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**Cooperative electrocatalytic alcohol oxidation with electron-proton transfer mediators**

Developing new strategies to power fuel cells with biomass rather than hydrogen gas.

**The Science**

The electrochemical oxidation of alcohols is a major focus of energy and chemical conversion efforts, with potential applications ranging from fuel cells to biomass utilization and chemical synthesis.

**The Impact**

This research studied the electrochemical oxidation of alcohols, and found a pair of catalysts that oxidize alcohols with significantly better energy efficiency. In the long term, this research could be the basis for using biomass rather than hydrogen gas in fuel cells.

**Summary**

Researchers in the Great Lakes Bioenergy Research Center examined the electrochemical oxidation of alcohols and identified a cooperative catalyst system, with two components capable of moving two electrons using the same energy needed to move one electron. One of the components is the organic nitroxyl TEMPO, while the other one is a molecuar copper complex (Cu(bpy)). The co-catalyst system represents a unique class of electrocatalysts for alcohol oxidation, and in the case of the Cu(bpy)-TEMPO, the modular composition of that electrocatalyst makes it well suited for further optimization and development. The (bpy)Cu/nitroxyl catalysts studied exhibited substantially higher rates than the widely used TEMPO-only catalyst for all substrates tested, including excellent reactivity with methanol and ethanol. By working with a first-row transition metal (such as bpy(Cu)), electron-proton transfer mediators provide the basis for efficient proton-coupled 2-electron reactivity, and it can lead to much faster electrocatalytic rates and lower overpotentials, both of which are crucial in energy-conversion applications.

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**Publications**

[Badalyan A, Stahl SS. “Cooperative electrocatalytic alcohol oxidation with electron-proton-transfer mediators”. Nature (2016) [DOI: 10.1038/nature18008]](http://www.nature.com/nature/journal/v535/n7612/abs/nature18008.html)

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