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Spotlights on Recent *JACS* Publications

NICKEL CATALYST MAY BE A CHEAP ROUTE TO HYDROGEN PRODUCTION

To successfully make alternative energy sources a reality, the energy collected from solar or wind power needs to be stored, preferably in a dihydrogen bond. However, hydrogen production is not cheap. A group led by Monte Helm has synthesized a nickel(II) cyclic diphosphine electrocatalyst with incredibly high turnover rates for the production of H_2 (DOI: 10.1021/ja400181a). The only ways scientists know how to make hydrogen gas efficiently is to use either hydrogenase enzymes or platinum catalysts. Hydrogenases are both expensive and impractical, while platinum is also costly. Researchers have long been looking for a cheaper way to make the fuel, focusing mainly on catalysts with more abundant metals, such as nickel, cobalt, iron, or molybdenum.

At the Ni(II/I) couple potential, turnover frequencies range from 2400 to 27 000 per second with protonated dimethylformamide in acetonitrile. Adding water up to 1.0 M increases this turnover, with frequencies between 4100 and 96 000 per second. The researchers find that the planarity of the compound is a factor in the success of this catalyst, as is the position of pronated pendant amine with respect to the reduced metal center. This research represents a good step forward in the search for a cheaper hydrogen-evolving catalyst, and eventually clean and cheap alternative energy sources. **Leigh Krietsch Boerner, Ph.D.**

TRANSFERRING DAMAGED GOODS

Marc Greenberg and co-workers combine organic synthesis and genetic engineering methods to fabricate synthetically damaged DNA, in an effort to better understand the molecular details surrounding one particularly hard-to-repair type of lesion (DOI: 10.1021/ja400915w).

Many important therapeutics, especially anticancer drugs, function by damaging DNA. These chemotherapeutic agents modify specific sites on DNA, causing lesions that can lead to DNA breakage and various additional downstream effects, including cell death. Though enzymes exist whose job it is to repair the damage done by these agents, a common DNA lesion called the C4′-oxidized abasic site (C4-AP) has been shown to be particularly resistant to the primary repair pathway employed in cells.

The authors create pieces of DNA containing C4-AP and incorporate these fragments into DNA−protein complexes called nucleosomes, which are normally found in the cell nucleus. Studies with the synthetic nucleosomes reveal that the proteins, called histones, actually accelerate DNA strand breakage and then incorporate the DNA lesion into their own structure. This modification of histone structure could have various ramifications, including altering regulation of gene expression. By delineating the immediate molecular consequences of C4-AP lesions, this study offers unique insight into how DNA-damaging agents might contribute to impaired cellular function and death. **Eva J. Gordon, Ph.D.**

COLLOID ANTIBODIES SHAPE UP TO KILL MICROBES

With the hope of developing improved antibacterial therapies, researchers led by Vesselin N. Paunov demonstrate a new method that uses colloid particles to recognize and kill cells on the basis of their shape (DOI: 10.1021/ja400781f).

In this proof-of-principle demonstration, the team creates concave gold−silica colloids by depositing gold nanoparticles and silica which form a shell on the surface of yeast cells. When fragmented and removed from the yeast, these colloidal shell fragments retain the concave shape of the cells and are able to recognize and bind cells with the same shape, in a way that resembles the antibody−antigen interaction. When incubated in a cell suspension containing both yeast and rod-shaped bacteria, these shape-selective binding agents recognize only the yeast cells and deliver gold nanoparticles directly on their surface. When the team shines a laser on the suspension, the gold nanoparticles, which have photothermal properties, cause the heat-induced death of only the yeast cells.

This approach represents a new way to think about making antimicrobial binding agents that are tailored to recognize and kill certain pathogens while leaving other cells unscathed. The method can be used to explore the possibility of developing new treatments for diseases caused by bacteria that are resistant to conventional antibiotics. **Christine Herman, Ph.D.**

FUNGI BEWARE: NEW CLASS OF KILLER POLYMERS UNVEILED

The similarities between fungal and human cells have made it difficult to develop drugs that kill the harmful pathogenic cells without damaging host cells. As a result, fungal infections are a major health challenge. But now, researchers led by Kristyn S. Masters and Samuel H. Gellman describe a new class of easy-to-synthesize polymers that exhibit antifungal properties with minimal toxicity toward mammalian cells (DOI: 10.1021/ja4006404).

Nature's way of fending off bacterial infection involves the use of small peptides, known as host-defense peptides, which self-aggregate into amphiphilic structures and compromise bacterial cell membranes, leading to growth inhibition or death. Previous reports have described synthetic polymers capable of mimicking this antibacterial selectivity. But when it comes to designing polymers to selectively target eukaryotic fungi, new challenges arise due to the similarities in cell membrane composition between fungi and mammalian cells.

The new report shows that nylon-3 polymers exhibit potent antifungal activity with low toxicity toward human red blood cells and mouse fibroblasts, and sheds light on the relationship between structural characteristics and biological activity. In contrast to previously reported sequence-specific antifungal peptides, which can be difficult to synthesize, the sequence-random polymers used in this study are readily prepared on a large scale. **Christine Herman, Ph.D.**

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