



# Heterogeneous Catalyst for Improved Selectivity

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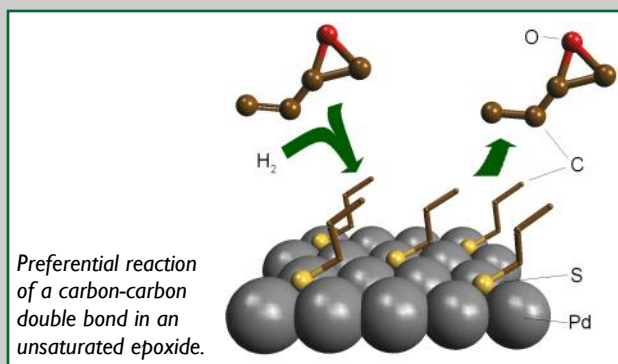
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## Background

In today's industrial processes, heterogeneous catalysts are widely used because of their stability and ease of separation from the reactant phase compared to their homogenous counterparts. A continual challenge in the advancement of heterogeneous catalysts is in the improvement of selectivity, which can significantly reduce costs of product purification and waste. Historically, homogenous catalysts offer high selectivity utilizing specific interactions, while heterogeneous catalysts employing these principles are lacking. Therefore, a heterogeneous catalyst utilizing specific interactions for high selectivity is desired.

## Technology

A University of Colorado research group led by Will Medlin has discovered a method for improving selectivity in heterogeneous catalysts using a palladium catalyst with a thiol coating. Thiols consist of a sulfur atom with a hydrocarbon "tail", which can be composed of a number of functionalities such as alkanes, alkenes, alcohols, acids, amines, and aromatics. When deposited on a metal surface from a dilute solution, these thiols can spontaneously arrange to form a self-assembled monolayer (see figure below).



The team has found that the addition of an alkanethiol self-assembled monolayer (SAM) of propanethiol, hexanethiol, dodecanethiol, or octadecanethiol to a palladium catalyst enhances the preferential reaction of a carbon-carbon double bond in an unsaturated epoxide over the epoxide functionality. Ordinary supported metal catalysts show low selectivity to this reaction due to the tendency of the epoxide group to decompose on the metal surface. Because unsaturated oxygenates similar to epoxybutene and crotonaldehyde are an important group of biorefining intermediates, the selectivity self-assembled monolayer modified catalysts confer will be useful for reactions of many biomass-derived molecules.



### Data Update

Details on additional applications of this technology are available under CDA.



### Key Documents

"Materials and Methods for Improving Selectivity in Heterogeneous Catalysts and Products Thereof." Provisional patent application filed February 25, 2010. Available under CDA.

[Controlled Selectivity for Palladium Catalysts Using Self-Assembled Monolayers.](#) Nature Materials 9, 853–858 (2010). PDF available upon request.

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