

Iron-based process promises greener, cheaper and safer drug and perfume production

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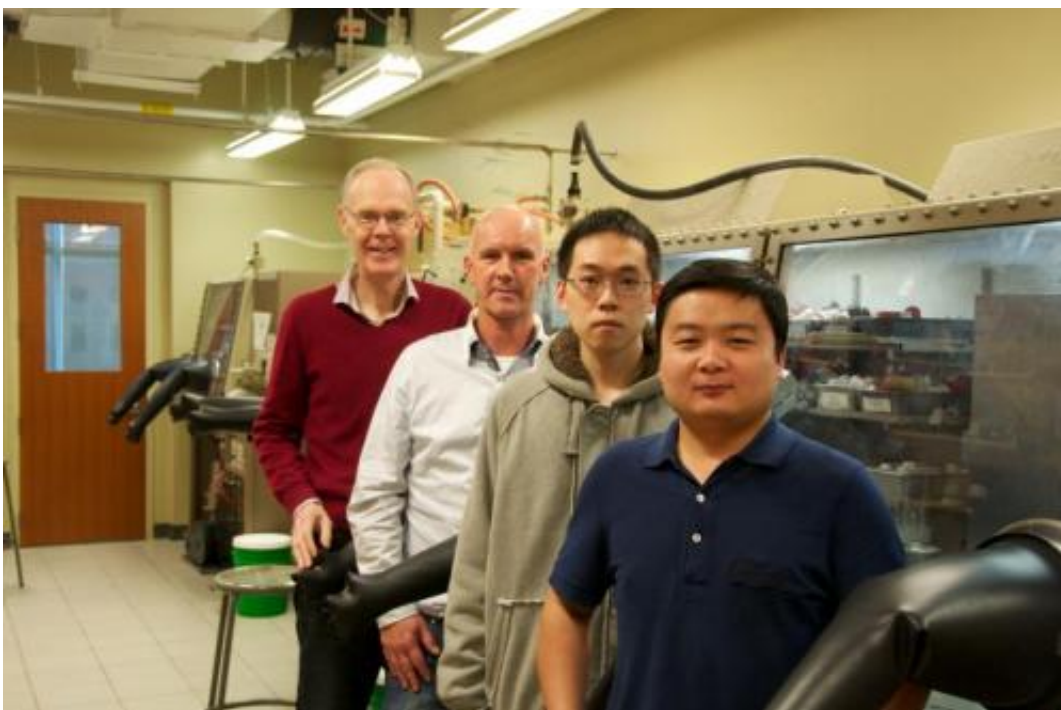


Photo of the authors: (from left to right) Professor Robert Morris, Dr. Alan Lough, Mr. Young Li, and Dr. Weiwei Zuo. Credit: Demyan Prokopchuk

University of Toronto researchers have developed a series of techniques to create a variety of very active iron-based catalysts necessary to produce the alcohols and amines used in the drug and perfume industry. The new synthetic methods promise to be safer and more economical and environmentally friendly than traditional industrial processes.

The research takes advantage of Earth's extensive supply of iron – the fifth most abundant naturally occurring metal – substituting it in place of the rare elements of [ruthenium](#), rhodium, palladium and platinum traditionally used in the design of hydrogenation catalysts. The result is an exceptionally efficient class of [iron complexes](#) whose abilities rival and even surpass those of conventional industrial catalysts.

"There is a research effort world-wide to make chemical processes more sustainable and green by replacing the rare, expensive and potentially toxic elements used in hydrogenation, catalytic converters in cars, fuel cells for the efficient conversion of chemical energy into electricity, and silicone coatings, with abundant ions such as iron," says U of T chemistry professor Robert Morris, principal investigator of a study reported in the November 29 issue of *Science*. "Iron is about 10,000 times cheaper to obtain than ruthenium. And less than 200 metric tons of platinum-type metals are mined in the world every year, not all of it can be recycled after use, it is not essential to life, and it can be toxic."

"We found a way to make the ferrous form of iron behave in a catalytic process much more efficiently than a precious metal. We did this by finding molecules containing nitrogen, phosphorus, carbon and hydrogen, that bond to, and enhance, the reactivity of iron," says Morris.

The scientists inexpensively produced varieties of alcohol with different biological properties – which can be used in flavour and drug synthesis – and different smells, a property important to the perfume industry. In one example from the study, the precursor alcohol to a cancer treatment can be made using the [hydrogenation](#) process catalyzed by iron. Using iron, the resulting complex is often a better catalyst than the industrial one based on ruthenium.

The sustainable technology incubator GreenCentre Canada is already pursuing the commercialization of the new [iron](#) catalysts.

More information: "Amine(imine)diphosphine Iron Catalysts for Asymmetric Transfer Hydrogenation of Ketones and Imines," by W. Zuo et al. *Science*, 2013.

Provided by University of Toronto

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