

Spotlights on Recent JACS Publications

■ THERMOPHORESIS TRACKS MOLECULAR MOTION WITHIN CELLS

At its heart, every biological process involves intermolecular interactions. These interactions are often studied *in vitro*, but given the complexity within cells, this environment is not ideal. One *in vitro* method for studying molecular interactions is thermophoresis, which tracks molecular motion in response to heat. Now, Maren Reichl and Dieter Braun report on progress toward an intracellular implementation of this method (DOI: 10.1021/ja506169b).

The researchers have used an inverted microscope outfitted with an infrared laser to supply thermal energy and an LED and total internal reflection fluorescence (TIRF) laser light source to monitor molecular motion. As the sample, sandwiched between a microscope coverslip and chromium-coated microscope slide, is heated from below, the microscope captures fluorescent changes from above, recording them pixel by pixel over time.

Applying their system to HeLa cells, the authors measure the diffusion and the thermophoretic mobility of DNA and a fluorescent dye. Now, the researchers hope to apply the technique to measure molecular binding events. "With this approach, *in vivo* thermophoresis from molecules inside cells can be obtained, and when thermophoresis data from inside living cells are available, binding measurements *in vivo* become a realistic goal," they write.

Jeffrey M. Perkel

■ DIRECTED REGIOSELECTIVE HYDROBORATION WITHOUT A TRACE

Carboranes—boron-rich polyhedral cage clusters—especially the stable icosahedral *ortho*-dicarbadodecaboranes, or simply *o*-carboranes, bear strong similarity to organic compounds in terms of chemical reactivity. While this trait has made carboranes prime targets in materials and medical research, little exploration has been carried out regarding their catalytic B–H functionalization.

Now, Zuwei Xie and Yangjian Quan report a direct iridium-catalyzed cage B–H activation that enables facile and regioselective alkenylation of *o*-carboranes (DOI: 10.1021/ja509557j). The site-selective activation at the B(4) position relies on the unique iridium–substrate coordination geometry dominated by a neighboring carboxyl group that can subsequently be easily removed *in situ*.

For the first time in the realm of carborane chemistry, regioselective boron functionalization is conveniently realized with the assistance of a traceless directing group. This novel strategy opens avenues to a wide and varied range of new *o*-carborane derivatives, and it also sets an excellent example for the development of selective B–H activation in other carborane species.

Xin Su, Ph.D.

■ NMR SIGNAL BOOST FOR LIPID BILAYERS AT ROOM TEMPERATURE

Nuclear magnetic resonance spectroscopy suffers from a sensitivity problem, but dynamic nuclear polarization (DNP), which involves transferring polarization from unpaired electrons to nuclei, can boost signals significantly. Combining DNP with NMR offers opportunities to study membrane proteins embedded in lipid bilayers, a notoriously challenging biological system. The standard approach for DNP-enhanced NMR, cross effect, requires a low temperature to slow electron relaxation, however those freezing temperatures create disorder in the sample and broaden spectral lines. Clemens Glaubitz and colleagues have devised a strategy to transfer nuclear spin polarization using the Overhauser effect, thereby enabling the collection of DNP-enhanced NMR data at room temperature (DOI: 10.1021/ja509799s).

The researchers trigger the Overhauser effect with microwave radiation, which excites free radicals and, thereby, facilitates DNP. The experimental setup, designed to reduce excessive heating from the microwave radiation, includes a microwave resonator as well as a radiofrequency probe. The observed sensitivity enhancement in the fluid lipid bilayer at ambient temperatures with Overhauser DNP demonstrates the potential of the method for the study of membrane proteins.

Erika Gebel Berg, Ph.D.

■ ONE STEP CLOSER TO LONG RANGE LITHIUM BATTERIES

A team led by Marnix Wagemaker and Linda Nazar provides insight into the charging mechanism of lithium–air batteries, which could influence the future design of electrodes for these devices (DOI: 10.1021/ja508794r).

Lithium–air batteries hold the promise of much higher energy density in comparison to conventional lithium-ion batteries, because they use oxygen from the surrounding air instead of storing an oxidizer internally to drive the battery. The potential performance improvement offered by lithium–air batteries is especially important for the automotive industry, where this new technology could enable the manufacture of electric cars with significantly longer driving range than currently possible.

Here, the authors use *in situ* X-ray diffraction to study the oxidation of lithium peroxide in the charging reaction of a lithium–air battery cell. Differences in the oxidation pathway of lithium peroxide generated in various ways indicate that the charging mechanism depends on the nature of the peroxide including its size, shape, and crystallinity. This understanding could be applied to the more efficient design of electrodes for high-performance lithium–air batteries.

Dalia Yablon, Ph.D.

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■ BIODEGRADABLE POLYMERS GET IMPROVED PROPERTIES WITH A LITTLE STEREOCHEMICAL HELP

Julie Longo and Angela DiCiccio in the Coates group at Cornell have discovered a new approach for synthesizing biodegradable polymers with improved properties via stereocomplex formation (DOI: 10.1021/ja509440g).

Biodegradable polyesters are in demand for use in medical devices and plastics manufacturing. However, the properties of these polymers are often inferior to widely used polymers. Here, the researchers introduce a way to chemically synthesize a biodegradable polyester with properties similar to linear low-density polyethylene.

The material, poly(propylene succinate), is made by copolymerizing two common monomers, succinic anhydride and propylene oxide. The researchers first create complementary samples of the enantiopure polymers that, when mixed in a 1:1 ratio, form a semicrystalline stereocomplex that, unexpectedly, has a higher melting point than either single-handed component. This stereocomplex formation allows the researchers to easily modify the crystallinity and biodegradability of the resulting material. The new polymer could be used in a range of applications from biodegradable medical devices, such as sutures and implants, to biodegradable films, coatings, and packaging materials.

Deirdre Lockwood, Ph.D.