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Nano World: Methanol fuel cell thru nano

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Nanotechnological fuel cells that run on methanol could one day power everything from cell phones to cars, experts told UPI's Nano World.

For laptops, cell phones and other portable electronics, "we envision a fuel cell system about the size of a cigarette lighter that could be refueled by inserting a small cartridge of methanol," said researcher Prashant Kumta, a materials scientist at Carnegie Mellon University in Pittsburgh. Methanol fuel cells would also "definitely be useful for automotive applications, with cars running on just a tank of methanol."

Fuel cells generate electricity by reacting fuel. Most fuel cells use hydrogen as fuel, but hydrogen is currently expensive and hard to produce in large quantities.

The fuel cells Kumta and his colleagues are investigating are powered by commonly available methanol and water. When the methanol and water make contact with a catalyst, they break down into electrons, protons and carbon dioxide. A special plastic membrane allows the protons to pass while blocking the electrons, which instead flow through a circuit to generate an electrical current. The carbon dioxide gets vented away.

The catalyst in methanol fuel cells is coated onto a support typically made of carbon, a good conductor that holds up well in the acidic environment inside the fuel cells and is common and cheap. The problem was that the catalyst particles, often made of platinum or of platinum and ruthenium, bonded very poorly onto the carbon, instead tending to migrate off, clump together and eventually dissolve, thereby reducing performance.

Kumta and his team instead used titanium nitride as supports. They grew particles of catalytic platinum-ruthenium roughly three nanometers or billionths of a meter wide onto titanium nitride particles 10 nanometers across. The titanium nitride bonds strongly with the catalyst and is as electrically conductive as carbon, "if not better," Kumta said. The titanium nitride and catalyst nanoparticles showed excellent activity and stability compared with carbon-supported platinum-ruthenium catalysts, he added. These are preliminary findings and improvements are possible with further optimization.

"This piece of work is quite an advance in my opinion," said electrochemist S.R. Narayanan at NASA's Jet Propulsion Laboratory in Pasadena, Calif. "Using titanium nitride is definitely technically a good idea."

The nanoscale nature of these components ensures an extraordinarily high amount of surface area for the fuel cell reactions to take place on, which should help lead to highly efficient devices. Kumta presented his team's research on February 18 at the annual meeting of the American Association for the Advancement of Science in St. Louis.