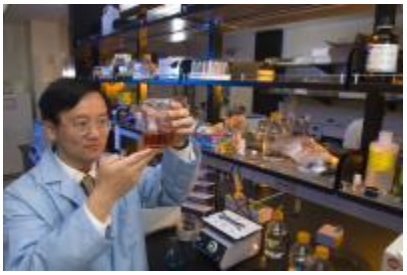
Breakthrough In Hydrogen Fuel Production



Hydrogen fuel production could revolutionize alternative energy market with a new method that is environmentally friendly and inexpensive.

That is the claim from a team of Virginia Tech researchers have discovered a way to extract large quantities of hydrogen from any plant, a breakthrough that has the potential to bring a low-cost, environmentally friendly fuel source to the world. Y.H. Percival Zhang, an associate professor, and his team have succeeded in using Xylose, the most abundant simple plant sugar, to produce a large quantity of hydrogen that previously was attainable only in theory. Zhang's method can be performed using any source of biomass.

The commercial market for hydrogen gas is now around $100 billion for hydrogen produced from natural gas, which is expensive to manufacture and generates a large amount of the greenhouse gas carbon dioxide. Industry most often uses hydrogen to manufacture ammonia for fertilizers and to refine petrochemicals, but an inexpensive, plentiful green hydrogen source can rapidly change that market. "**It really doesn't make sense to use non-renewable natural resources to produce hydrogen," Zhang said. "We think this discovery is a game-changer in the world of alternative energy."**

Hydrogen Powered Vehicles

Quoting form The Guardian: http://www.theguardian.com/science/blog/2013/jul/19/sweet-hydrogen-sugar-energy-needs

Zhang sees a future in which hydrogen-fuelled electric cars will phase out our dependence on fossil fuels. There are problems with hydrogen in transport, however: the gas needs to be stored and transferred at high pressure, and it's highly flammable. This has prevented the technology from being implemented in small vehicles. But Zhang's proposed solution to this problem is simple. "Why should we transport hydrogen? We can transport sugar instead, and perform the reaction in the car or in the service station."

The ultimate test for the method's viability will be the creation of a prototype, but at the moment researchers are still working to obtain maximum efficiency from the reaction. "In the future, these devices will be small enough to be incorporated in a car, where a fuel cell will then turn the hydrogen into electricity," says Zhang.

"Our bio-reactors will be a feasible option for small vehicles, but they will also work for big industrial complexes. We are designing the whole system to be very cheap, to scale it up easily."

Process

For seven years, Zhang's team has been focused on finding non-traditional ways to produce high-yield hydrogen at low cost, specifically researching enzyme combinations, discovering novel enzymes, and engineering enzymes with desirable properties.

The team liberates the high-purity hydrogen under mild reaction conditions at 122 degree Fahrenheit and normal atmospheric pressure. The biocatalysts used to release the hydrogen are a group of enzymes artificially isolated from different microorganisms that thrive at extreme temperatures, some of which could grow at around the boiling point of water. The researchers chose to use xylose, which comprises as much as 30 percent of plant cell walls. Despite its abundance, the use of xylose for releasing hydrogen has been limited. The natural or engineered microorganisms that most scientists use in their experiments cannot produce

hydrogen in high yield because these microorganisms grow and reproduce instead of splitting water molecules to yield pure hydrogen.

To liberate the hydrogen, Virginia Tech scientists separated a number of enzymes from their native microorganisms to create a customized enzyme cocktail that does not occur in nature. The enzymes, when combined with xylose and a polyphosphate, liberate the unprecedentedly high volume of hydrogen from xylose, resulting in the production of about three times as much hydrogen as other hydrogen-producing microorganisms.The energy stored in xylose splits water molecules, yielding high-purity hydrogen that can be directly utilized by proton-exchange membrane fuel cells. Even more appealing, this reaction occurs at low temperatures, generating hydrogen energy that is greater than the chemical energy stored in xylose and the polyphosphate. This results in an energy efficiency of more than 100 percent — a net energy gain. That means that low-temperature waste heat can be used to produce high-quality chemical energy hydrogen for the first time. Other processes that convert sugar into biofuels such as ethanol and butanol always have energy efficiencies of less than 100 percent, resulting in an energy penalty.In his previous research, Zhang used enzymes to produce hydrogen from starch, but the reaction required a food source that made the process too costly for mass production.

Source: http://revolution-green.com/breakthrough-in-hydrogen-fuel-production/