U of M researchers close in on technology for making renewable petroleum

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University of Minnesota researchers are a key step closer to making renewable petroleum fuels using bacteria, sunlight and dioxide, a goal funded by a $2.2 million United States Department of Energy grant.

Graduate student Janice Frias, who earned her doctorate in January, made the critical step by figuring out how to use a protein to transform fatty acids produced by the bacteria into ketones, which can be cracked to make hydrocarbon fuels. The university is filing patents on the process.

The research is published in the April 1 issue of the Journal of Biological Chemistry. Frias, whose advisor was Larry Wackett, Distinguished McKnight Professor of Biochemistry, is lead author. Other team members include organic chemist Jack Richman, a researcher in the College of Biological Sciences' Department of Biochemistry, Molecular Biology and Biophysics, and undergraduate Jasmine Erickson, a junior in the College of Biological Sciences. Wackett, who is senior author, is a faculty member in the College of Biological Sciences and the university's BioTechnology Institute.

"Janice Frias is a very capable and hard-working young scientist," Wackett says. "She exemplifies the valuable role graduate students play at a public research university."

Aditya Bhan and Lanny Schmidt, chemical engineering professors in the College of Science and Engineering, are turning the ketones into diesel

fuel using catalytic technology they have developed. The ability to produce ketones opens the door to making petroleum-like hydrocarbon fuels using only bacteria, sunlight and carbon dioxide.

"There is enormous interest in using carbon dioxide to make hydrocarbon fuels," Wackett says. "CO2 is the major greenhouse gas mediating global climate change, so removing it from the atmosphere is good for the environment. It's also free. And we can use the same infrastructure to process and transport this new hydrocarbon fuel that we use for fossil fuels."

The research is funded by a $2.2 million grant from the U.S. Department of Energy's Advanced Research Projects Agency-energy (ARPA-e) program, created to stimulate American leadership in renewable energy technology.

The U of M proposal was one of only 37 selected from 3,700 and one of only three featured in the New York Times when the grants were announced in October 2009. The University of Minnesota's Initiative for Renewable Energy and the Environment (IREE) and the College of Biological Sciences also provided funding.

Wackett is principal investigator for the ARPA-e grant. His team of co-investigators includes Jeffrey Gralnick, assistant professor of microbiology and Marc von Keitz, chief technical officer of BioCee, as well as Bhan and Schmidt. They are the only group using a photosynthetic bacterium and a hydrocarbon-producing bacterium together to make hydrocarbons from carbon dioxide.

The U of M team is using Synechococcus, a bacterium that fixes carbon dioxide in sunlight and converts CO2 to sugars. Next, they feed the sugars to Shewanella, a bacterium that produces hydrocarbons. This turns CO2, a greenhouse gas produced by combustion of fossil fuel

petroleum, into hydrocarbons.

Hydrocarbons (made from carbon and hydrogen) are the main component of fossil fuels. It took hundreds of millions of years of heat and compression to produce fossil fuels, which experts expect to be largely depleted within 50 years.

Provided by University of Minnesota