

Spotlights on Recent JACS Publications

■ HARNESSING SOLAR POWER WITH THE HELP OF DENDRIMERS

Mimicking natural photosynthesis is no simple task. To do so, researchers must design a material that can absorb multiple wavelengths of light, efficiently transport that captured energy, and ultimately focus it into a target molecular system, where it can be transformed into other usable forms of energy. Dendrimers, with their chemically controlled branched architectures, have enormous potential for achieving efficient light capture and transport.

Now, Valeria Kleiman, Adrian Roitberg, and co-workers describe a new light-harvesting dendritic molecule and learn about the mechanism underlying its energy-transfer process (DOI: [10.1021/jacs.5b04075](https://doi.org/10.1021/jacs.5b04075)). In the combined theoretical–experimental study, the team investigates an unsymmetrical dendrimer composed of phenylene–ethynylene units and find that it can funnel energy unidirectionally down a gradient toward an energy sink. The energy-transfer process is efficient and fast—on the femtosecond time scale. The knowledge gleaned from this study may help lay the groundwork for the development of improved organic photovoltaics and other solar energy conversion technologies.

Christine Herman, Ph.D.

■ AMBIENT PRESSURE ANALYSIS OF CATALYTIC PATHWAY

Transition metals are commonly used as heterogeneous catalysts due to their moderate cost and relative abundance over noble and precious metals. A roadblock in developing new transition metal catalysts is an imprecise understanding of the reaction mechanism in standard environments; most current studies take place under the ultra-high-vacuum conditions in which traditional surface science instruments operate.

With a powerful X-ray spectroscopy instrument that can function under standard reaction conditions, Miquel Salmeron and colleagues have examined the industrially important reaction of carbon monoxide oxidation on copper surfaces, uncovering the most active phase of the copper catalyst during the reaction (DOI: [10.1021/jacs.5b07451](https://doi.org/10.1021/jacs.5b07451)). Previously, the chemical state of the copper catalyst during the oxidation of carbon monoxide was proposed to be a mixture of Cu, Cu₂O, and CuO, where CuO was thought to poison the catalyst.

Using ambient pressure X-ray spectroscopy, the researchers follow the chemical structure and evolution of the copper catalyst surface, revealing CO₂^{δ-} as the main reaction intermediate and Cu₂O as the most active catalyst phase. CuO is not observed under reaction conditions. *In situ* measurements of reaction pathways such as this one will continue to improve researchers' ability to design and synthesize catalysts with optimal performance and cost.

Dalia Yablon, Ph.D.

■ AROMATIC SANDWICH COMPLEX CONTAINS ONLY METAL ATOMS

Zhong-Ming Sun, Hua-Jin Zhai, and their colleagues have made the first all-metal aromatic sandwich complex, [Sb₃Au₃Sb₃]³⁻ (DOI: [10.1021/jacs.5b07730](https://doi.org/10.1021/jacs.5b07730)). A simple synthesis yields a molecule with a triangular sheet of gold atoms nestled between two sheets of antimony atoms. The molecule's overall structure, a ligand-free triangular prism, is also unique.

The first sandwich complex synthesized was ferrocene, a molecule with an iron atom suspended between two aromatic cyclopentadienyl rings. Since then, researchers have made a carbon-free analogue, with a titanium atom hovering between phosphorus rings; others have built sandwich complexes with a sheet of metal atoms in the center, rather than a single atom.

Since its discovery, ferrocene has been used in synthesis, catalysis, and materials science. The authors hope this new all-metal aromatic sandwich complex will lead to the synthesis of a new class of molecules with varied uses.

Melissae Fellet, Ph.D.

■ LESS IS MORE IN TOXIN NEUTRALIZATION WITH “PLASTIC APTAMERS”

Sometimes less is more, and this old adage appears to ring true for so-called “plastic aptamers”. Researchers led by Yu Hoshino report a new strategy for the creation of synthetic polymer ligands that can bind and neutralize a model bee venom protein (DOI: [10.1021/jacs.5b05259](https://doi.org/10.1021/jacs.5b05259)). The trick for creating these highly specific toxin-binding ligands is keeping the number of polymer side chains to a minimum.

The new synthetic polymer ligands recognize a hemolytic peptide toxin, known as melittin, from among two other peptide toxins with similar molecular weights and amino acid compositions. The team reports a binding constant in the low micromolar range and 100-fold stronger affinity for the target toxin compared to the control peptides. Even the smallest polymers can neutralize red blood cell lysis completely in a hemolysis neutralization assay, as long as a minimum number of functional groups are present, and the most selective ligands are those with the lowest density of functional groups appended to the polymer backbone.

This so-called “minimization strategy” is a promising tool for the creation of inexpensive and physicochemically stable substitutes for biomolecular protein-binding ligands, such as antibodies and aptamers.

Christine Herman, Ph.D.

Published: September 8, 2015