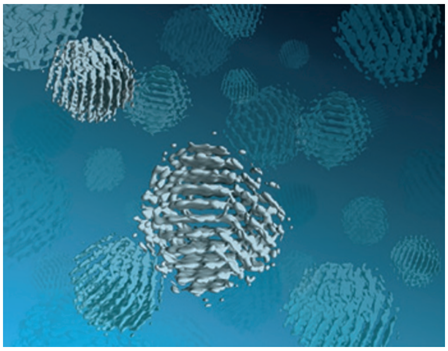
NANOPARTICLES

3D imaging in liquids

Science **349,** 290–295 (2015)



BERKELEY LAB

Electron microscopes are frequently used to characterize nanoparticles. The samples probed are, however, typically in the solid state, as the electron beam of the microscope requires a high-vacuum environment, while nanoparticles are often synthesized and utilized (as catalysts, for example) in solution. Paul Alivisatos and colleagues have now shown that an electron microscope can generate 3D images of platinum nanoparticles that are floating freely in solution.

The researchers — who are based at institutes in the US, Australia and South Korea — used a transmission electron microscope to examine nanoparticles encapsulated in a liquid cell made from two graphene sheets; the graphene acts as an ultrathin cover for the samples, allowing liquid conditions to be maintained in the vacuum of the electron microscope. With the set-up, numerous 2D images of individual nanoparticles were taken as the particles rotated in the solution. These images were then combined into 3D reconstructions of the nanoparticles that had near-atomic resolution, with the help of an algorithm previously developed to analyse cryo-electron microscopy images of biomolecules. *OV*

PAPER-BASED TECHNOLOGIES

Biosensors and electronics

ACS Nano http://doi.org/6cg (2015)
ACS Nano http://doi.org/6ch (2015)

Paper is light, flexible, inexpensive, biodegradable, and is made from abundantly available materials such as plants and non-pathogenic bacteria found on fruits. As a result, it is a useful substrate for many applications in diagnostics and electronics. Two independent research groups have now shown that paper can be given optical properties for biosensing applications, and can be turned into invisible electronics for anti-theft applications in art and packaging materials.

Arben Merkoçi and colleagues from institutes in Spain, Iran, and the Czech Republic created paper that exhibits plasmonic and photoluminescent properties by depositing either gold, silver or upconversion nanoparticles on bacterial cellulose paper. When thiourea is added to the gold-containing paper, it causes the gold nanoparticles to aggregate and the paper changes from red to dark red. Similarly, the drug methimazole could be optically detected when added to the silver-containing paper. By decorating the paper with antibodies, quantum dots, and graphene oxide, the paper is used to detect the presence of bacteria.

Alternatively, Jun Zhou and colleagues at Huazhong University of Science and Technology and the University of Maryland created a transparent-paper-based generator that is powered by applying pressure with a finger. The generator is made by adhering one sheet of carbon-nanotube-containing transparent paper to another similar sheet that has an additional polyethylene film. Polyethylene is an electret — a polarized piece of dielectric material. When pressure is applied to the generator, the air gap between the two papers decreases. This causes a differential charge distribution in the papers and induces current flow, which is used to power a liquid-crystal display. When implemented on artwork or packaging material, the generator can reveal critical information, such as a logo or date, by simply pressing and releasing the generator. *ALC*

SKYRMIONS

Room temperature and beyond

Nature Commun. **6,** 7638 (2015)

Skyrmions are nanoscale spin textures distinguished by their topological stability. They have been observed in several chiral magnets, both in bulk and thin-film form, where they are stable in well-defined pockets of the magnetic field–temperature phase diagram. Besides a fundamental interest generated by their emerging electromagnetic properties, they are attracting significant attention as promising candidates for information carriers in low-power, dense memory devices. A major hurdle towards mainstream applications is the fact that skyrmions have only been observed at a maximum temperature of 278 K. Now, Yoshinori Tokura and colleagues have shown that skyrmion crystals can form at room temperature and above in Co–Zn–Mn metallic alloys, which are cubic chiral magnets with a different chiral space group compared with the compounds previously investigated.

The researchers — who are based at the RIKEN Center for Emergent Matter Science, University of Tokyo, Paul Scherrer Institute and EPFL — investigated the presence of a skyrmion phase in a series of these alloys with varying composition using multiple experimental techniques, including Lorentz transmission electron microscopy, magnetization measurements and small-angle neutron scattering. Skyrmions were found in samples with a thickness of 150 nm at temperatures from 283 to 345 K, under application of a magnetic field of a few hundred oersteds. In bulk form, skyrmions form in a narrower temperature range, from 311 to 320 K, and for applied magnetic fields of around 1 kOe. *ED*

ARTIFICAL MEMBRANES

Phospholipids grow non-stop

Proc. Natl Acad. Sci. USA **112,** 8187–8192 (2015)

Natural cell membranes grow during cell replication. Researchers have been able to make artificial membranes with similar capabilities by embedding a catalyst that promotes the synthesis of phospholipids in the bilayer structure of the membrane. As the membrane grows, though, the concentration of the catalyst decreases and the membrane loses the ability to grow further. Now, Neal Devaraj and colleagues at the University of California in San Diego have designed a catalyst that can self-synthesize, as well as catalyse the formation of phospholipids.

The researchers use a tertiary amine attached to three alkyl triazole arms. This compound can coordinate Cu^{+} ions. Once it does so, it becomes a dual purpose catalyst. On the one hand, it promotes self-catalysis from three alkyl azides and a tripropargylamine precursor. On the other hand, it can catalyse the formation of new phospholipids from an alkyl azide and a lipid precursor containing an alkyne linking group. Both reactions are catalysed through click chemistry, azide–alkyne reactions facilitated by the presence of the chelated Cu^{+} in the structure of the catalyst. Using this method, Devaraj and colleagues achieve sustained growth of their artificial membrane and observe new vesicle formation once a critical surface area is reached. *AM*

Written by Ai Lin Chun, Elisa De Ranieri, Alberto Moscatelli and Owain Vaughan.