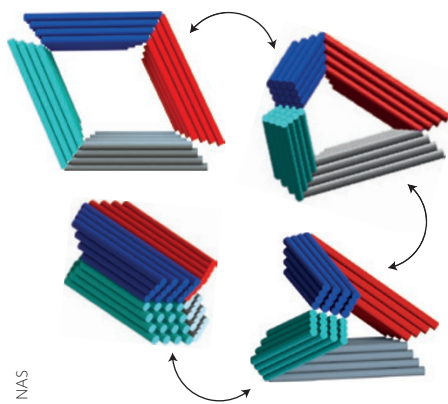


DNA ORIGAMI

On the move

Proc. Natl Acad. Sci. USA <http://doi.org/x4p> (2015)



DNA origami is a technique in which a long strand of DNA is folded into a predetermined shape with the help of a number of shorter 'staple' strands. The approach has been used to create a range of intricate two- and three-dimensional structures, but these are typically static or, if they can move, offer limited operations. Carlos Castro and colleagues at the Ohio State University have now built origami structures capable of programmable two- and three-dimensional motion by transferring macroscopic machine designs to the nanoscale.

The researchers used a combination of stiff double-stranded DNA components and flexible single-stranded components to first create origami joints capable of

simple angular (a hinge) and linear (a slider) motion. These joints could then be integrated to form devices capable of more complex motion such as a crank–slider, which uses three hinges and one slider joint, and a Bennett linkage, which uses four hinges and can transition between a compact bundle and an open frame. Castro and colleagues also show that the Bennett linkage can be made to undergo reversible conformational changes using DNA input strands. OV

2D MATERIALS

A memory for images

Nano Lett. **15**, 259–265 (2015)

Two-dimensional materials such as graphene and transition metal dichalcogenides are being widely investigated for use in electronic and optoelectronic devices because of their flexibility and versatile optical and electronic properties. Now, Antony George, Liehui Ge, Pulickel Ajayan and colleagues at Rice University and Lanzhou University add to the pool of existing optoelectronic devices by creating an imaging sensor made from few-layer $\text{CuIn}_7\text{Se}_{11}$.

In these devices, incident light excites photoelectrons in a semiconductor channel made of $\text{CuIn}_7\text{Se}_{11}$. When a positive gate voltage is applied, the electrons are then trapped in the channel by a potential well formed by the Schottky barriers at the contacts between the 2D material and the source and drain metal electrodes. The amount of trapped charge is proportional

to the exposure dose of light, analogous to conventional charge-coupled device imaging sensors. Information about the photoexcitation is maintained until a negative source–drain voltage is applied, which allows the trapped electrons to be released and for the stored information to be read.

Each device of this kind could form a pixel in a memory array that can capture and store an image, and the researchers demonstrate a three-unit array. They also illustrate the generality of the approach by fabricating sensors in few-layer InSe and monolayer MoS_2 . The flexibility of 2D materials means that such sensors are advantageous compared with conventional imaging sensors when it comes to flexible electronic applications, or when integration with other 2D electronic devices is required. ED

RESPONSIVE MATERIALS

Cleaning oil spills remotely

Nanoscale <http://doi.org/zj6> (2014)

There are a variety of materials for cleaning an oil spill, but many of them can only be operated *in situ*. In some extreme cases, where polluted waters could harm the safety of workers, there is a need for materials that can be used from a distance. Inspired by marine mussels, Yong Zhao and colleagues have now developed a magnetically responsive film that can efficiently absorb a variety of oils.

The researchers — who are based at various institutes in Beijing — created fibrous poly(vinylidene) fluoride films through electrospinning, and used dopamine (a compound found in the adhesive proteins of mussels) to anchor magnetic iron oxide nanoparticles onto the surface of the fibres. The resulting composite material is magnetically responsive and absorbs oils of different viscosity from water, including soybean oil, diesel and gasoline. Films that contained nanoparticles showed better oil adsorption capacities than the undecorated ones. This is because the nanoparticles increased the surface roughness of the film, which, in turn, increased its ability to repel water and adsorb oils. Films containing oil could be easily separated using a magnet, offering a way to remotely manage oil spills. Moreover, adsorbed oils can be removed from the film by extrusion or centrifugal separation, and the films could be reused without any obvious changes in adsorption capacity over the five cycles examined in the study. ALC

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

GOLD NANOPARTICLES

Metallic up to a point

J. Am. Chem. Soc. <http://doi.org/zj7> (2014)

The chemical properties of gold nanoparticles change with size. In particular, as the size of the nanoparticles gets smaller, their electronic structure changes from that typical of a metal, with surface electrons that behave in a collective manner, to that typical of a molecule, with discrete energy levels. But at what size exactly does this transition occur? To find this out, Hannu Häkkinen, Tatsuya Tsukuda, Yuichi Negishi and colleagues have now analysed the optical absorption and X-ray diffraction spectra of a series of thiolate-protected gold clusters composed of precise numbers of atoms, from Au_{520} to Au_{38} .

The researchers — who are based at the University of Jyväskylä, the University of Tokyo and the Tokyo University of Science — find that there is a clear transition in the optical absorption spectra from a featureless plasmonic band, typical of metals, to a band with vibronic structures, typical of molecules, when the size of the cluster reduces from 187 to 144 gold atoms. As confirmation of the loss of metallic behaviour at around this size, the team show clusters with 144 atoms or fewer no longer have the face-centred cubic crystal structure typical of metallic gold.

Furthermore, owing to the good agreement between the X-ray spectra and density functional theory calculations, Häkkinen and colleagues are able to propose new structures for several Au clusters with more than 100 atoms. These clusters can be thought of as having core–shell structures in which the core Au atoms have a different geometry to the shell Au atoms. AM