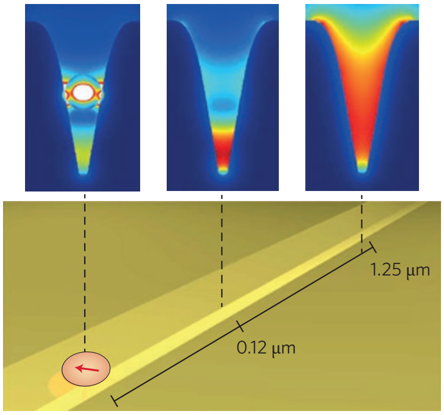
QUANTUM PLASMONICS

## Diamonds in waveguides

*Nature Commun.* **6,** 7883 (2015)




NATURE PUBLISHING GROUP

The field of quantum plasmonics looks to exploit the strong confinement of the electromagnetic field for high-speed and ultra-compact on-chip devices for quantum technology. A major issue that hinders realistic implementations is minimizing the plasmon losses in order to increase their propagation length. To this end, Romain Quidant, Sergey Bozhevolnyi and colleagues study theoretically and experimentally the coupling between a quantum emitter and channel plasmon polaritons from a V-groove plasmonic waveguide. In particular, they deterministically place a single nitrogen–vacancy centre in diamond (a well-known bright photon source, operating at room temperature) inside the waveguide, based on the results of the theoretical investigation about its exact position for optimal coupling with the plasmons. They demonstrate that the emission from the nitrogen–vacancy centre is effectively guided for about 5 µm before being out-coupled into free-space propagating light. The high coupling efficiency between the emitter and the modes (42%) combined with the reported top-down fabrication technique bring plasmonic circuitry closer to reality. *MM*

IMPLANTABLE DEVICES

## A solid base

*Adv. Healthcare Mater.* http://doi.org/f3czxp (2015)

Microelectrode arrays composed of multiple silicon needles are used as penetrating devices to record brain electrical activity *in vivo*. Long and ultrathin needles are required to reach deeper regions in the brain while minimizing penetration-induced tissue damage; however, an increased aspect ratio reduces the stiffness of the needle, which may break during the implantation procedure. Now, Satoshi Yagi and colleagues show that a bioresorbable silk layer deposited at the base of 650-µm-long, 5-µm-thick silicon needles acts as a temporary reinforcement that allows the devices to pierce the brain of a mouse without buckling or fracturing. Once in contact with the biological tissues, the silk base dissolves allowing the needles to penetrate completely. With respect to previous approaches proposing coating of the full microelectrode array with bioresorbable materials, this strategy does not increase the diameter of the needles thus minimizing the invasiveness of the devices. The researchers suggest that this method can be used to implant recording and stimulating electrodes, as well as hollow microneedles for drug delivery. *LM*

GLASSES

## Melting frameworks

*Nature Commun.* **6,** 8079 (2015)

For the most part, the many practical applications of metal–organic frameworks (MOFs) are a result of the properties of these structures in the crystalline state. Where other materials (such as metals) may be easily melt-cast or reshaped — retaining their chemical composition and functional properties — the instability of crystalline MOFs has prevented similar processing into other forms. Now, Thomas Bennett and colleagues report a new phase transition behaviour observed on heating zeolitic imidazole frameworks (ZIFs). By carefully increasing temperature over time they were able to prevent ZIF degradation, and instead observed framework melting into an amorphous liquid. On further heating a dense crystalline phase was observed, which can also be remelted. Subsequent quenching yields a hybrid glass. Apart from the potential new practical applications for MOFs that this behaviour may allow, this process may also offer a route for the synthesis of glasses with controllable chemical functionality. *JH*

SUPERCONDUCTIVITY

## Raising the temperature

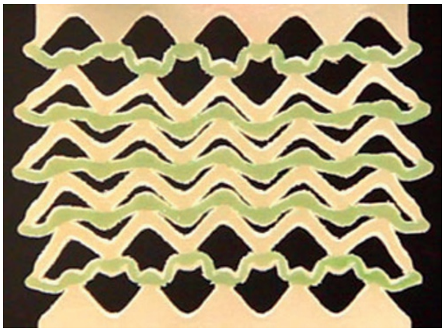
*Nature* **525,** 73–76 (2015)

Below their superconducting critical temperature, $T_c$, superconductors show zero resistance. The highest $T_c$ reported so far has been found in unconventional superconductors. These materials do not follow the Bardeen–Cooper–Schrieffer (BCS) theory (the first microscopic model to explain the superconductivity), and the mechanisms leading to their superconductivity are not well understood, which makes it difficult to predict their properties. Now, Alexander Drozdov and colleagues show that $H_2S$, under pressures of around 200 GPa, becomes a conventional superconductor with a record high $T_c$ of 203 K. Based on spectroscopic measurements and theoretical calculations, the authors claim that $H_2S$ decomposes forming $H_3S$ at high pressure. This material is, in fact, the first superconductor to be predicted that was subsequently confirmed experimentally. This study also demonstrates that the BCS theory can be used to look for room-temperature superconductivity in other hydrogen-based materials. *DC*

ARCHITECTURED MATERIALS

## Snapping metamaterials

*Adv. Mater.* http://doi.org/f3f5tx (2015)



WILEY

Mechanical metamaterials are well known to be capable of nonlinear stress–strain behaviour, associated with their unique architecture rather than their chemical make-up. Now, Ahmad Rafsanjani *et al.* report a design that permits a series of large serrations — or load drops — during tensile loading, caused by snapping beam buckling. Their design relies on an architecture consisting of two features, bearing and snapping segments, with the snapping segments periodically attached to the bearing segments. During tensile straining of the rubber-like material, the snapping segments behave like clamped beams, reaching a critical strain at which they snap from one configuration to the next. The snapping segments in the multilayered structure are activated at different strains, permitting substantial periodic load-drops in the system's mechanical response. Up to 150% strain is demonstrated for a fully elongated structure and finite element simulations and modelling point towards how mechanical characteristics can be controlled. The authors suggest that such an architecture might be useful in deployable structures, and for vibration isolation and damping. *JP*

*Written by David Ciudad, James Hennessy, Maria Maragkou, Luigi Martiradonna and John Plummer.*