Neuron Imaging used to improve fuel cells

Research for nuclear-genenerated hydrogen

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To improve the performance of the kinds of fuel cells most likely to power more environmentally friendly automobiles in the future, Penn State researchers have begun using something called neuron imaging.

Neuron imaging sees through fuel cells and shows the flowing water within.

his helps to understand how the design of a fuel cell and the materials it is made of relate to its performance, according to researchers.

One of the biggest difficulties of fuel-cell design is in understanding how water behaves inside fuel cells. The amount of water flowing within a fuel cell and the distribution of the water play the biggest role in determining the performance and durability of the fuel cell, Matthew Mench, assistant professor of mechanical engineering, said.

For every fuel-cell design there is an optimum amount of water that can flow within, said Jack Brenizer, a nuclear engineering professor.

If a fuel cell does not have enough water, it is inefficient, and if it has too much water, it is inefficient, Brenizer added.

The more evenly the water flowing within a fuel cell is distributed, the better. Climate conditions can also pose a problem for fuel-cell use in automobiles, Mench said.

"Say your car is parked in a cold environment, and the liquid is not properly removed from your fuel-cell stack at shut-down; it can freeze and expand to damage the fuel-cell components the same way the water will expand and damage the cells inside a tomato," Mench wrote in an e-mail message.

In contrast to today's automotive engines, which run on gasoline and produce smog-forming pollutants as well as heat and water, fuel cells run on hydrogen and produce electrical current as well as heat and water, Mench said.

Without emitting carbon dioxide, carbon monoxide or other smog-forming pollutants, fuel-cell-powered automobiles are obviously more environmentally friendly than internal-combustion, engine-powered automobiles, he said. Additionally, fuel cells generally run on hydrogen more efficiently than internal-combustion engines run on gasoline, which adds to their environmental friendliness, Mench added.

As one fuel cell alone is not nearly up to the task of motivating an automobile, multiple fuel cells are stacked together to get the wheels turning.

Today's demand for hydrogen is met with hydrogen produced using natural gas as well as other fuels containing carbon, which means that smog is produced so that fuel cells can run without producing smog. While this is more environmentally friendly than producing smog so that internal-combustion engines can run while producing smog, as is today's case, there are plans to cut carbon out of the equation altogether, Mench said.

Nuclear, solar, wind and water power are all capable of producing hydrogen, as is a process called bio-generation, in which bacteria eat human waste and in turn produce waste of their own hydrogen. The next generation of nuclear plants that can produce hydrogen on a large scale will be extremely safe, will not meltdown and can be put anywhere, Mench said.