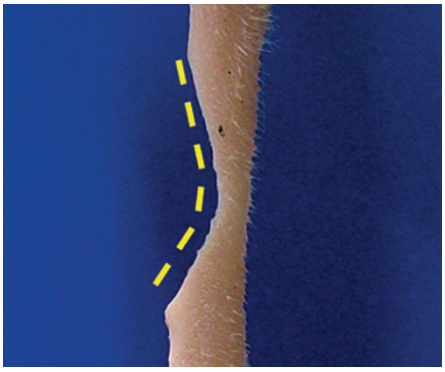
BIOMATERIALS

Tearing skin

Nature Commun. **6,** 6649 (2015)



NATURE PUBLISHING GROUP

Skin is a vital yet often overlooked organ. One of its major functions is to offer the first line of defence against an organism's external environment, with its resistance to tearing being an important characteristic. Although the elastic nature of skin is now well established, its response to loading conditions that would otherwise introduce a tear are less well documented, especially with regard to the underpinning micro-mechanisms. Wen Yang and colleagues now perform a detailed study of deformation in notched rabbit skin specimens, including the use of *in situ* X-ray diffraction and microscopy, to understand its extraordinary resistance to tearing. It is found that resistance to the propagation of a pre-introduced notch is associated with the curvy and disordered nature of collagen fibrils in the skin, which permits them to straighten, stretch, reorientate and slide in response to an applied load. These mechanisms mitigate further stress build-up at a site of stress concentration, blunting a tear. This demonstration provides another example of how some organisms have adapted to survive in their environment. *JP*

SUPERCONDUCTIVITY

Splitting Cooper pairs

Phys. Rev. Lett. **114,** 096602 (2015)

Cooper pairs are two electrons bound together and are responsible for superconductivity. Breaking the pairs apart provides a source of entangled electrons whose quantum states cannot be described independently. Many efforts have been devoted to realize an efficient splitting process, which can be applied in quantum technologies. Now, Zhenbing Tan and colleagues report a device with efficiencies close to 10%. It consists of two graphene quantum dots electrically connected by a grounded lead of superconducting aluminium. The geometrical configuration used allows independent bias of the dots and their independent tuning with two side gates. When the energy levels of the decoupled dots are asymmetric a conductance correlation across them is detected, providing evidence of pair splitting. The efficiency obtained is larger than that predicted by current theoretical models (which therefore should be revised) and fosters expectations for quantum information solid-state-based devices. *DC*

METAMATERIALS

Thermally tunable

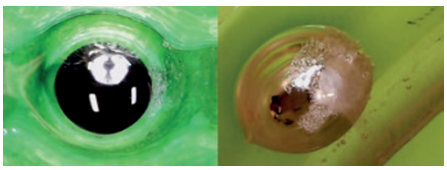
Nature Commun. **6,** 7590 (2015)

Research on metamaterials has recently shifted towards the dynamic tunability of their properties in an effort to overcome limitations in, for example, bandwidth, fabrication and tolerance. Now, Wiktor Lewandowski, Martin Fruhnert and colleagues have demonstrated a metamaterial whose properties can be actively tuned with temperature. The silver nanoparticles coated with a thermally switchable ligand showed a different arrangement at high and low temperatures. At 120 °C, the particles had a separation distance of 7.2 nm, whereas when the temperature was lowered, they moved closer (6 nm) and formed distinct layers; the plasmon band blueshifted by 20 nm and the metamaterials exhibited epsilon-near-zero properties at both extremes. The process is fully reversible, albeit slow (about 60 min is required to lower the temperature). Although the tunability range and reconfiguration timescales need to be improved, these findings underline the potential of self-assembly techniques based on liquid-crystalline surface ligands for reconfigurable metamaterials. *MM*

LIQUID METALS

Self-propelled droplets

Adv. Mater. http://doi.org/f26cb6 (2015)



WILEY

Car engines are familiar examples of systems able to convert chemical energy into kinetic energy, allowing motion of vehicles. Much simpler motors are required to allow self-propulsion of millimetre-sized machines or robots in aqueous environments. Jie Zhang and colleagues now report an example of such a system, composed of just a droplet of a liquid metal in contact with a flake of aluminium. A NaOH-rich aqueous solution dissolves the flake generating hydrogen bubbles, and this process is accelerated by the liquid metal that modifies the mechanical and electrical properties of aluminium. In addition, the electrochemical reactions between the two metals alter the charge distribution on the surface of the droplet and decrease the surface tension in the proximity of the flake. The resulting pressure difference between the rear and the front of the droplet, together with the flow of hydrogen bubbles, propels this simple motor for 1 hour at an average speed of 5 cm s^{-1}. *LM*

CELL MIGRATION

Speed–persistence coupling

Cell http://doi.org/3f3 (2015)

Cells that move fast change direction less often than slower cells. In fact, only recently it has been shown that in three dimensions and in the absence of significant environmental cues and constraints, cells do not follow a random walk. Yet the underlying mechanism has remained elusive. Now, Paolo Maiuri *et al.* confirm by using previously published data for a variety of cell types that the persistence of cell movement in one direction depends exponentially on cell velocity, and demonstrate that this coupling between cell persistence and cell velocity is general and mediated by actin flows. The intracellular actin flows reinforce cell polarity in polarized migrating cells by enhancing the asymmetry of actin-interacting polarity cues. Although the molecules responsible for the generation of such polarity cues (which most likely depend on cell type) remain to be discerned, the researchers note that the velocity–persistence coupling of cell migration also applies to the movement of individual cell protrusions, and thus may apply to other phenomena that are also driven by actin polymerization. *PP*

Written by David Ciudad, Maria Maragkou, Luigi Martiradonna, Pep Pàmies and John Plummer.