Scientists now have convincing evidence that the inner cell membrane protein MurJ is the long-sought-after flippase. This enzyme is known to be essential to forming bacterial cell walls and represents a target for developing new antibiotics. MurJ has been one of a few strong suspects as the protein that transports, or flips, peptidoglycan precursors from inside the cell’s cytoplasm where they’re formed to the outer regions where they combine to form tough cell walls. Although current antibiotics interfere with various stages of bacterial peptidoglycan-forming processes, scientists would like to be able to develop new drugs by targeting flippase. A team led by Natividad Ruiz of Ohio State University and Thomas G. Bernhardt of Harvard Medical School developed a method for monitoring flippase activity in the sometimes pernicious bacterium Escherichia coli (Science 2014, DOI: 10.1126/science.1254522). When the group inactivated MurJ in the bacteria, flippase activity dropped precipitously, strongly suggesting that MurJ is the mystery flipper.—EKW

**MOUSING AROUND WITH NANO PARTICLES YIELDS GUT IMAGES**

Stuffed between the stomach and the large intestine, the small intestine is a 23-foot digestive wonder. But when there’s trouble brewing down there, doctors can have a tough time seeing precisely what’s going on because typical medical imaging techniques can’t detect the small movements of muscles propelling food through the turning and twisting organ. A team led by Jonathan F. Lovell of the University at Buffalo, SUNY; Weibo Cai of the University of Wisconsin, Madison; and Chulhong Kim of South Korea’s Pohang University of Science & Technology has come up with a way to let doctors study the small intestine in action. The researchers developed a family of nanoparticles that can be used in photoacoustic tomography, a technique in which the particles respond to laser light by generating pressure waves that can be detected with ultrasound (Nat. Nanotechnol. 2014, DOI: 10.1038/nnano.2014.130). The nanoparticles are micelles made from a biocompatible surfactant and naphthalocyanine dye that can withstand the harsh conditions of the stomach and intestines, avoid systemic absorption, and provide good optical contrast for photoacoustic imaging. When fed to mice, the micelles proved to be effective and nontoxic imaging agents.—BH

**SOLVENT ENGINEERING IMPROVES SOLAR CELLS**

By devising a multisolvent method for producing highly uniform perovskite thin films, researchers in South Korea have come up with an improved way to make inexpensive high-performance solar cells (Nat. Mater. 2014, DOI: 10.1038/nmat4014). Perovskite-based solar cells, which feature a sunlight-absorbing organometal halide with the perovskite crystal structure, are layered devices typically made via spin-coating, a simple solution-phase film-deposition method. But that method yields perovskite films that don’t perfectly coat the underlying surface, thereby limiting light-to-electricity conversion efficiency. Vacuum deposition is an alternative method that boosts film quality and device performance, but it raises costs. Those challenges led Sang II Seok and coworkers of the Korea Research Institute of Chemical Technology to devise a solvent-processing method that yields more uniform films and leads to conversion efficiencies on par with the best vacuum-deposition perovskite cells reported to date. The team starts by spin-coating a solution of methyl ammonium halides and lead halides in a mixture of γ-butyrolactone and dimethyl sulfoxide solvents. During the spinning process, the team adds a third solvent in which the perovskite-forming reagents are insoluble, such as toluene or chloroform, dropwise on the spreading layer. That extra step helps stabilize an intermediate phase, which the researchers heat to yield the desired uniform perovskite film.—MJ

**THE LEAD OUT OF PRIMARY EXPLOSIVES**

Working with explosives is tricky business, so a small amount of sensitive primary explosive is usually used to ignite a more stable secondary explosive. As rocker Bruce Springsteen put it: “You can’t start a fire without a spark.” The most common primary explosives are lead azide and lead styphnate, which have caused considerable lead contamination on military training grounds. Researchers in Germany have come up with a lead-free primary explosive with properties that are as good as or superior to the lead compounds (Angew. Chem. Int. Ed. 2014, DOI: 10.1002/anie.201404790). Dennis Fischer, Thomas M. Klapötke, and Jörg Stierstorfer of Ludwig Maximilian University Munich have found that 1,1′-dinitramino-5,5′-bistetrazolate, or K₂DNABT, outperforms lead azide in detonation tests and is similar to lead azide in terms of sensitivities, such as impact, friction, and electrostatic discharge. What’s more, the compound possesses high thermal stability, resisting decomposition when held at 100 °C for 48 hours. “All tests point to the fact that this material is a suitable and nontoxic replacement for lead azide, with a straightforward synthesis from commonly available chemicals,” the team notes.—BH

**LEAD FINALLY FOUND**

The protein MurJ is essential for bacterial cell-wall construction.
ALLYLIC C–H OXIDATION YIELDS CYCLIC ETHERS

A palladium-catalyzed C–H bond-activation reaction starting with terminal olefins makes it possible to synthesize pharmaceutically important six-membered cyclic ethers with unprecedented generality (J. Am. Chem. Soc. 2014, DOI: 10.1021/ja500332e). Cyclic ethers such as chromans and pyrans are common elements in bioactive small molecules. But reactions used to create cyclic ethers are highly varied, involving different types of starting materials, catalysts, and reaction conditions—potentially making it difficult to decide which synthetic route to take. Using alcohols as nucleophiles to functionalize C–H bonds has not been one of the available options for making cyclic ethers. M. Christina White and coworkers at the University of Illinois, Urbana-Champaign, have now devised a Pd(II)/sulfoxide-catalyzed allylic C–H oxidation reaction that for the first time uses alcohol nucleophiles for that purpose. The reaction has a novel proposed mechanism in which allylic C–H cleavage to form a π−allyl intermediate, alcohol deprotonation, and C–O bond formation all occur at the palladium metal center. White’s team believes the reaction will be useful to chemists seeking to access cyclic ether-based drug candidates.—SB

GREENER BUILDING BLOCK FOR FUNGICIDES

Scientists at specialty chemical company Solvay have developed a cost-effective, environmentally friendlier synthesis of a difluoromethylpyrazole intermediate that provides a key structural unit in the fast-growing family of succinate dehydrogenase inhibitor (SDHI) fungicides, which includes Syngenta’s Sedaxane, BASF’s Fluxapyroxad, and Bayer’s Bixafen (Org. Process Res. Dev. 2014, DOI: 10.1021/op500128p). The current method starts with tetrafluoroethylene and proceeds through ethyldifluoroacetate, which is converted to the pyrazole intermediate by a Claisen condensation with ethyl acetate followed by a cyclization step with methylhydrazine. This approach requires excess reagents and generates a large amount of waste salts and aqueous waste contaminated with halogenated organics. The Solvay team of Janis Jaunzems and Max Braun created a procedure that largely avoids those limitations by starting with trichlorodifluoroethane (a waste product from another process), using a photooxidation step to make an acyl chloride intermediate, and then concluding with a ketene condensation before the methylhydrazine cyclization. The new, fully scalable process uses nearly equimolar amounts of reagents, has better yield, and reduces total waste from about 10 kg per kg of difluoromethylpyrazole made to 2.4 kg per kg.—SR

NEW LATTICES FOR SILICON SOLAR CELLS

Materials scientists backed by computer simulations have identified several silicon lattice arrangements that are predicted to be more efficient at converting sunlight to electricity than the cubic diamond structures typically employed in crystalline silicon solar cells (J. Am. Chem. Soc. 2014, DOI: 10.1021/ja5035792). Some of the most efficient solar modules on the market rely on silicon’s diamond-like allotrope. But these crystals harbor an inherent inefficiency: an indirect band gap. Incident light shining on the solar cells needs an assist from lattice vibrations, or phonons, to excite charge carriers to the material’s conduction band and generate an electric current. Julong He of China’s Yanshan University and his coworkers identified six different silicon geometric crystal arrangements (three shown) with direct or quasirect direct band gaps that should produce a photocurrent without phonons. In addition, the team’s simulations revealed that the crystals should be stable at room temperature, and five of them should survive beyond 700 °C, which the researchers believe is further cause for optimism. Actually fabricating these structures is the next challenge, but scientists have already developed techniques for packaging group 14 elements into various crystalline configurations, He says.—MD