



Advanced Glucose Fuel Cells

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In the search for new sources of electricity, researchers are exploring bioenergy as a possibility. Recently, several concepts for biofuel cells have emerged.

Dr. Sang Choi at NASA Langley Research Center is investigating novel methods for using glucose as the energy source in fuel cells.

Although glucose and other carbohydrates are plentiful, renewable, have high energy density, and are convenient as fuels, there are some challenges.

One issue is converting corn or another starch into glucose for fuel would drive up the price of the vegetables for human and animal consumption. Choi's team is looking into biomass as the raw material, because it contains cellulose.



Biomass

“What we are talking about actually is cellulose glucose, like a wood stock. We change the wood stock into glucose and then we use it as fuel in a fuel cell,” according to Dr. Choi.

Another challenge for converting the glucose into energy, is finding the right catalyst to use in the process. A potential solution comes from Choi's previous research. While working on a bionano battery, he discovered a special methyl viologen chemical that can help to extract more electrons from glucose.

Choi's fuel cell process is fairly simple. It uses methyl viologen as a catalyst immobilized on an electrode where chemical reaction is induced. This helps oxidize the glucose. The resulting product is carbonate and water.

In lab testing, the team's results have been exceptional.

“Our fuel cell, as opposed to others already available, is much more efficient. You can extract actually 24 electrons out of this fuel cell process, four times better than the others.”

In order to eventually move the technology from laboratory to industry, it will need to be scaled up.

“We are developing a nanostructured electrode to improve the reaction rate. We need to have a large area of reactive surface. So the nanoscale structure of electrode increases the reaction area drastically.”

Biofuel cells would have many applications, including some for NASA.

“Suppose that we send astronauts to the moon and mars. We know there is water. So, suppose we grow some type of vegetation. Most of the left-over vegetation after use as an oxygen generation and food supply can be used as fuel for this energy generation system. We can actually help space missions, too,” says Choi.