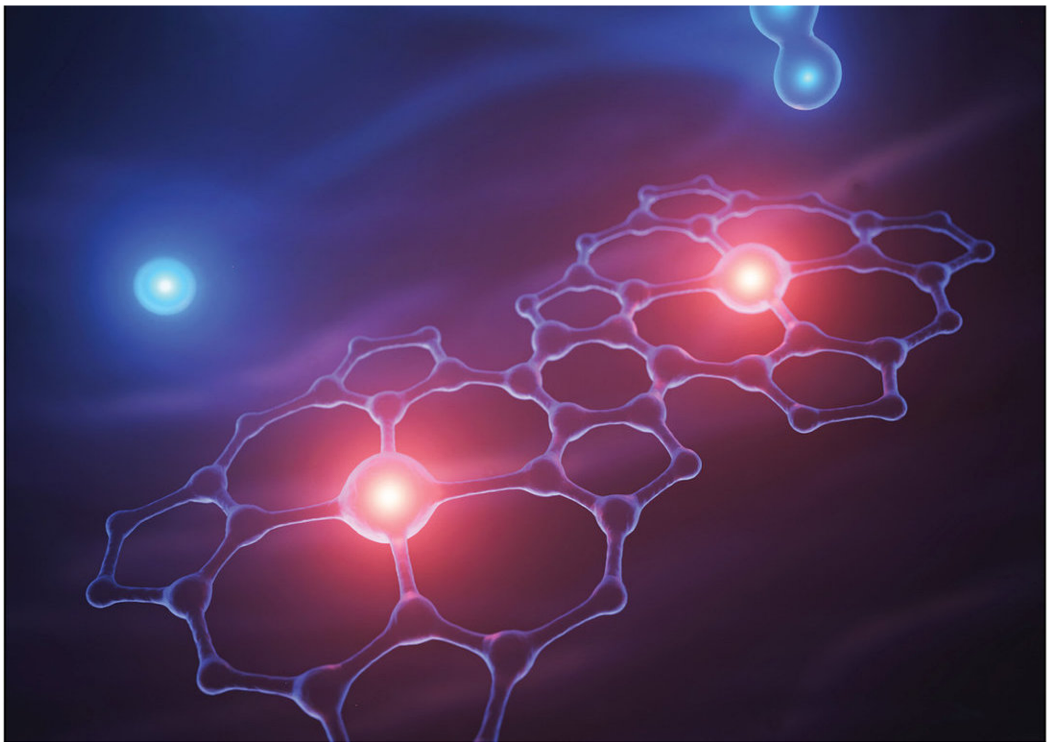
ASU research graces cover of ACS journal

October 6 2018, by Gabrielle Hirneise



A new study from Biodesign researcher Gary Moore appears on the October cover of the journal *ACS Catalysis*. Credit: Jason Drees

Publishing a high-impact scientific article is a significant achievement for researchers. Being featured on the journal cover is even better.

A new study outlines advances in the field of catalysis research, with broad applications for innovative energy technology.

Gary Moore, an assistant professor in the School of Molecular Sciences and a researcher with the Biodesign Center for Applied Structural Discovery, and his team won the coveted honor when their research article, "Electrocatalytic Properties of Binuclear Cu(II) Fused Porphyrins for Hydrogen Evolution," was selected for the cover of the October edition of *ACS Catalysis*.

Moore's graduate students, Diana Khusnutdinova and Brian Wadsworth, were the lead authors on the study. Jason Drees, former multimedia developer for Biodesign designed the journal cover.

"It's always a pleasure to have others take special notice of my group's research," Moore said.

Established in 2011, *ACS Catalysis* is a peer-reviewed journal that publishes manuscripts covering experimental and theoretical research on materials and molecules that are catalytic in nature. Catalysts play an essential role in energy conversion processes in biology and technology. They act to provide low-energy pathways for chemical reactions and find their way into applications ranging from fuel manufacturing to guiding the bioenergetic reactions essential to all living organisms.

Moore's lab studies the ways in which catalytic materials powered by photovoltaics can produce energy to meet humans' needs while minimizing environmental impact. According to Moore, their studies are inspired by the process that plants and other photosynthetic organisms use to convert sunlight to fuels through a series of photochemical reactions.

"This process powers our biosphere and supplied the fossil fuels our modern societies rely on," Moore said.

The cover art illustrates the molecular structure of the reported catalyst, a binuclear copper(II) fused porphyrin which is composed of two porphyrin macrocycles, as well as the union of two protons to synthesize hydrogen (H2). The study explores the electrocatalytic properties of the porphyrins in this hydrogen evolution reaction.

"In our recent *ACS Catalysis* publication we describe a new class of catalyst for driving the hydrogen evolution reaction (HER)," Moore said. "The product of this reaction is a fuel and an important chemical feedstock. The reported catalyst uses a molecular framework to house two copper metal centers. Under appropriate conditions, a single molecule of the catalyst produces more than 2,000,000 molecules of hydrogen per second. This rate constant is among the highest reported in the literature."

By understanding the physical and chemical properties of these electrocatalysts, Moore believes further enhancement of their catalytic properties is possible.

With human energy demands rapidly increasing and with serious concerns about the environmental impacts of the fossil fuel economy, clean alternatives in energy production are desperately needed. Research like Moore's may pave the way for a more sustainable future that will enable humans to meet acute energy needs with a more eco-friendly, low carbon regime.

"We imagine the promising features of the catalyst described in our current report will provide a foundation for achieving new energy technologies requiring enhanced control of matter and energy at the molecular level," Moore said. "Human-engineered systems capable of converting sunlight and water to fuels offer a promising approach to obtaining a sustainable energy future."

As Moore explains, one innovation that makes this study stand out is the use of copper in lieu of the industry's standard, platinum.

"The long-established industrial catalyst for activating this reaction is elemental platinum. However, concerns that future market demands for platinum and other rare-earth elements could outpace availability have prompted researchers to seek alternative materials and design principles to prepare catalysts for the production of hydrogen and other industrially relevant chemicals," Moore said.

Not only did the study pave the pathway for the use of copper in hydrogen evolution reactions, but it also yielded results on the kinetics associated with the compound.

"The copper-based assembly achieves one of the highest maximum turnover frequencies reported for a molecular hydrogen evolution reaction catalyst," Moore said.

Moore and his team are pursuing follow-up studies that will continue to shed light on the electrocatalytic properties of these assemblies.

"Members of my research team and I, including Diana Khusnutdinova and Brian Wadsworth, are currently in France to perform in situ X-ray absorption measurements at the SOLEIL synchrotron. These studies will investigate the electronic structure of the catalyst described in our current *ACS Catalysis* article and other related materials," Moore added.

Work is also currently underway involving catalysts that make use of other types of earth-abundant metal centers and molecular-based scaffolds to house them, which Moore's group looks forward to reporting on in the near future.

More information: Diana Khusnutdinova et al, Electrocatalytic Properties of Binuclear Cu(II) Fused Porphyrins for Hydrogen

Evolution, *ACS Catalysis* (2018). DOI: 10.1021/acscatal.8b01776

Provided by Arizona State University