

Environmentally safer catalyst proves more active in hydrogen production

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Ohio State University engineers have developed a chemical catalyst that increases hydrogen production without using a toxic metal common to other catalysts.

Though the new catalyst is still in the early stages of testing, it could represent an important step toward using the nation's coal supply to power alternative fuel vehicles and equipment.

The catalyst uses a combination of iron, aluminum and other metals to harvest hydrogen from carbon monoxide and water, explained Umit Ozkan, professor of chemical and biomolecular engineering at Ohio State. In tests, the catalyst performed up to 25 percent better than a commercially available alternative.

Ozkan described the catalyst Wednesday at the American Chemical Society national meeting in San Diego.

Around the world, researchers are working to develop fuel cells -- devices which would use chemical reactions to produce electricity. Cars are a prime target for this technology, and experts believe that the type of fuel cell that is best suited to cars is one that runs on hydrogen.

“Hydrogen is the ultimate fuel,” Ozkan said. “At the same time, we have very large coal reserves. If we could somehow go from coal to hydrogen, we could put those reserves to use in a new way.”

That's why the Ohio Coal Development Office and the Ohio Department of Development are funding Ozkan's research.

The first step for making hydrogen from coal is a process called gasification, which converts coal to a carbon monoxide-rich stream. But the next step -- retrieving hydrogen from a reaction between carbon monoxide and water -- only works within a narrow range of low temperatures. New catalysts are needed to boost the reaction, especially for large-scale coal gasification, she said.

Until now, the most popular commercial catalyst has been one made from iron and the toxic metal chromium. During hydrogen production, the catalyst can release chromium as a byproduct. When the catalyst material has passed its useful lifetime, it requires expensive disposal methods.

Because researchers don't fully understand why the iron-chromium catalyst works as well as it does, coming up with a more environmentally friendly alternative hasn't been easy.

"We didn't just want to make a better catalyst, but also understand why it's better, and what we can do to make it work even better," Ozkan said.

She and her team suspected that the chromium helps maintain the pore structure of iron during the reaction, so they looked for a metal with a similar chemical structure. That led them to aluminum, and to other complementary metals that greatly increased hydrogen production.

"What is important is not only which metals are used, but how these metal molecules fit together. We believe the specific way we prepare the catalyst is a key factor in its superior performance," she said. "This performance was maintained when we tested the catalyst using a feed mixture similar to what is produced from coal gasification," she added.

The next thing Ozkan and her colleagues want to do is test whether their catalyst works in the presence of sulfur, since coal from Ohio and much

of the American northeast is sulfur-rich.

The coal gasification process typically removes sulfur, she pointed out. “The amount that’s left behind -- our catalyst may be able to handle that,” she said.

Source: Ohio State University

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