Researchers make strides toward selective oxidation catalysts

November 5 2012

Oxide catalysts, typically formulated as powders, play an integral role in many chemical transformations, including cleaning wastewater, curbing tailpipe emissions, and synthesizing most consumer products.

Greener, more efficient chemical processes would benefit greatly from solid oxide catalysts that are choosier about their reactants, but achieving this has proven a challenge. Now researchers from Northwestern University and Argonne National Laboratory have developed a straightforward and generalizable process for making reactant-selective oxide catalysts by encapsulating the particles in a sieve-like film that blocks unwanted reactants.

The process could find applications in energy, particularly the conversion of biomass into sugars and then fuels and other useful chemicals.

A paper detailing the research, "Shape-selective Sieving Layers on an Oxide Catalyst Surface," was published October 28 in the journal *Nature Chemistry*.

Especially for selective oxidation, "The ability to conduct these reactions in a selective way opens doors to new applications in green chemistry and sustainability," said Justin Notestein, assistant professor of chemical and biological engineering at Northwestern's McCormick School of Engineering and the paper's corresponding author. "Unlike current processes, which may require enzymes or precious metals, our method relies only on harmless, inert oxides. These are powders you can hold in your hand."

In testing their method, the researchers focused on photocatalytic oxidations such as the conversion of benzyl alcohol into benzaldehydes, reactions that are notoriously unselective. The researchers coated a core particle of titanium dioxide, a harmless white pigment, with a nanometer-thick film of aluminum oxide. They used a synthesis method that resulted in a film pitted with tiny holes they dubbed "nanocavities," less than two nanometers in diameter.

This sieve-like coating allowed only the smaller reactants in a mixture to slip through the holes and react with the titanium oxide, while larger reactants were blocked. The result was much higher selectivity (up to 9:1) toward the less hindered reactants.

The process was conducted at room temperature and required only a low-power light source, whereas other catalysts may require precious metals or hazardous oxidants.

More information: www.nature.com/nchem/journal/v … full/nchem.1477.html

Provided by Northwestern University

Citation: Researchers make strides toward selective oxidation catalysts (2012, November 5) retrieved 24 April 2024 from https://phys.org/news/2012-11-oxidation-catalysts.html