Novel method creates important industrial chemicals simply, cheaply

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Washington State University Professor Norbert Kruse and post-doc Vizhi Xiang have used a simple, common industrial process in a new way to create chemicals used widely as fuel additives and as feedstock for plasticizers, detergents, lubricants and cosmetics. Credit: Washington State University

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as fuel additives and as feedstock for plasticizers, detergents, lubricants and cosmetics.

Using the Fischer-Tropsch process to make alcohols and aldehydes in large amounts could lower the cost and energy required to produce the chemicals and possibly provide cleaner manufacturing.

The work is reported in today's issue of *Nature Communications*. A patent has been filed on the process by Norbert Kruse, WSU Voiland Distinguished Professor, and Yizhi Xiang, a postdoctoral fellow in the Gene and Linda Voiland School of Chemical Engineering and Bioengineering. Kruse holds a joint appointment at the U.S. Department of Energy's Pacific Northwest National Laboratory in Richland, Wash.

Fischer-Tropsch process provides petrochemical alternative

The Fischer-Tropsch process is a chemical reaction that uses catalysts to convert two gases, carbon monoxide and hydrogen, to liquid fuels in a simple, one-step process. It has been used for almost a century to create liquid fuels, which are made of long chains of molecules containing only carbon and hydrogen.

Current industrial processes to make alcohols and aldehydes require starting with a complex, petrochemical-based target molecule, an olefin, which is then converted to liquid chemicals in a complicated series of several steps.

To make the alcohols and aldehydes in the one-step Fischer-Tropsch process, the WSU researchers used a catalyst made of cobalt, manganese and potassium. To form the liquid, the two gases react at the surface of the solid catalyst.

"The catalyst preparation is really important," Kruse said. "And the chemistry aspect is wonderful: Starting with only two gases, we end up with a technically useful liquid that you usually obtain only after a number of steps in petrochemical refining. I think there is a good chance for industrial implementation."

Both cobalt and manganese are abundantly available, and the entire process could be significantly less expensive than more complicated methods.

Commercialization underway

The researchers also determined for the first time that they can create different amounts of chemicals depending on the ratio of carbon monoxide and hydrogen gases.

"This has rarely been done so far," said Kruse. "It was most intriguing to see how easily you can influence the relative amounts of chemicals you produce without changing the length of the hydrocarbon scaffold."

The researchers have started working with industry partners to commercialize their method.

Though it has been used for almost a century, researchers don't exactly understand how the Fischer-Tropsch process works at the molecular level.

"We are making progress and are working very hard on that," said Kruse. "Possibly we can crack that nut."

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