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Spotlights on Recent *JACS* Publications

FLUORESCENT PROBES LIGHT UP AMYLOID PROTEINS IN BRAIN

Amyloids, abnormal fibrous protein aggregates found in organs and tissues, are associated with many well-known neurodegenerative disorders. Effective probes for diagnosing and monitoring amyloid-based diseases are of great importance to therapeutic development. A new class of fluorescent probes allows researchers to distinguish different types of amyloid deposits in brain tissue, bringing them one step closer to developing selective probes for discrimination between different amyloid-related diseases with similar symptoms (DOI: 10.1021/ja3063698).

Researchers led by Jerry Yang and Emmanuel Theodorakis at the University of California, San Diego, synthesized three fluorescent probes based on aminonaphthalenyl 2-cyanoacrylate (ANCA), which had previously been shown to label amyloid-β (Aβ) plaques in human brain sections from patients with Alzheimer's disease. The ANCA fluorophores belong to a class of molecular rotor whose intensity of fluorescence emission is significantly enhanced upon binding to a substrate. The researchers found that, due to the differences in polarity of the substrate binding sites, each of the three probes exhibits a different maximal emission wavelength when bound to two different types of amyloid substrates, Aβ proteins (Alzheimer's disease) and prion proteins (prion disease). This is the first study to reveal this fundamental difference in the polar environment presented to probes by Aβ and prion proteins and offers a new way to detect specific amyloid deposits in tissue, information that may aid in developing treatments targeted to specific diseases. **Christine Herman, Ph.D.**

NEW INSIGHTS INTO ION CHANNEL FUNCTION

Synthetic ion channels are composed of small molecules that insert themselves into lipid bilayers and enable the conductance, or transport, of ions across the membrane. Researchers have exploited the efficient transport capabilities of synthetic ion channels in the development of antibiotics and have also demonstrated their utility in sensors and other analytical methodologies.

Despite being a structurally diverse class of molecular assemblies, synthetic ion channels have a limited range of conductances and durations of channel openings. In an effort to better understand this phenomenon, researchers led by Thomas M. Fyles investigated the mechanism of ion transport through several structural variants of fluorescent oligoester channels (DOI: 10.1021/ja306596m).

The team synthesized and analyzed the membrane activity of four linear oligoesters containing a diphenylacetylene core. They found one compound that exhibited a unique behavior: the channel's ion transport activity slowly decreased over time. The researchers used steady-state and time-resolved fluorescence to determine that a change in the distribution of the individual monomers within the channel over time caused the decrease in transport activity. The study sheds light on the relationship between synthetic ion channel structures and observed conductance behaviors. **Christine Herman, Ph.D.**

CONTROLLING METAL-TWEEZING MOLECULES WITH LIGHT

Dendrimers, first identified during the 1980s, are an interesting class of molecules that consist of branches extending out from a central core; the branches can be designed or customized to perform different functions. Dendrimers with units that harvest light, switch from a *trans* isomer to a *cis* isomer when hit by light waves (photoisomerization), or form metal complexes (coordination) with a variety of metal ions have received intense scrutiny from researchers.

Now, Paola Ceroni and co-workers for the first time have developed two dendrimers in which the three functionalities—light harvesting, photoisomerization, and coordination—are combined within a single molecule (DOI: 10.1021/ja307522f). The units in these dendrimers cooperate with each other, causing the dendrimers to function as light-controlled "tweezers" that can capture or release metal ions in solution.

To synthesize these molecules, the researchers appended two cyclam coordination units to the dendrimer core, an azobenzene moiety. To each coordination unit they attached either three or six light-harvesting naphthalene chromophores, which can harvest light and induce the switching of the azobenzene unit from one isomeric state to another. As a consequence, the distance between the two coordination units changes, controlling the uptake or release of specific metal ions. Such a combination of three different functions in a single molecular species is a major milestone in the very active field of dendrimer research. **Alexander Hellemans**

SNEAKY SULFUR THE CAUSE OF REDOX ANOMALY

The ability to build hydrogen-evolving catalysts from cheap, abundant materials is an important step in producing attainable and efficient alternative fuels. Previously, a series of cobalt dithiolene complexes were synthesized that are capable of producing hydrogen gas in aqueous solution. However, upon the addition of trifluoroacetic acid, the compound in the series that should yield hydrogen gas most easily instead turns out to be the least active electrocatalyst. The reason for this anomalous behavior has been unclear.

Through a computational study, Brian Solis and Sharon Hammes-Schiffer have found the answer to this problem (DOI: 10.1021/ja306857q). By studying specifically how hydrogen is formed, they discovered that the protonation of each ligand is of critical importance. The anomalous compound, a cobalt maleonitrile-2,3-dithiolate, has one fewer sulfur atom protonated than the other molecules in the series. As a result, the reduction of Co^{II} to Co^{I} requires a more negative potential. Through proton transfer, this reduced species then forms the catalytically active metal hydride, which goes on to produce

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hydrogen. With this work, the researchers show that ligand protonation plays a key role in understanding electrocatalytic activity, which is crucial in the design and synthesis of efficient solar devices for viable alternative energy technologies. **Leigh Krietsch Boerner, Ph.D.**

PLATINUM AT THE HEART OF GOLD NANOCLUSTER CHARACTER

Doping a foreign metal atom into nanoclusters can affect their optical, electronic, and catalytic properties and has practical applications for sensing and photovoltaic materials. Lately, interest in doping gold nanoclusters with platinum has surged due to predictions that it can maintain both the geometry and electronic structure of the nanocluster while creating highly stable supramolecular systems. However, since the atomic weight of platinum is so close to that of gold—merely a 1.89 Da difference over the ~7.4 kDa total mass of the nanocluster—it is difficult to distinguish a doped from a nondoped nanocluster by the most-commonly used analytical technique, mass spectrometry. It is also tough to tell platinum from gold by X-ray crystallography due to their very similar electron densities. For these reasons, platinum doping has rarely been attempted.

Now Rongchao Jin and co-workers have synthesized and identified platinum-doped gold nanoclusters by a combination of multiple analytical techniques, and they found that the nanocluster consists of a gold icosahedral core with platinum at its heart, topped by six gold–thiolate ligands (DOI: 10.1021/ja307657a). In addition, the researchers computationally modeled a number of possible doped isomers and showed that the platinum-centered icosahedral structure is energetically favored and the simulated optical spectrum is in good agreement with experiment. Doping platinum into the gold nanocluster core drastically alters its optical, electronic, and catalytic behavior and illustrates how properties can be effectively customized for the potential use in devices. **Leigh Krietsch Boerner, Ph.D.**

FLUORESCENT PROBE HIGHLIGHTS CO IN CELLS

Carbon monoxide is well-known for its toxicity, but recent research suggests that human cells produce the gas themselves. It may even play a critical role in cell signaling. Now researchers led by Christopher Chang report a fluorescent probe that produces light upon reacting with CO (DOI: 10.1021/ja307017b). They say it could allow scientists to study the gas's nontoxic role in human biology.

Current methods for detecting cellular CO either destroy the cells or use external devices that, like smoke detectors, catch CO as it wafts out. To measure CO inside living cells, Chang and his team developed a probe that binds to it without interacting with other small reactive molecules, such as hydrogen sulfide or nitric oxide. They designed a palladium-containing probe that releases a fluorescent molecule after it reacts with CO.

To test the probe, the researchers mixed it with seven small reactive molecules common in cells, including nitric oxide. They also mixed it with a molecule that releases CO. The probe lit up only in the presence of the CO-releasing molecule. The authors hope that the low micromolar to high nanomolar detection ranges will be low enough to selectively sense intracellular carbon monoxide. **Erika Gebel, Ph.D.,** *C&EN*

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