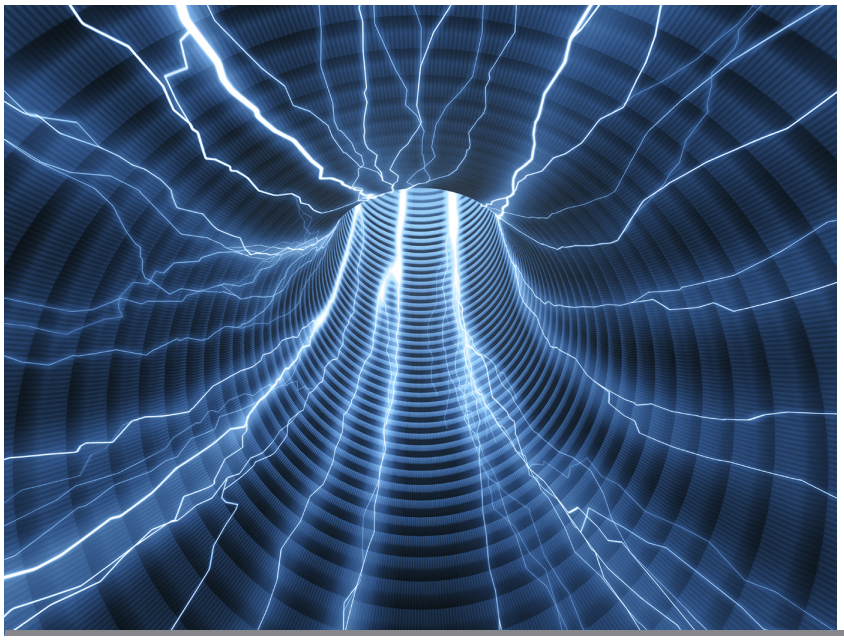


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Power Generation and Storage

Fuel Cell Power Management

Produces multiple power levels from a single fuel cell stack

An innovation from NASA's Glenn Research Center increases the efficiency and versatility of fuel cell stacks for power generation. When there is a large increase in the power demand from a fuel cell system, the voltage of the fuel cell system decreases, sometimes below the lowest acceptable threshold. To meet the requirements of a fuel cell system, engineers have typically added direct-current-to-direct-current (DC-to-DC) converters that boost the voltage produced at the ends of the fuel cell stack or added additional fuel cell systems to manage the increased power demand. However, adding DC-to-DC converters or additional fuel cell systems increases cost, reduces efficiency, and adds both mass and volume. NASA's innovative technique features multiple power points that connect different numbers of cells in an electrical series to a device connected to the fuel cell system, allowing the fuel cell system to maintain the desired voltage to the device under very large electrical power demand changes. This capability eliminates DC-to-DC converter electronics, thereby reducing cost and simplifying the system.

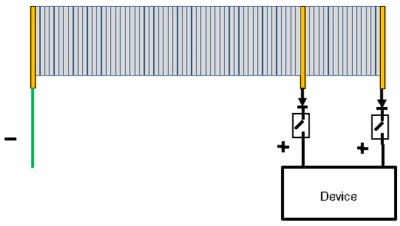
BENEFITS

- Less costly: Fuel cell systems can be built without the added cost of converters
- More efficient: This technique eliminates the need for an additional step in the process of generating usable power from fuel cells
- More reliable: This improvement decreases the part count within the design, thus reducing the number of potential points of failure in the system
- Reduced size: Removing the converters or additional fuel cell systems decreases the mass and volume of the overall system

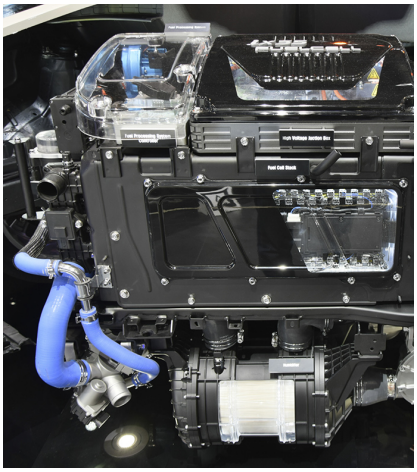
THE TECHNOLOGY

In general, individual fuel cells produce relatively small electrical potentials, so fuel cells are "stacked" or placed in series (anode to cathode) to increase the combined voltage and meet the application's requirements. The current is drawn off by connection points, which typically are at the extreme ends of the fuel cell stack. DC power converters reduce or boost the voltage produced at the ends of the stack into a voltage that can be used by attached device. However, these converters add cost, mass, volume, and potential failure points into the fuel cell system.

With NASA Glenn's groundbreaking technique, the fuel cell stack includes a plurality of connection points to the device instead of having a fixed number of individual fuel cells. By connecting additional cells in the same stack to the device the system power can be to be tailored to produce the required voltage for the connected device. Initially, this plurality includes a ground, a first connection point, and a second connection point. Additional connection points to the device can be added as needed, resulting in various powers that are available for use. Each connection point allows power to be drawn the combined voltages of the fuel cells located between the connection point and the ground. This configuration permits the voltage to be adjusted to the system power requirements of the device without the need to add DC power converters to the fuel cell system to add additional fuel cell systems to meet the power demand of the device. For larger fuel cell configurations in particular, NASA's innovative technique results in a far less costly, more efficient means of power generation.



Fuel cell stack with multiple connection points



Fuel cell powered vehicle

APPLICATIONS

The technology has several potential applications:

- Power (e.g., energy generation and storage, emergency power, uninterrupted power systems)
- Aerospace (e.g., aircraft, spacecraft, weather stations)
- Communications (e.g., remote or back-up power)
- Military (e.g., portable field deployment, naval, submarines)
- Unmanned vehicles
- Turbines (e.g., cogeneration for residential and commercial use)
- Industrial machinery

PUBLICATIONS

Patent No: 10,320,015

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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