MECHANOTRANSDUCTION

Golden nanoprobes

ACS Nano **11,** 541–548 (2017)

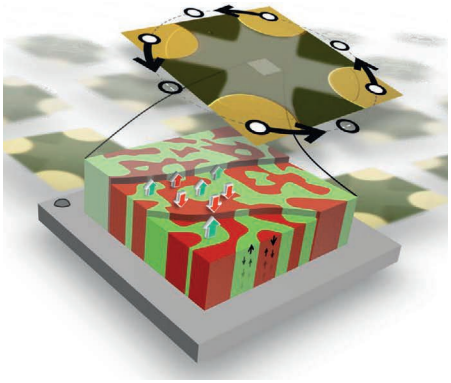
In mechanotransduction, mechanical stimuli sensed at the cell surface are propagated through the cytoskeleton and converted into biochemical signals for the modulation of cellular activities. Techniques such as atomic force microscopy and optical tweezers are used to quantify the forces exerted at specific locations on the cellular surface. Now, Xiong *et al.* report on a plasmonic nanomechanical probe that can simultaneously monitor force transduction events at different sites on the cell surface.

The probe, dubbed a plasmonic nanospring, translates cellular mechanical stimuli into spectral outputs. It consists of two gold nanoparticles attached to the cell surface and to a glass substrate, respectively, and separated by an elastic chain of polyethylene glycol. The nanoparticles give rise to spectral effects that are dependent on their separation, which in turn is a function of the force experienced by the nanoparticle attached to the cell surface. Using the nanosprings, the researchers mapped the dynamics of HeLa cell mechanical responses at several locations following generation of reactive oxygen species after exposure to H_2O_2. Their results suggest that reactive oxygen species can trigger the mechanotransduction signalling pathway through modulation of the actin filaments in the cytoskeleton. *CP*

ANTIFERROMAGNETIC SPINTRONICS

Improving memory

Nat. Commun. **8,** 13985 (2017)



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The ferromagnetic materials used for the fabrication of magnetic random access memory devices are sensitive to spurious magnetic fields, usually causing undesired instabilities. Furthermore, the need for charge currents to encode information increases the overall power consumption of these devices. Several approaches reported in the literature have addressed these issues separately by using either antiferromagnetic materials — aiming at better device stability — or magnetoelectric materials, enabling writing processes via electric fields, hence without any power dissipation due to electric currents.

Now, Kosub *et al.* report on the use of these approaches simultaneously, describing a random access memory prototype that works at room temperature and is based on α-Cr_2O_3 — a magnetoelectric antiferromagnet. An ultrathin layer of Pt, which has a high paramagnetic polarizability, makes it possible to sense the magnetic state of α-Cr_2O_3. This precaution avoids coupling Cr_2O_3 to ferromagnetic materials and allows the researchers to perform all-electrical read-out processes via anomalous Hall magnetometry. A thicker Pt electrode allows data writing in combination with a static magnetic field that need not be removed during the read-out stage.

Energy is consumed only during the write and read stages. Also, the reported writing thresholds are sizably lowered if compared to the devices based on ferromagnets. *GP*

SILICON NANOWIRES

Swallowed whole

Sci. Adv. **2,** e1601039 (2016)

The ability to integrate inorganic nanomaterials with biological systems presents exciting opportunities to design therapeutic and diagnostic devices that can be incorporated directly into cells. Silicon nanowires (SiNWs) are biocompatible, possess unique electronic properties and can host a range of functional groups on their surfaces, making them an ideal platform for such devices. They have already been exploited as biosensors and drug delivery agents, but little is known about how these materials enter cells or how they behave once inside. This is especially true for systems where the nanowires are not labelled with tracking markers that could potentially alter the nanowire–cell interactions.

Now, Zimmerman *et al.* report on a technique obtained by combining electron microscopy with optical imaging to visualize how endothelial cells — those lining the walls of blood vessels — internalize label-free SiNWs. They show that cell entry occurs via a phagocytosis pathway: the membrane extends to surround and engulf a nanowire and the resulting vesicle breaks off inside the cell. The process is morphology-dependent so the cell can distinguish between high-aspect ratio wires and particles of other shapes. Once internalized, cellular machinery shuttles the vesicle in short, rapid bursts from the edge of the cell to the area around the nucleus, where the nanowires eventually cluster inside larger lysosomal compartments. This fresh insight may prove invaluable when it comes to designing future devices. Moreover, whereas endothelial and macrophage cells spontaneously internalize SiNWs, neurons and cardiac muscle cells are found to reject them, implying that SiNW-based therapeutic devices could be made to target specific cell types. *VR*

SUPRAMOLECULAR CHEMISTRY

A temporary change of hands

Angew. Chem. Int. Ed. **56,** 1329–1333 (2017)

Biochemical transformations involve a local exchange of energy that affords natural systems with their unique ability to adapt to environmental conditions. Biological assemblies, for example, are often transient species that can perform a specific function. Their transient character results from the complex interplay of biochemical reactions that promote and suppress their formation. Recreating transient assemblies in artificial supramolecular systems can be useful to fabricate adaptive materials that can respond in a spatially and temporally controlled manner to environmental changes. Dhiman *et al.* now describe a supramolecular assembly that can temporarily switch its chirality.

The system comprises a naphthalene diimide molecule functionalized with a phosphate receptor group that self-assembles in a helical stack in response to binding with either ATP or ADP molecules. Notably, ATP drives the formation of P-helices, whereas ADP drives the formation of M-helices. Dhiman *et al.* take two enzymes, one that generates and one that consumes ATP through different pathways. Starting with the substrate that produces ADP, they observe the formation of an M-helical stack. Subsequent addition of the substrate that generates ATP triggers the conformational switch to a P-stack, as ADP-bound molecules are converted into ATP by the first enzyme. At this point, the presence of a high concentration of ATP activates the second enzyme, reverting the helicity of the stack. By changing various parameters, Dhiman *et al.* can program the lifetime of the transient species. *AM*

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