JACS
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY
Spotlights
pubs.acs.org/JACS

Spotlights on Recent *JACS* Publications

TURNING A SIMPLE PEPTIDE INTO A POWERFUL ANTIBIOTIC

In a world where bacteria are rapidly gaining resistance against pharmaceuticals, novel antibiotics are of great medical interest. Nature is an excellent source of unique antibiotics, and thiopeptides are one class of compounds that scientists look to for solutions. These naturally occurring cysteine-rich antibiotics are built in the ribosome and finished through a series of post-translational modifications. To better understand how thiopeptides are formed and how to bioengineer modified peptides with useful functions, Douglas Mitchell, Wilfred van der Donk, and colleagues study the biosynthesis of the thiopeptide thiomuracin (DOI: 10.1021/jacs.6b08987).

Thiopeptides are made up of a leader sequence of amino acids, which is recognized by enzymes involved in post-translational modifications of the peptide, and a core sequence, which is the substrate for those modifications. Mitchell's team identifies the specific elements in thiomuracin that biosynthetic enzymes recognize and in what order the enzymes work. Interestingly, the researchers find that some enzymes depend on the leader sequence for recognition, while others are leader-independent. And rather than all the enzymes working their way down the peptide in either the N-to-C or C-to-N direction, some of the enzymes lack directionality. The researchers intend to use these insights in the in vitro synthesis of existing thiopeptides as well as the development of thiopeptide analogues with improved functions.

Erika Gebel Berg, Ph.D.

THERMOELECTRIC MATERIALS: WHERE DEFECTS CAN BE A GOOD THING

In everyday language, a "defect" is not something we would consider to be a good thing—quite the contrary, in fact. But when it comes to thermoelectric materials, an anomaly in the right location can have a beneficial impact on a material's properties. So it should come as no surprise that decades of research has focused on how to engineer these kinds of beneficial defects to yield materials with desirable properties for applications in renewable energy, energy conversion technologies, and more.

In a new Perspective, Yi Xie, Chong Xiao, and colleagues call on researchers to focus their efforts on a handful of under-exploited aspects of defect chemistry that they say can help drive improvements in the electrical and thermal transport properties of thermoelectric materials (DOI: 10.1021/jacs.6b08748). While previous efforts have aimed at tuning the electronic and phonon structures of materials, the team argues that there has been less emphasis on how additional degrees of freedom caused by defects contribute to material properties. The authors say that they hope to "arouse intense attention to the overlooked parts of defect engineering...to enable the full potential of defect engineering for boosting thermoelectric performance."

Christine Herman, Ph.D.

BRIDGING THE SELF-ASSEMBLY GAP WITH LIQUID LIPIDS

To better control particle self-assembly, some researchers have explored binding directionally interacting colloidal particles using forces including electrostatic, van der Waals, hydrophobic, and lock-and-key types. Bhuvnesh Bharti, Orlin Velev, and co-workers demonstrate another force that can join these particles: liquid lipids that form capillary bridges (DOI: 10.1021/jacs.6b08017).

The researchers craft polystyrene microbeads with iron oxide surface patches. When immersed in a fatty acid amine salt solution, a liquid-lipid layer selectively accumulates on the patches, promoting the formation of interparticle capillary bridges. At temperatures high enough to maintain the fluid nature of these bridges, the particles self-assemble into two- and three-dimensional clusters. The liquid nature of these capillary bridges allows the bound particles to realign as more join each cluster until they reach a true equilibrium state. However, at lower temperatures, the lipids form a gel that inhibits cluster formation, providing a thermal switch to control particle assembly and disassembly. Experimental evidence and simulations show that the patch characteristics of these particles largely control the equilibrium cluster morphology, particularly the patch size, number, and shape. The authors suggest that this binding method could be extended to other particle types, shapes, and surface chemistries, eventually leading to the formation of sophisticated colloidal molecules.

Christen Brownlee

UNCAGING AN AMINO ACID TO PROBE PROTEIN FUNCTION

To explore biochemically important proteins in living cells and organisms, researchers have used small molecules to manipulate their function in an approach called chemical decaging. The method works by first adding a chemical cage that blocks functionality of part of the protein, and then rescuing this function with another reagent. So far this approach has mainly been used to restore lysine activity in proteins. Now, Peng Chen and colleagues expand it to recover tyrosine activity (DOI: 10.1021/jacs.6b08933). This residue has catalytic function in many significant enzymes and is also involved in a variety of post-translational modifications with a role in signal transduction.

The researchers design an allene-based caging moiety and then use palladium as the decaging reagent. They show, in vitro and in living cells, that this system frees up critical tyrosine residues on Taq polymerase, the bacterial DNA polymerase commonly used in the polymerase chain reaction, and on the lethal factor of anthrax. The method could be applied to modify a diverse range of proteins' structure, function or localization in live cells and provides a valuable contribution to the chemical toolbox for the precise perturbation and characterization of biological processes.

Deirdre Lockwood, Ph.D.

Published: December 7, 2016

DOI: 10.1021/jacs.6b12096
J. Am. Chem. Soc. 2016, 138, 15510−15510