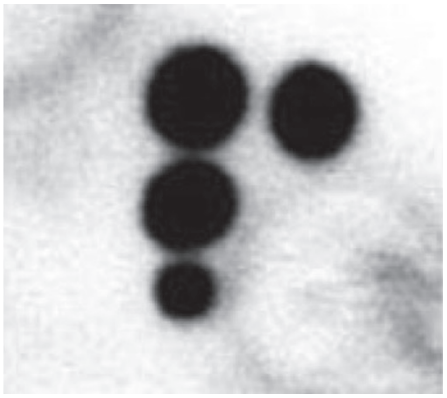
DNA NANOSTRUCTURES

Ring the changes

Nature Commun. **4,** 2000 (2013)



DNA is a versatile molecule that can be used to form a variety of intricate self-assembled nanostructures and devices. The molecule has, for example, been used to direct the assembly of dynamic nanoparticle structures such as dimers and superlattices that can be switched between two different states. Itamar Willner and colleagues at the Hebrew University of Jerusalem and Ohio University have now used interlocked rings of DNA to form switchable arrangements of gold nanoparticles that can modulate their spectroscopic properties.

The researchers used three-ring catenated DNA nanostructures, which can be converted into different configurations using fuel and blocker DNA strands. Switchable arrangements of nanoparticles were created by attaching two, three or four gold nanoparticles of different sizes to the catenated structures with DNA tethers. By adjusting the distance between the different gold nanoparticles, the plasmonic coupling interaction between the particles could be controlled. Similarly, by adjusting the distance between a fluorophore and a gold nanoparticle that were both attached to the DNA nanostructures, surface-enhanced fluorescence and fluorescence quenching phenomena could be detected.

Willner and colleagues suggest that their catenated DNA machines could also be used to explore the fundamental properties of assemblies of nanoparticles with various sizes and compositions. *SS*

OPTICAL BEAM LITHOGRAPHY

Nanoscale features in 3D

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The top-down fabrication of nanoscale electronic devices relies on electron-beam lithography, which has a resolution of a few nanometres and is limited by the electron-sensitive resins used. This method is not suitable for creating three-dimensional features, and as a result alternative techniques based on optical lithography have been developed, which exploit a focused laser beam for direct writing. However, the feature size that can be achieved with optical lithography is limited by diffraction to hundreds of nanometres. Min Gu and colleagues at Swinburne University of Technology and CSIRO Materials Science and Engineering have now developed three-dimensional optical beam lithography that is capable of producing features of 9 nm and achieving a two-line resolution (the minimum distance between two features) of 52 nm.

The improved resolution is attained through the use of a photoresin with high mechanical strength and a two-beam configuration. The photoresin has activation channels for both photopolymerization and photoinhibition, and one optical beam (with a wavelength of 800 nm) acts as the writing beam and the other as the inhibition beam, which spatially confines the photopolymerization induced by the writing beam. This approach allows feature sizes and resolutions to be achieved well below the diffraction limit (around 250 nm) of the writing beam. *ED*

MOLECULAR SWITCHES

A scaffold for perfect control

Angew. Chem. Int. Ed. **52,** 7879–7882 (2013)

Molecular motors can exert a macroscopic effect if their stimulus–response units work in a coordinated fashion. Controlling these molecular units is, however, not an easy task because a host of different configurations and reaction pathways are possible, particularly at room temperature. Gebhard Haberhauer and colleagues the University of Duisburg-Essen have now developed a method to control both the direction and type of conformational change that an azobenzene derivative — a common photoresponsive unit — can undergo when exposed to light.

Azobenzene is a molecule composed of two benzene rings linked by a nitrogen–nitrogen double bond, and can undergo a *trans–cis* isomerization on irradiation. The researchers embedded the azobenzene unit in a molecular scaffold composed of a cyclic imidazole peptide with two phenyl upright side-arms by attaching the two benzene rings of the azobenzene to these side-arms. When irradiated with light, only motion around the nitrogen–nitrogen double bond (a flipping process in which the phenyl rings move towards each other) can take place, whereas, the competing isomerization pathway, inversion around one of the nitrogen atoms (a process in which one phenyl ring slides past the other), is hindered by the presence of the scaffolding. Because of the scaffolding, the flipping motion can also only occur in one of the two possible directions.

The flipping process is reversible and under appropriate conditions can be made continuous, a process the authors compare to the wingbeat of a bird. *AM*

NANOPARTICLES

Cancer gets spooked

Nano Lett. **13,** 3248–3255 (2013)

The two main strategies of nanoparticle delivery of anticancer therapeutics, passive and active targeting, are limited by variations in the architecture of tumours and the complexity of incorporating targeting groups into the delivery vehicle, respectively. Marcelle Machluf and colleagues at the Technion Israel Institute of Technology have now demonstrated tumour-specific delivery of a therapeutic using nanoghosts — nanoparticles produced from the membranes of mesenchymal stem cells (MSCs).

Intact MSC cell membranes (ghost cells) were reduced to nanoscale particles, while entrapping the biological anticancer agent sTRAIL, the clinical use of which is limited by hepatoxicity and a short half-life. A single administration of drug-loaded nanoghosts derived from human- or rat-MSCs was found to inhibit the growth of tumours in mice with human prostate cancer by over 70% and for up to two weeks. Nanoghosts derived from human smooth muscle cells (SMCs) and loaded with sTRAIL did not have any therapeutic effect, illustrating that the effective nanoghosts were specific to the tumour and not the species.

Although the uptake mechanism has not yet been fully elucidated, Machluf and colleagues highlight that the SMC-nanoghosts shared the same size and physical properties as MSC-nanoghosts, providing insight into the differences between active and passive strategies of targeting tumours. *SB*

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