JACS
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

Spotlights

pubs.acs.org/JACS

Spotlights on Recent *JACS* Publications

EASILY ACCESSIBLE, MULTIPURPOSE GOLD MATERIALS

Valentine Ananikov and co-workers have developed a simple, straightforward, and general synthesis for a crucial collection of catalytic gold complexes and gold nanoparticles with varying size and shape for catalysis and material science applications (DOI: 10.1021/ja311258e). The research improves on existing methods toward soluble gold complexes that involve impractical intermediates, and methods toward gold nanoparticles that are complicated by the requirement for intermediate stabilizers.

Gold catalysts are practically ubiquitous, and they simplify the synthesis of a wide range of molecules, from drugs to plastics. However, gold-catalyzed reactions are extremely sensitive to small changes in the catalyst structure: ligand or counterion modifications can result in completely different reaction pathways and products, and the shape and size of the nanoparticles can affect the reaction as well.

The researchers find that different gold products are accessible from the readily available $HAuCl_4$ precursor through a simple, sequential process using common reagents. The size and shape of the particles and the nature of the soluble gold complexes were tuned by utilizing a range of different reagents and ligands in the reactions. The simple synthesis of varied gold catalysts that can be applied in diverse reactions has relevance to both basic research and industry. The authors anticipate further exploration "in the area of tuning the properties of gold complexes and particles at the molecular level and finding new chemical applications." **Leigh Krietsch Boerner, Ph.D.**

CLICK REACTION "CLICKS" IN VACUUM

Kurt Gothelf, Trolle Linderoth, and co-workers have shown that "click" reactions work in a solvent-free system of reactant molecules adsorbed on a copper metal surface under ultrahigh vacuum conditions (DOI: 10.1021/ja312303a).

Click reactions—simple, often high-yielding reactions—can be thought of as modular pathways for creating useful molecular building blocks. One well-known click reaction involves a terminal alkyne ($C\equiv C$) and an azide (N_3) in solution. In the presence of a solvated copper(I) catalyst, a single product triazole is formed selectively.

The researchers observe this same result under ultrahigh vacuum conditions, although the azide molecules are found to degrade on the metal surface and thereby limit the yield. The observation of an on-surface click reaction is an exciting development, as surface scientists are quite interested in organic reactions of molecules on surfaces as a way to design and create "bottom up" materials. Possible applications for new materials include molecular electronics or sensors. **Polly Berseth, Ph.D.**

UNRAVELING A STICKY PROTEIN

Markus Zweckstetter and his team, in collaboration with the group of Eckhard Mandelkow, have unraveled the interactions between tau, a floppy protein that clumps together to form filaments in the brains of people with Alzheimer's disease, and pthalocyanine tetrasulfonate (PcTS), an organic molecule that has been observed to inhibit the formation of protein clumps (DOI: 10.1021/ja312471h).

Gnarled globs of protein in the brain are the hallmarks of Alzheimer's disease and other neurodegenerative disorders. There is no cure for Alzheimer's disease, but some agents, such as PcTS, have been observed in experiments to inhibit the formation of protein clumps and to dissolve the snarls once formed, though little is known about the mechanism. The hope is that such agents may someday prevent or even cure diseases caused by protein aggregation.

Using a combination of NMR spectroscopy, electron paramagnetic resonance, and small-angle X-ray scattering, the researchers discover that PcTS binds to specific aromatic residues in the core of tau. That interaction prevents aggregation, in vitro and in cells, by prompting tau to form smaller clumps of between 7 and 24 molecules called oligomers. The core of the PcTS-induced oligomers is structurally different from that of the filaments. Moreover, the researchers establish that the oligomers formed in the presence of PcTS are distinct from those associated with toxicity in Alzheimer's disease. **Erika Gebel, Ph.D.**

GRAPHENE SUBSTRATES BRING ORDER TO ORGANIC ELECTRONICS

Kai Xiao and colleagues have demonstrated that graphene films can enhance the functionality of organic semiconducting materials by ordering and aligning the molecules that make up these materials (DOI: 10.1021/ja3125096).

Graphene—a recently discovered new crystalline form of carbon in which atoms are arranged in a single layer in a hexagonal or honeycomb pattern—has remarkable electrical, optical, and mechanical properties. When used as a substrate, this transparent and flexible conducting film can alter the properties of molecules on its surface.

The researchers deposit copper phthalocyanine (CuPc), a widely used starting material for blue dye, but also a promising organic semiconductor, on silicon substrates and on graphene films. They find that, on a silicon substrate, the planar square-shaped CuPc molecules form edge-on layers, like books on a shelf, while on a graphene substrate they assume a face-on orientation, like tiles on a roof. In the latter configuration these molecules can form large, aligned superstructures with improved charge transport and reduced losses. The authors conclude that the use of graphene substrates in organic transistors and organic photovoltaic cells should improve the performance of these devices. **Alexander Hellemans**

CYCLIZATION REACTION YIELDS WIDE RANGE OF DRUG-LIKE HETEROCYCLES

A new study led by Jonathan Ellman uncovers a reaction sequence that affords highly substituted heterocyclic compounds and may find use in the synthesis of natural products

Published: February 26, 2013

dx.doi.org/10.1021/ja401902h | *J. Am. Chem. Soc.* 2013, 135, 3301−3302

and many potential drug candidates (DOI: 10.1021/ja312311k). This sequence—which provides nonaromatic nitrogen-containing frameworks—improves on earlier studies focused on either aromatic nitrogen heterocycles or non-aromatic compounds that required a substituent at the 2-position.

The researchers use rhodium-catalyzed C−H bond functionalization/annulation chemistry of trimethylsilyl acetylenes with α,β-unsaturated imines to generate silyl-substituted dihydropyridines. These dihydropyridines are precursors to densely substituted tetrahydropyridines as well as some polycyclic alkaloids. Tropanes, for example, are accessible by intermolecular [3+2] cycloaddition of an alkyne via an unstabilized azomethine ylide, and azabicyclo[3.1.0] systems can be obtained through stereoeselective acid-mediated Nazarov-like cyclization.

"Nonaromatic nitrogen heterocycles such as piperidines, tropanes, and pyrrolidines are valuable, ubiquitous structural motifs in biologically active alkaloids as well as drugs that have had a major impact on disease," the authors write. For example, a number of active pharmaceutical substances containing a tropane moiety in their structure are currently used as anti-nausea medications, anesthetics, and bronchodilators. **Sonja Krane, Ph.D.**