

## Spotlights on Recent JACS Publications

### ■ SHORTCUT TO USEFUL ORGANOBORON INTERMEDIATES

As one of the most widely used organic reactions, the Suzuki–Miyaura coupling has made organoboronates, especially the chiral ones, highly desirable intermediates for pharmaceuticals and fine chemicals. In light of the fact that access to chiral organoboronates usually requires multistep transformations from commercially available starting materials, now researchers led by James P. Morken develop a new strategy to streamline the process (DOI: 10.1021/ja500029w).

The authors discover that symmetric geminal bis(boronates) can be readily converted into non-racemic chiral boronates in excellent yields via an enantioselective Suzuki reaction. An inversion of carbon configuration during the catalytic transmetalation step occurs, and this step appears to be responsible for the high stereoselectivity.

This advancement in constructing chiral organoboronates can provide shortcuts to a variety of derivatives that are otherwise difficult to prepare, and its efficacy is demonstrated by the convenient synthesis of (*R*)-tolterodine, an antimuscarinic drug. In addition, the mechanistic studies represent a pioneering effort in probing mechanisms with <sup>10</sup>B-enriched substrates.

Xin Su, Ph.D.

### ■ BOTTLE-BRUSH POLYMER MIMICS NATURAL JOINT LUBRICANT

When doctors implant artificial joints in patients, they usually have to replace the devices after 10 years because the lack of good lubrication causes the joints to wear out. To find a better water-based lubricant, Xavier Banquy, Krzysztof Matyjaszewski, Jacob Israelachvili, and co-workers have synthesized a polymer that mimics the structure and function of lubricin, a protein that occurs naturally in the fluid that cushions our joints (DOI: 10.1021/ja501770y).

Lubricin has two end domains that anchor it to surfaces and a dense, but springy, area in the middle shaped like a bottle brush. When two lubricin-coated surfaces move toward each other, they do not actually touch; instead the bottle-brush domains touch and compress as the applied pressure increases. Now, the researchers have developed a synthetic version of the lubricin structure. This polymer has a methyl methacrylate backbone with a bottle-brush block—dangling zwitterionic chains of poly(2-methacryloyloxyethyl phosphorylcholine)—and two end domains for surface adhesion.

To test the lubricant, the researchers place the polymer between two mica plates and measure both the normal force by moving the plates together and the friction force by sliding them past each other. They find that their material lubricates much better than lubricin over a wide range of sliding speeds and pressures.

Leigh Krietsch Boerner, Ph.D., *C&EN*

### ■ DESIGN PLANS FOR ORGANIC FERROELECTRICS

Xiao Cheng Zeng and Shuang Chen develop a new computer-based method to design ideal organic ferroelectric crystals, materials that could have applications in sensing, data storage, and electro-optics (DOI: 10.1021/ja5017393).

Crystalline materials tend to be highly symmetric. After all, crystallization is all about the reduction of disorder. But in some crystals, the atoms arrange so that a component with a bit more positive or negative charge tends toward one side. This effect polarizes the crystal, and such crystals are called ferroelectric materials. Ferroelectric materials can switch this electric polarization under the influence of an external field, and those with strong polarization are important for applications in computer memory, capacitors, transistors, and sensors.

For uses that require lightweight, flexible, and non-toxic materials, researchers have turned to carbon-based organic ferroelectrics. So far, development of organic ferroelectrics has been slow. Recent efforts have yielded a few candidates, but these suffer from either sub-optimal polarization or low stability.

Using the technique they develop, the researchers predict three new crystals that would possess much higher spontaneous polarization than their predecessors in addition to their high stability. As the authors point out, if their predictions are correct, their recommended computational procedure can be further exploited to design many other such materials.

Jenny Morber, Ph.D.

### ■ NANOPARTICLES SERVE UP CALIBRATED COCKTAILS TO TREAT CANCER

Jeremiah A. Johnson and colleagues have synthesized a nanoparticle scaffold that can simultaneously deliver specific ratios of three different chemotherapeutic agents to cancer cells (DOI: 10.1021/ja502011g). Cocktails of multiple chemotherapeutic agents are very useful in treating cancer. But to make these combination therapies most effective, researchers want to be able to deliver specific, controlled doses of each of the cocktail components at specific times. However, even if components are introduced at a specific ratio, their different properties often cause them to accumulate in cells at different ratios, which can lead to non-ideal dosing as well as toxicity.

Now Johnson and his colleagues have designed polymeric nanoparticles that serve as a tunable delivery device for three chemotherapeutic agents—doxorubicin, camptothecin, and cisplatin. The team efficiently synthesizes the nanoparticles using a ring-opening polymerization method. The nanoparticles deliver the three agents at a specific stoichiometric ratio, with each of the agents triggered independently for release.

This synthetic strategy could be used to create nanoparticles for fine-tuned delivery of many different combinations of drugs, leading to more tailored treatments for different types of cancer and other diseases.

Deirdre Lockwood, Ph.D.

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## ■ QUADRUPLY SELECTIVE: SYNTHESIS OF CHIRAL 2H-PYRROLES

Pyrroles—electron-rich nitrogen heterocycles—are the building blocks of important biomolecules such as chlorophyll and heme, and are hence of great synthetic interest. Asymmetric dearomative hydrogenation of pyrroles provides facile access to chiral, partially or fully saturated pyrrolines and pyrrolidines. However, similar dearomative alkylation reactions are largely limited by the lack of selectivity.

In an effort toward constructing alkylated pyrroles with a high degree of functionalization, Shu-Li You and co-authors report an efficient catalytic strategy for polysubstituted chiral 2H-pyrroles through intermolecular dearomative allylation (DOI: 10.1021/ja5028138). Using a commercially available palladium/chiral ligand combination, they construct well-defined stereogenic quaternary carbon centers from pyrroles with up to four substituents and allylic carbonate-based electrophiles in excellent yields.

Remarkably, the researchers overcome a four-fold challenge in terms of chemo-, regio-, and enantioselectivities during this transformation. Moreover, enantioenriched 2H-pyrrole products can be conveniently converted into chiral pyrrolines and cyclic imines via selective reductions, further enhancing the utility of the new method.

Xin Su, Ph.D.

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