Catalyst removes cancer-causing benzene in gasoline

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Northwestern University scientists are experimenting with ways to eliminate a cancer-causing agent from gasoline by neutralizing the benzene compound found in gasoline. They developed a catalyst that effectively removed benzene from the other aromatic compounds in gasoline, making it cleaner and more efficient.

An estimated 137 billion gallons of gasoline were consumed in the United States last year, according to the U.S. Energy Information Administration, a daily average of about 375 million gallons. Within each gallon of gas is a chemical compound known as benzene, which has been recognized by the Environmental Protection Agency as a known contributor to cancer. A research team led by Northwestern's Tobin J. Marks has found a way to remove it.

"The gasoline we buy is one-third a mixture of aromatics, and benzene is one of them," said Marks, explaining that aromatics are necessary to improve gas octane numbers and fuel efficiency. "Only benzene is known to be cancer causing, and it's very difficult to remove. Our catalyst opened a whole new way to do that—and probably a very inexpensive way."

Marks is the Vladimir N. Ipatieff Research Professor of Chemistry in the Weinberg College of Arts and Sciences and professor of materials science and engineering in the McCormick School of Engineering and Applied Science.

"We could keep the cost of gasoline down," Marks added, "and a big environmental and health problem would be solved."

He describes his team's catalyst as an organometallic molecule, which is not composed of an expensive platinum metal but an affordable, simple metal, which is absorbed onto a particular oxide support. After almost two years of research experimenting with the selective hydrogenation of benzene, the team created a catalyst that removed the benzene from the other aromatics with high selectivity.

"We really know what the catalyst structure looks like," Marks said, "the relative rates of reactions, how the catalyst and aromatics interact with each other and how selective the catalyst is."

The research team, which includes scientists from Argonne National Laboratory and Universal Oil Products, released their findings in a paper featured on the cover of the June 3 issue of the *Journal of the American Chemical Society*.

The cover image depicts their catalyst, with a backdrop of the Chicago River and the architecture that towers over it along Michigan Avenue.

"It's eye catching," Marks said. "We tried to blend science with something that looks a little bit different."

More information: "Benzene Selectivity in Competitive Arene Hydrogenation: Effects of Single-Site Catalyst—Acidic Oxide Surface Binding Geometry" *J. Am. Chem. Soc.* DOI: 10.1021/jacs.5b03254

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