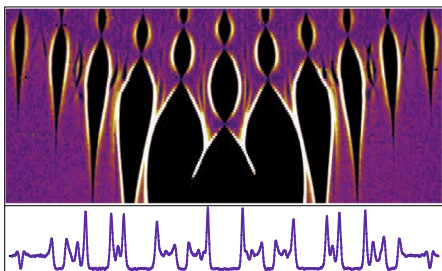


TOPOLOGICAL SUPERCONDUCTIVITY

A non-trivial junction

Phys. Rev. Lett. **121**, 097701 (2018)



Credit: APS

Topological crystalline insulators are a subclass of topological insulators. Rather than spin-orbit coupling, a particular crystalline symmetry gives rise to non-trivial metallic surface states in these otherwise insulating materials. If made superconducting, these insulators will turn into topological superconductors. These superconductors host Majorana quasiparticles, which are electron and hole in one, and may be useful to build qubits with built-in protection against errors.

Rodney Snyder and co-workers have now fabricated a Josephson junction from superconducting aluminium with a weak link made from the topological crystalline insulator $\text{Pb}_{0.5}\text{Sn}_{0.5}\text{Te}$. In addition to the common signatures observed in trivial Josephson junctions, transport measurements unveil features that indicate deviations from the ordinary sinusoidal current-phase relation. Because additional transport channels with high transmission

give rise to such skewing, this is good evidence for the supercurrent not being entirely carried by the low-conductance bulk states. Instead, part of the supercurrent could be channelled through 1D spin-polarized states induced by symmetry-breaking step edges at the surface of a topological crystalline insulator. Alternatively, the 2D surface states of the topological insulator could account for the high-conductance channels. Either way, these experiments point to the realization of a topological superconductor, this time made from a topological crystalline insulator.

BH

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OXYGEN INCORPORATION

Beyond traditional reactivity models

Nat. Commun. **9**, 3710 (2018)

It is widely known that surface atomic configuration can affect the reactivity of the oxygen reduction and evolution reaction. But it remains unclear how the oxygen exchange mechanism is influenced by the surface atomic structure, owing to a lack of methods for accurately controlling and probing surface atomic structures under reaction conditions. Now Diebold from TU Wien, Yildiz from MIT and co-workers overcome the challenge and demonstrate that the surface atomic structure is the dominant factor that determines oxygen incorporation on perovskite surfaces.

They prepare 0.5 wt% Nb-doped $\text{SrTiO}_3(110)$ with (4×1) and (2×5)

surface phase symmetries. These two surface structures are demonstrated to be stable with no observable Sr segregation when treated in oxygen atmosphere. The researchers then monitor the ^{18}O -labelled oxygen exchange kinetics on these two reconstructions at 450 °C. The reactivity on the (4×1) surface phase is found to be three times that on the (2×5) phase. This acceleration cannot be interpreted through the conventional vacancy, work function or band-bending models in density functional theory calculations. Instead, it is the atomic structure that determines the oxygen adsorption and dissociation. The higher the polyhedral flexibility, the faster is the oxygen incorporation.

WS

<https://doi.org/10.1038/s41565-018-0286-9>

SUPRAMOLECULAR CHEMISTRY

Tricks inside a cage

J. Am. Chem. Soc. **140**, 11502-11509 (2018)

The chemical environment inside nanometre-scale cages typically differs from that in bulk solution. This effect is manifest in proteins, which contain pockets that carry out a host of tasks that would be impossible in bulk water. Taking the lead from natural systems, chemists have demonstrated several examples in which they could run a chemical reaction only if the reagents were enclosed in nanometre-scale cages. Adding to this arsenal, Rizzuto et al. now show that structurally rigid metal-organic coordinated cages can be designed to host molecules that undergo unique chemistry.

In a specific example, zinc(II) amino-terminated porphyrins are linked together through zinc(II) anions with a phenanthroline linker to give a cuboctahedral metal-organic complex with an internal volume of about 3,000 Å³. At the centre of the three pairs of faces of the cuboid, there is a Zn(II) atom that can be itself used as a secondary coordination centre for a guest molecule. If the guest molecule is a Co(II) porphyrin, Rizzuto et al. observe a decrease of the oxidation potential and the formation of Co(III); if the guest molecule is a high-spin Ni(II) porphyrin, they observe a high-spin to low-spin transformation. Neither of the two reactions would occur outside the cage.

AM

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BIOMATERIALS

Damage control

ACS Nano **12**, 7826-7837 (2018)

Myocardial infarction is caused by formation of a thrombus that occludes the blood vessels, interrupting the blood flow to the heart with subsequent ischaemic damage. A first line of treatment consists in administration of anticoagulant drugs to dissolve the aggregated fibrin in the thrombus and re-establish blood flow. But a sudden rush of blood to the heart can result in ischaemic reperfusion injury and cardiac fibrosis.

Mihalko and collaborators present a fibrin-targeted nanogel that releases tissue plasminogen activator (tPA), for blood thinning, and Y-27632, a small drug that inhibits the cellular mechanisms underlying fibrosis. The nanogel is composed of a polymeric mesh of different densities, with a highly cross-linked core entrapping the smaller molecule and a looser shell encapsulating tPA. This architecture enables release of tPA for clot dissolution, followed by delivery of Y-27632. Upon injection in animal models, the nanogel targets the damaged heart with little accumulation in other organs and leads to improved cardiac functions, measured in terms of increased left ventricular ejection fractions, diminished fibrin deposition and reduced scar-tissue formation.

CP

<https://doi.org/10.1038/s41565-018-0287-8>