Making methane on Mars

How UCI physicists are making a return trip from the Red Planet a possibility
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Ian Anzlowar
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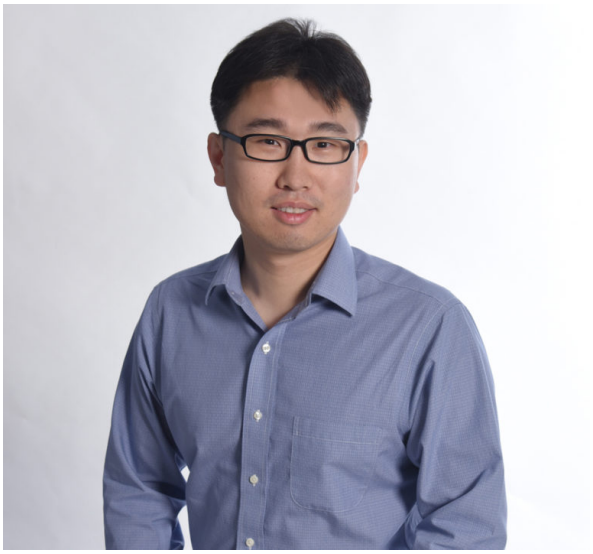
This concept depicts astronauts and human habitats on Mars. NASA’s Mars 2020 rover will carry a number of technologies that could make Mars safer and easier to explore for humans.

Picture Credit:
NASA

Houlin Xin, an assistant professor in physics & astronomy, may have found a solution.

He and his team have discovered a more efficient way of creating methane-based rocket fuel theoretically on the surface of Mars, which can make the return trip all more feasible.



“Lots of engineering and research is needed before this can be fully implemented. But the results are very promising,” says UCI’s Houlin Xin. UCI

The novel discovery comes in the form of a single-atom zinc catalyst that will synthesize the current two-step process into a single-step reaction using a more compact and portable device.

“The zinc is fundamentally a great catalyst,” Xin says. “It has time, selectivity and portability – a big plus for space travel.”

The process of creating methane-based fuel has been theorized before, initially by Elon Musk and Space X. It utilized a solar infrastructure to generate electricity, resulting in the electrolysis of carbon dioxide, which, when mixed with water from the ice found on Mars, produces methane.

This process, known as the Sabatier process, is used on the International Space Station to produce breathable oxygen from water. One of the main issues with the Sabatier process is that it is a two-stage procedure requiring large faculties to operate efficiently.

The method developed by Xin and his team will use anatomically dispersed zinc to act as a synthetic enzyme, catalyzing the carbon dioxide and initializing the process. This will require much less space and can efficiently produce methane using materials and under conditions similar to those found on the surface of Mars.

“The process we developed bypasses the water-to-hydrogen process, and instead efficiently converts CO2 into methane with high selectivity,” Xin says.

Currently, rockets created by Lockheed and Boeing use liquid hydrogen as fuel for the rockets. While it is cheap and effective, this fuel source has its drawbacks. Liquid hydrogen leaves carbon residue in the engine of the rocket, which requires cleaning after each launch; something that would be impossible on Mars.

Space X and Elon Musk have developed and are currently testing a methane fuel-based engine, known as the Space X Raptor. Raptor will power Space X's next generation of spacecraft named Starship and Super Heavy. At this time, neither have made it into orbit, and only one has consistently taken flight.

Despite the breakthrough, the process developed by Xin is far from implementation. Currently they only have a "proof of concept," meaning that while it has been tested and proven in a lab, it has yet to tested in real world – or planet – conditions.

"Lots of engineering and research is needed before this can be fully implemented," he says. "But the results are very promising."

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