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Spotlights

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Spotlights on Recent *JACS* Publications

A NEW TWIST ON FLUORESCENCE MICROSCOPY

Chiral molecules or structures absorb circularly polarized light differently for right- and left-handed structures, a property called circular dichroism (CD). Marco Finazzi and co-workers show that they can combine CD measurements with scanning confocal fluorescent microscopy to map the spatial distribution of chiral domains in a thin film (DOI: 10.1021/ja209916y).

The authors develop a method to combine two-photon fluorescence measurements with microscopy, and they demonstrate its application by mapping the chiral domains of a polymer thin film, with resolution well below 500 nm. The materials studied in this work are of interest for organic thin-film devices, as they will potentially provide control over photophysical properties.

In the experiments, two long-wavelength photons are absorbed for each fluorescent event. This two-photon technique greatly reduces background noise in 3D imaging, and long wavelengths are scattered less than short wavelengths, so the sensitivity is improved. Also, the lower energy excitation source does not cause as much sample degradation, which is important when this technique is applied to biological samples. When CD measurements are combined with scanning confocal fluorescent microscopy, researchers are able to obtain spatial information about the sample and also to map molecular organization. **Polly Berseth, Ph.D.**

MOLECULE DECOMPOSES CLEANLY INTO A CATHODE FOR THIN-FILM BATTERIES

Evgeny Dikarev and co-workers are the first to produce a volatile single-source molecular precursor for lithium−manganese oxide, a common cathode material in batteries for medical devices and vehicles (DOI: 10.1021/ja301112q). To make a lithium−manganese oxide film, a molecular precursor that contains all the elements in the correct ratio can be used; however, making such a precursor is quite challenging. With commercially available reagents, the researchers synthesized a highly volatile precursor that thermally decomposes cleanly into lithium−manganese oxide.

Many types of electronics, including cameras, cell phones, laptops, power tools, medical devices, and vehicles, use durable, lightweight, and energy-dense lithium ion batteries. A demand for more portable electronic devices leads to a demand for smaller batteries. Material scientists have made thin-film batteries that are just nanometers thick, and the cathode material is a crucial component in these tiny batteries.

As Dikarev's precursor is volatile, it is ideal for making lithium−manganese oxide films or crystals that can act as cathodes in miniature batteries. This precursor is also soluble and retains its heterometallic structure in non-coordinating solvents. Thus, it is potentially compatible with liquid injection chemical vapor deposition techniques for making thin films, as well. **Yun Xie, Ph.D.**

HYDROGEL PROTECTS PROTEIN CRYSTALS FROM OSMOTIC SHOCK

Drug discovery stands to benefit from high-throughput protein X-ray crystallography because the interactions between potential drug candidates and target proteins can be visualized in three dimensions. The best way to get crystals of drug candidates, which are ligands, bound to target proteins is to soak protein crystals in a solution of the ligand. But the soaking step poses a problem in many cases because ligands tend to be in concentrated organic solvents or high ionic strength solutions. These solutions damage protein crystals by osmotic shock.

Shigeru Sugiyama, Hiroyoshi Matsumura, and colleagues have created a way to circumvent the osmotic shock problem (DOI: 10.1021/ja301584y). Previously, they had grown protein crystals in hydrogels. Now, they demonstrate that these hydrogel-grown crystals can be safely soaked in organic solvents and high ionic strength solutions without suffering damage. The hydrogel-grown crystals are also more mechanically stable than conventional protein crystals produced from solution.

The investigators show that their new approach generates crystals of the ligand−protein complex suitable for detailed structural analysis. They soaked hydrogel-grown avidin crystals in an organic solution of a biotin ligand. These crystals generated electron density maps of sufficient resolution to clearly show the ligand bound in the protein active site. **Rajendrani Mukhopadhyay**

BUILDING A BETTER TOPOLOGICAL INSULATOR

Hui Li and co-workers grow small sheets of topological insulators Bi_2Se_3 and Bi_2Te_3, materials that are effective insulators in their interiors but conduct electricity on their surfaces, with highly regulated structural characteristics (DOI: 10.1021/ja3021395). Theoreticians have suggested that these strange materials could hold promise for investigating exotic physical phenomena as well as more practical applications, such as quantum computing. However, since topological insulators' potential relies heavily on their physical characteristics, developing a synthesis method that carefully controls orientation, thickness, position, and layout is an important goal.

The researchers take advantage of van der Waals epitaxy—a way to grow crystal layers on even dissimilar materials, held together by weak attractions—to build layers of these topological insulators on chemically inert mica. Tweaking the growing conditions gave these investigators control over the size and thickness of the resulting materials, up to 0.1 mm across and down to 12 nm thick. Hitting the mica with directed bursts of oxygen plasma created areas where the topological insulators were not able to grow, precisely directing their placement. Angle-resolved photoemission spectroscopy, a technique that determines the distribution of electrons on surfaces, confirmed that the grown materials were indeed

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topological insulators. The authors suggest that this method could pave the way for developing topological insulators for a variety of applications. **Christen Brownlee**

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