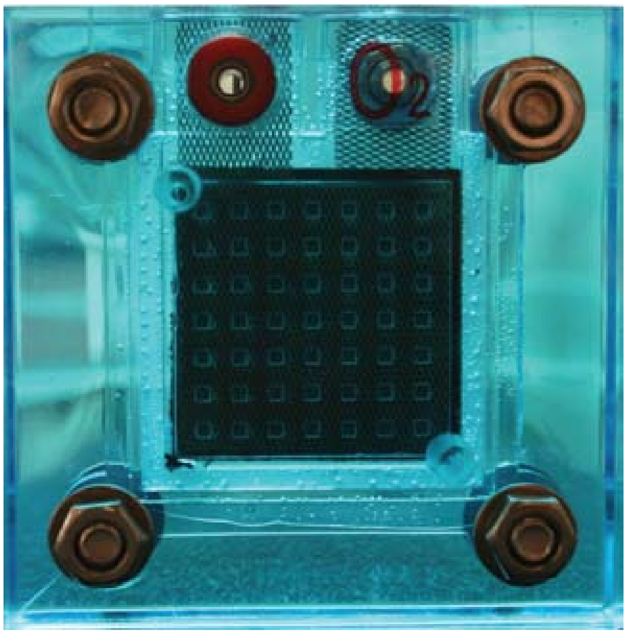
National Aeronautics and Space Administration

technology opportunity

Fuel Cell Power System with Self-Regulating Control of Parasitic Loads

Simplifying control strategies with load-dependent voltage



Innovators at NASA's Johnson Space Center (JSC) have developed a method for efficiently controlling parasitic power in fuel cell systems. "Parasitic power" refers to power required for internal system maintenance rather than for the system's primary purpose of net power output. Originally designed for spacecraft, this novel method employs a single self-regulating control signal that does away with overly complex control strategies and external power controllers, such as electronic power control units, sensors, and thermostatic controllers. In situations where efficiency and reliability are crucial, this innovative method simplifies and reduces operating costs for fuel cell power systems.

Benefits

- **Efficient**: Boosts power output, making added power available for necessary maintenance tasks
- **Simple**: Eliminates the need for complex control strategies
- **Reliable**: Optimizes parasitic load control without an external power source
- **Cost-Effective**: Conserves power by adjusting parasitic loads proportional to need, reducing total fuel cell power costs

Applications

- Cars, buses, and material handling vehicles (such as forklifts) that run on fuel cells
- Distributed energy storage systems for Smart Grid applications
- Next generation renewable energy applications
- Telecommunications back-up systems
- Deep-sea oil drilling operations
- Uninterruptible power supplies
- Fuel cell critical power systems where reliability and efficiency are primary concerns (such as military vehicles, aircraft, and undersea vehicles)

Technology Details

Fuel cell systems typically must control several parasitic power functions such as pumps for circulating coolant or reactant gases, electric heaters for maintaining operating temperatures, and centrifugal water separators. Operating these functions steadily at their full power is wasteful and reduces the overall efficiency of the power system. This unique method allows smooth adjustment of parasitic control voltages in situations where the power demand from parasitic devices depends on the power output of the fuel cell power system.

How It Works

The method takes advantage of the operating characteristics of fuel cell stacks, particularly the fact that voltage drops off with increasing current density in greater extremes than with battery-based power systems. In one configuration, the innovation uses two or more fuel cell stacks (one or more primary and a parasitic-load stack) in parallel. Between the negative ends of the fuel cell stacks, a device that is to be controlled from a parasitic power standpoint is placed with its positive electrical power input feed from the negative terminal of the primary stack. The negative output terminal of the parasitic powered device is attached to the negative terminal of the parasitic power stack (see Figure 1).

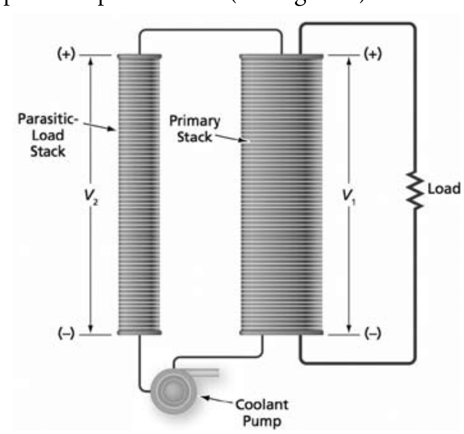


Figure 1. The voltage applied to the coolant pump ($V_2 - V_1$) would increase as V_1 decreases with increasing current through the load.

As the electrical power output of the fuel cell system increases, the voltage of the primary stack decreases as a function of the voltage versus current density response of the particular fuel cells incorporated into the primary stack. As the primary stack voltage decreases, the voltage difference between the primary and parasitic stacks increases, resulting in current flow through the parasitic device. By carefully selecting cell stack areas, numbers of cells in the two stacks, and resistance of the parasitic power device, the system will operate in a self-regulating, load-following manner.

Why It Is Better

Conventional methods of controlling parasitic power involve active control features such as electronic power units, electrical or mechanical thermostatic control, current sensors, and variable frequency inverters. Such features increase overall system complexity and reduce reliability. Most existing methods work by turning a parasitic device on and off as requirements change, which is less efficient than the continual adjustment offered by JSC's novel method.

Patents

Johnson Space Center is seeking patent protection for this technology.

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program (IPP), which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing this Self-Regulating Control of Parasitic Electric Loads in Fuel Cell Power Systems technology (MSC-24169-1) for commercial applications.

For More Information

If If you would like more information or want to pursue transfer of this technology, please contact:

msc24169@fuentek.com

For more information about other technology licensing and partnering opportunities, please visit:

Innovation Partnerships Office
NASA's Johnson Space Center
http://technology.jsc.nasa.gov