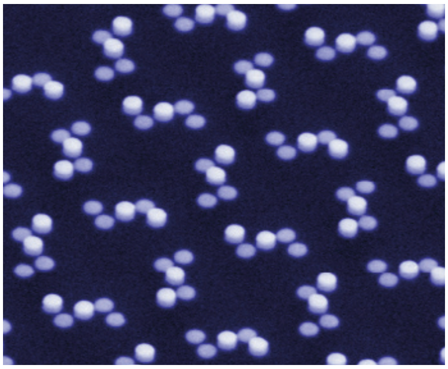
METAMOLECULES

Now with added chiral centre

Nano Lett. **13,** 600–606 (2013)



Ensembles of metallic nanoparticles that exhibit plasmonic properties are often called metamolecules because their building blocks interact with each other in a way that is similar to how atoms interact with each other in a molecule. This chemical analogy has also been extended to the concept of chirality and has led to the synthesis of chiral metamolecules that have a single chiral centre. Mario Hentschel and colleagues at the University of Stuttgart and the Max Planck Institute, Stuttgart have now created plasmonic diastereoisomers — structures that have multiple chiral centres.

The researchers start by placing a set of three nanodisks on a surface to form an L-shape and then place a fourth on top. It has previously been shown that this type of ensemble can either be chiral or achiral depending on the position of the fourth nanodisk. However, by adding a second set of four nanodisks to create an S-shaped ensemble (pictured) the system can be endowed with diasteroisomerism. The circular dichroism spectrum of the ensembles strongly depends on the position of the two nanodisks in the top layer and its intensity is equal to the sum of the intensities of the single L-shaped chiral centres, as long as the electric fields of the nanodisks do not overlap too much.

Notably, all metamolecules created with this method are chiral and show a marked circular dichroism. The absence of mesostructures — which have two or more chiral centres but are achiral because of a symmetry plane in the molecule — is due to the fact that the bottom layer of nanodisks sit on a surface and therefore the structures lack the necessary symmetry plane. *AM*

TWO-DIMENSIONAL SEMICONDUCTORS

Assessing disorder

Appl. Phys. Lett. **102,** 042104 (2013)

Two-dimensional dichalcogenides such as MoS_2 can be thought of as a semiconducting alternative to graphene and have been used to create high-mobility field-effect transistors. There is, however, uncertainty surrounding how the different elements of the transistor affect the electron mobility of these materials, which makes it difficult to optimize the performance of the devices.

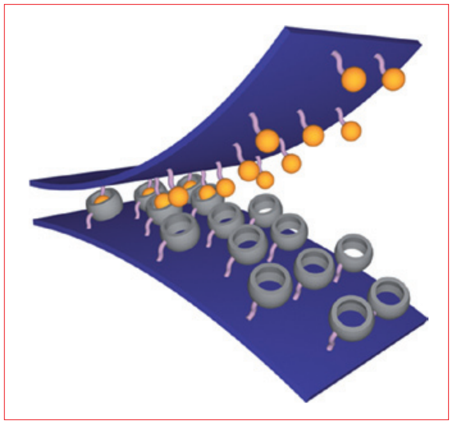
Wenzhong Bao and co-workers at the University of Maryland have now examined the influence of the dielectric material that is used in the transistor to separate the MoS_2 layer from the gate electrode. The dielectric material is an essential part of the transistor but inevitably introduces disorder that can limit the electron mobility. This disorder can either be long range, such as that caused by spurious localized electrons or holes, or short range, such as that created by surface roughness or chemical bonding.

The researchers studied devices with different MoS_2 thicknesses using SiO_2 or polymethylmethacrylate (PMMA) as a dielectric material. For devices made with SiO_2, conductivity experiments showed that the mobility does not depend on the thickness of the MoS_2, which suggests that short-range disorder is dominant. However, for devices made with PMMA, a clear increase in mobility with thickness was observed, which suggests that long-range disorder is dominant. *FP*

SUPRAMOLECULAR CHEMISTRY

Underwater velcro

Angew. Chem. Int. Ed. http://doi.org/fz97cv (2013)



Marine organisms such as mussels or barnacles are often the inspiration for synthetic adhesives that can work underwater. For example, an amino acid known as 3,4-dihydroxy-L-phenylalanine (or DOPA) is found in the glue proteins excreted by mussels and has been used to make a variety of adhesives. However, these materials typically work with a curing agent that irreversibly binds it to a surface. Kimoon Kim and colleagues at Pohang University of Science and Technology have now shown that supramolecular host–guest chemistry can be used to create a strong reversible adhesive that works underwater.

The adhesive uses a hook-and-loop strategy, which is similar to commercial Velcro. The ‘hook’ surface is created by coating a silicon wafer with a guest molecule called aminomethylferrocene and the ‘loop’ surface by coating another wafer with a host molecule called cucurbit[7]uril. This host molecule has a hydrophobic cavity that can be accessed through two portals, and is known to form a very stable complex with the guest molecule in water.

After connecting the two surfaces in water by hand, and without using any curing agent, Kim and colleagues demonstrate that the supramolecular velcro is strong enough to support a 2 kg weight and, after drying, a 4 kg weight. They also show that the velcro can be unfastened chemically, as well as mechanically. *OV*

NANOFLUIDICS

Nanoparticles go with the flow

ACS Nano http://doi.org/khs (2013)

The surfaces of bones undergo continual restructuring as osteoclast cells pick up debris and osteoblast cells deposit new material. Inspired by this process, Anna Balazs and co-workers at the University of Pittsburgh have now devised a self-assembled lipid vesicle that can pick up nanoparticles from a surface and then drop them off at a different and controlled location.

Using dissipative particle dynamics simulations — a method similar to molecular dynamics but that also takes into account the hydrodynamics of the system — the researchers show that a lipid bilayer vesicle can be pushed along a hydrophilic surface by an imposed shear flow of a hydrophilic solvent. When the vesicle encounters a Janus particle exposing its hydrophobic side to the solution, it can incorporate the particle in its membrane structure detaching it from the surface. A vesicle with a diameter of 10 nm can pick up four particles that are around three times smaller than itself without breaking apart. The Janus particles can then be dropped off when the vesicle encounters a suitably sticky surface. *AM*

Written by Alberto Moscatelli, Fabio Pulizzi and Owain Vaughan.