated basic proof of principal with additional work planned including the construction of a standalone prototype.

The development of this technology was supported by the WARF Accelerator Program. The Accelerator Program selects WARF's most commercially promising technologies and provides expert assistance and funding to enable achievement of commercially significant milestones. WARF believes that these technologies are especially attractive opportunities for licensing.

Additional Information

For More Information About the Inventors

- Shannon Stahl
- Thatcher Root

Related Technologies

- P140274US02
- P170383US02

Tech Fields

- Clean Technology : Energy storage, delivery & resource efficiencies

For current licensing status, please contact Jennifer Gottwald at jennifer@warf.org or 608-960-9854