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Spotlights on Recent *JACS* Publications

SMALL BUILDING BLOCKS YIELD TOTALLY TUBULAR CAPSULE

Self-aggregating monomers have garnered interest among chemists for their ability to yield nano-sized supramolecular assemblies with interesting chemical and physical properties. The most popular designs to date consist of rigid scaffolds and functional groups that can be counted on to interact with one another in a particular way to create the desired structures. But these sophisticated monomers can come at a cost, as they typically involve elaborate syntheses and can be limited to forming a single supramolecular construct.

Seeking to eliminate these trade-offs, researchers led by Edvinas Orentas and Kenneth Wärnmark set out to explore how far they could go in downsizing the structure of a self-aggregating monomer while still encoding it with the necessary information to yield a well-defined cavity. In a new report, they describe the formation of a supramolecular ellipsoidal decameric capsule composed of small building blocks—three non-equivalent forms of the same isocytosine derivative, differing only in their hydrogen bonding with one another (DOI: 10.1021/jacs.5b03160). The team demonstrates the topology of the aggregate is dependent upon the solvent in which the assembly occurs. The results illustrate there is still more to learn about hydrogen-bonded structures and the role the chemical environment plays in the assembly pathway of self-aggregating molecules.

Christine Herman, Ph.D.

NONINVASIVE METHOD DETECTS POLYMER STRETCHING

An intimate connection exists between the stretching of single polymer chains and their resulting spectral response. Researchers hope to one day be able to exploit this relationship to better understand why materials under stress sometimes deform and fail. A team led by Joris Sprakel has taken a step in this direction with the development of a new, noninvasive method for the detection of polymer stretching at the nanoscale (DOI: 10.1021/jacs.5b05914).

The team creates a polyfluorene-based polyelectrolyte and demonstrates its use as a mechanosensor. Upon encapsulation within a protein capsid, the polymer undergoes conformational changes that the researchers monitor with fluorescence spectroscopy. The detection is possible because the protein capsid—consisting of bulky recombinant coat proteins—forms a complex with the anionic polyfluorene derivative, causing it to stretch, and this mechanical stretching can be detected by a shift in the vibronic spectra. The researchers show they can use the new approach to quantify even low degrees of protein binding as well as capsid disintegration.

Christine Herman, Ph.D.

NEW APPROACH TO KICKING THE NICOTINE HABIT

Nicotine addiction, commonly seen in smokers and consumers of other tobacco products, causes significant harm: In 2013, the World Health Organization estimated that each year, 6 million deaths are caused by tobacco use. With current pharmaceutical interventions to lessen nicotine addiction, such as antidepressant drugs and nicotine replacement therapy, less than 30% of smokers refrain from smoking for at least a year after treatment. As an alternative, researchers have tried to use antibodies to sequester the nicotine that enters the bloodstream from a cigarette, with limited success.

Now Kim Janda and colleagues propose using a special enzyme to kill the nicotine buzz (DOI: 10.1021/jacs.5b06605). The enzyme, called NicA2, is found in a nonpathogenic bacterium that relies on nicotine as its sole carbon and nitrogen source.

The researchers find that NicA2 is highly efficient in breaking down blood-level concentrations of nicotine, both in buffer and serum. The enzyme is stable at temperatures as high as 70 °C, and remains active at 37 °C for as long as 3 weeks and in serum for 3 days. The investigators also show products stemming from the enzymes degradation of nicotine to be non-toxic. Taken together, the findings suggest that NicA2 could be developed into a safe, effective, and long-lasting smoking-cessation therapy.

Rajendrani Mukhopadhyay, Ph.D.

FLUORESCENT MOLECULE MEASURES VOLTAGE IN CELLS

Certain cells in the body, such as neurons and some cells of the heart, rely on changes in membrane potential to function. Current methods to directly study voltage effects in cells involve clamping the cell membrane with a tiny electrode, a slow, tedious process that can injure cells. Noninvasive optical approaches exist to indirectly measure voltage in cells. However, a goal for researchers has been to develop a direct optical approach. Now Evan Miller and colleagues have created a fluorescent molecule, called Berkeley Red Sensor of Transmembrane potential, or BeRST 1 ("burst"), that can directly measure voltage optically (DOI: 10.1021/jacs.5b06644).

The investigators demonstrate that BeRST 1, which works in the far-red to near-infrared part of the electromagnetic spectrum, is bright and optically stable under illumination. It is very sensitive and quick to respond to membrane potential changes in cells. BeRST 1 can detect action potentials—rapid changes in membrane potential—in neurons, and it can be readily combined with other optical tools to give researchers the power to track the effects of voltage dynamics on cellular function.

The authors conclude that the speed, sensitivity, photostability, and long-wavelength fluorescence emission of BeRST 1 will be useful in analyzing complex neuronal activity in a noninvasive way.

Rajendrani Mukhopadhyay, Ph.D.

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