Novel catalysts improve path to more sustainable plastics production

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The second most-produced organic chemical in the world, propene is a key component of plastics found in consumer goods such as electronics, clothing and food packaging.

For years, oil refineries have produced an abundance of the compound

through the "steam cracking" process that converts oil-derived naptha into useful components. In the last decade, however, many U.S. refineries have instead moved toward shale gas cracking as domestic shale gas production has soared. As a result, the supply of propene has decreased, leaving a market opportunity for alternate methods of propene production.

To meet demand, the chemical industry has been working for decades to produce the compound through a chemical process called "oxidative dehydrogenation of propane" (ODHP).

Now, University of Wisconsin–Madison researchers have discovered a new type of catalyst to drive the ODHP reaction. In a paper published Dec. 1 in *Science*, a team led by chemistry and chemical engineering Professor Ive Hermans reports success with hexagonal boron nitride and boron nitride nanotube catalysts in the chemical reaction that converts propane to propene.

The new boron nitride catalysts produce a greater proportion of propene during the reaction than traditional oxide catalysts. Whereas the traditional catalysts sparked reactions that formed carbon dioxide and other undesirable byproducts in addition to propene, the new catalysts instead produce ethene—another industrially useful compound—as a byproduct.

"Boron nitride catalysts are nontoxic, they don't contain precious metals, and they reduce the temperature of the reaction, resulting in energy savings," says UW–Madison graduate student Joseph Grant, first author of the new study.

Additionally, the boron nitride catalysts may be used continuously without an intermediate regeneration step required in alternative dehydrogenation processes.

The new family of catalysts, Hermans explains, opens up an unexpected and less resource-intensive approach to converting propane to propene. In the future, the chemical industry could begin building production plants using this technology. However, because of the huge capital investments needed to build such facilities, scaling this process up to work in an industrial setting could still take years.

"All of these things are slowly moving the chemical industry toward producing the basic consumer goods we all need and want in a more sustainable way," says Hermans.

More information: J. T. Grant et al. Selective oxidative dehydrogenation of propane to propene using boron nitride catalysts, *Science* (2016). DOI: 10.1126/science.aaf7885

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