Scientists use gold to discover breakthrough for creating biorenewable chemicals

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University of Virginia chemical engineers Robert J. Davis and Matthew Neurock have uncovered the key features that control the high reactivity of gold nanoparticles in a process that oxidizes alcohols in water. The research is an important first step in unlocking the potential of using metal catalysts for developing biorenewable chemicals.

The scientific discovery could one day serve as the foundation for creating a wide range of consumer products from biorenewable carbon feedstocks, as opposed to the petroleum-based chemicals currently being used as common building blocks for commodities such as cosmetics, plastics, pharmaceuticals and fuels.

The researchers' paper on the subject -- "Reactivity of the Gold/Water Interface During Selective Oxidation Catalysis" -- appears in the October issue of the journal *Science*.

The U.Va. researchers have shown that gold – the most inert of all metals – has high catalytic reactivity when placed in alkaline water. They studied the mechanism for oxidizing ethanol and glycerol into acids, such as acetic acid and glyceric acid, which are used in everything from food additives to glues, by using gold and platinum as catalysts.

"We've shown that by better understanding the oxidation chemistry on gold and other metal catalysts, we can begin to outline a path for developing a range of different reactions needed to transition from a petroleum-based chemical industry to one that uses biorenewable carbon

feedstocks," said Davis, principal investigator on the research paper and professor and chair of the Department of Chemical Engineering in U.Va.'s School of Engineering and Applied Science.

By using water to help oxidize the alcohols with oxygen in the air as opposed to using expensive inorganic oxidants and harmful organic solvents, the growing field of biorenewable chemicals aims to offer a more sustainable, environmentally safe alternative to traditional petrochemical processes.

Until the completion of the U.Va. group's research, it wasn't fully understood how water can play an important role in the oxidation catalysis of alcohols. In the past, catalysis in water hasn't been a major issue for the chemical industry: Because petroleum and many petroleum products aren't water-soluble, water hasn't generally been considered to be a useful solvent.

The researchers, all from the Department of Chemical Engineering in U.Va.'s Engineering School, combined concepts in electrochemistry and catalysis to uncover the critical factors in the oxidation of alcohols to chemical intermediates.

More information: Paper: http://www.sciencemag.org/cgi/reprint/330/6000/74.pdf

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