throughout the channel, resulting in filamentary (percolation) conduction for larger gate electric fields. Both reports[4,5] describe the essential details of the QPC fabrication used by Gallagher and co-workers[1]. Despite the large width (2 μm) of the strip region under the Al_2O_3 insulator, the gating only creates a single weak link at one bank. It is quite likely that a large number of conduction paths are created over the entire strip region as the gate voltage increases. However, once a single filament is on the verge of touching the bank, the conductivity of the filament is increased exponentially and it rapidly overwhelms the others. Therefore, the appearance of a single QPC is the most probable result when gating the insulating $SrTiO_3$ single crystal.

With the ability to form a single QPC, Gallagher *et al.*[1] successfully observe quantized conductance at 14 mK. When the superconductivity of the $SrTiO_3$ banks is suppressed by an applied magnetic field of 0.25 T, strikingly the zero-bias conductance is half the value of the quantum conductance G_0. This half-G_0 can be considered evidence for the removal of the ground-state Kramers degeneracy, and may be caused by the ferromagnetism of $SrTiO_3$. When the magnetic field is turned off, the banks become superconducting. Then, fascinatingly, the zero-bias conductance is enhanced, superficially contradicting the depression of Andreev reflection at the superconductor/half-metal junction.

The seamless formation of the bank/tunnel/bank QPC on the same crystal is, in principle, applicable to any material, including high-temperature superconductors or topological insulators. Therefore, unexplored exotic quantum states become accessible with this innovative technique. ❐

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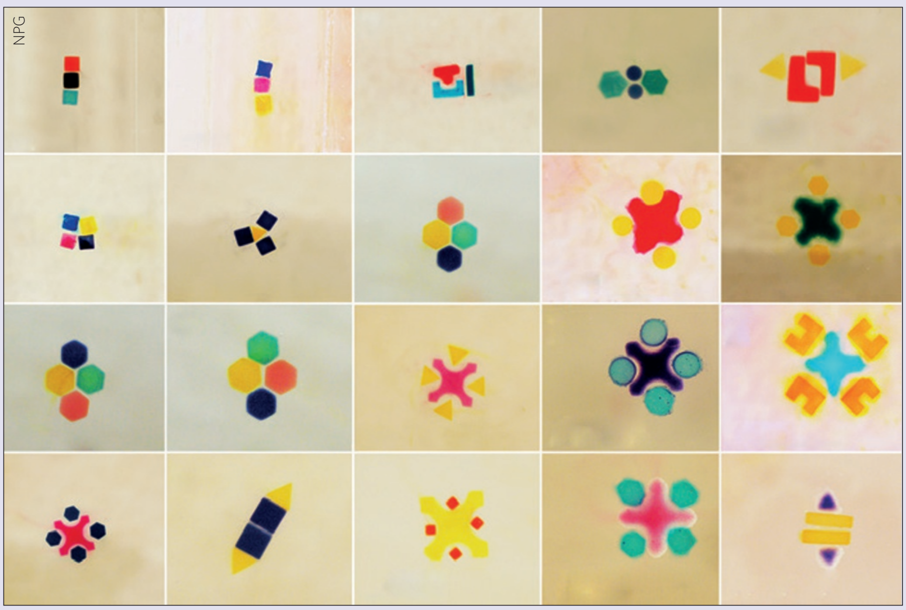
MAGNETISM

Radicals unite

Methods for magnetic manipulation on a micro-scale are many and varied, profiting in most cases from the versatility of magnetic nanoparticles. But using these particles in biomedical applications poses something of a challenge, in large part due to the fact that they're often laden with heavy metals. Now, Savas Tasoglu and colleagues have come up with a strategy for manipulating magnetically tunable 'microcomponents', which avoids these potentially poisonous inclusions (*Nature Commun.* **5,** 4702; 2014).

Non-magnetic techniques for massively parallel self-assembly are quick and inexpensive, but many suffer from low precision and insufficient yield, and overproduction can lead to costly redundancies. Tasoglu *et al.* overcame this problem — and that of the heavy metals associated with commercial magnetic beads — by exploiting the paramagnetism of free radicals.

By submerging hydrogels in a stable radical solution, they were able to paramagnetize them, and then use permanent magnets to create fields capable of controlling them, without the need for external power. The result was an assembly of complex constructs with diverse and tunable material properties.



The team performed mechanical compression tests to determine the Young's moduli of the gels, and showed that their technique could be used to levitate micro-scale objects. They verified the viability of encapsulating cells in the gels, with an eye on possible biomedical applications. Their gels can be stained, studded with cells, or otherwise engineered, all before being exposed to radicals.

One of the most appealing aspects of the technique is that the magnetization used to induce self-assembly can be switched off with the application of an antioxidant like vitamin E. This inbuilt control is particularly good news for tissue-engineering applications that may be incompatible with the invasive and potentially ineffective methods for nanoparticle expulsion associated with other approaches.

The applications are many and varied. Tissue engineering and soft robotics are obvious examples, but the technique might also be useful for engineering radicals with improved magnetic properties. Most importantly for some, the authors were able to play Tetris with their system — showcasing the exquisite control afforded by their approach.

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