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The Powder That Could Be Key for Natural-Gas Cars

A new technology could mean smaller and lighter tanks that are better suited to passenger vehicles

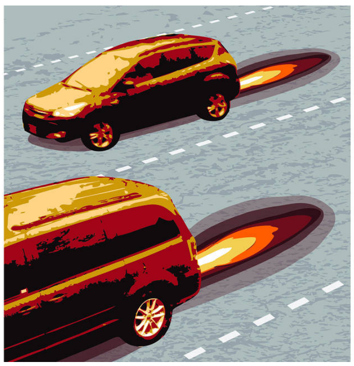

ILLUSTRATION: DANIEL HERTZBERG

By **DANIEL AKST**

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Natural gas burns relatively cleanly, and thanks to new extraction technologies, there is plenty of it. But few cars use it; most of the more than 150,000 U.S. vehicles running on natural gas are still trucks and buses.

One reason is that natural-gas-powered cars would need a much bigger fuel tank—perhaps filling the entire trunk as well as current gas-tank space—to achieve the range that drivers are accustomed to getting from gasoline. A given volume of gasoline contains more than triple the energy found in an equal volume of compressed natural gas.

Now scientists at the University of California, Berkeley, and other institutions on both sides of the Atlantic have come up with a new technology to pack more natural gas into a small space without the very high pressure or very low temperatures that are normally required. The result may be smaller and lighter tanks that are better suited to passenger vehicles.

"In a truck, you have space for a large, bulky pressure cylinder for compressed natural gas," says Jeffrey Long, the lead scientist and a chemistry professor at Berkeley. He adds that reducing the necessary pressure could also let drivers fuel up at home with a consumer-grade compressor connected to a household gas line.

The key is a powder of either cobalt or iron, with other substances, that looks like purple or yellow table salt. It has some special properties, foremost of which is a humongous surface area hidden away at the atomic level. One gram of this extraordinary material, says Dr. Long, can have a surface area almost as big as a football field. Coaxed only by moderate pressure, natural gas (mostly methane) binds tightly to all that surface area, letting go when pressure is reduced.

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And this material, known as a flexible metal-organic framework, has another special property: It expands (by becoming porous) as natural gas is pumped in, and it contracts (ceasing to be porous) when the gas is drained away by the engine.

The material's flexibility helps it to solve several gas-handling problems. For instance, when methane binds with a material such as charcoal, it releases heat, which has to be managed somehow. That is typically done with controls that take up additional space in a vehicle—a problem if you're trying to design a natural-gas-powered car. But the flexible metal-organic framework consumes much of the unwanted heat in the process of changing its structure as it comes in contact with the natural gas. When methane is released, heat is released as well, and that can help propel methane to an engine.

Dr. Long, who has worked for years on versions of this material, says that it might eventually be useful in many contexts. In oil refining, for example, it might help separate hydrocarbon components while consuming less energy than current techniques. In a power plant, it could be used to capture carbon-dioxide emissions to sequester them. A version of the material might make it possible to build higher density liquid-propane tanks. And Dr. Long's team is working on a variation of their magic powder that would store hydrogen.

"Methane storage in flexible metal–organic frameworks with intrinsic thermal management," Jarad A. Mason, Jeffrey R. Long and others, Nature (Oct. 26)