

A Quantum Filter for Improved Spintronics

A precisely engineered material interface can host the spin currents needed for practical spin-based electronics.

By **Ryan Wilkinson**

Ordinary electronic devices store and process information using only the charge of electrons, but spintronic devices also harness their spin for potentially greater speed and energy efficiency. In magnetoresistive random-access memory and some other spintronic technologies, data are encoded in magnetic bits, which are switched between 0 and 1 states using currents of spin-polarized electrons. A major challenge has been to produce spin currents with the spin orientations needed to reliably switch these bits without relying on external magnetic fields, which are difficult to produce and control on tiny scales. Now Liang Liu at Shanghai Jiao Tong University and his colleagues have overcome this challenge by engineering an asymmetric interface in platinum that can create the required spin currents [1]. This advance provides a path toward viable spintronics for future computing systems.

Platinum is widely used in spintronic devices because an electric current flowing through it naturally generates spin currents through the so-called spin Hall effect. But the

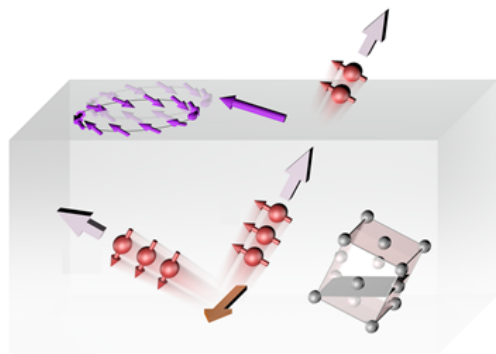
material's structural symmetry prevents those spins from having the out-of-plane orientations needed for the field-free switching of magnetic bits. To tackle that problem, Liu and his colleagues tailored the surface of a platinum crystal to act as a quantum filter: It preferentially transmitted electrons whose spins were aligned with an intrinsic local field produced by the surface itself. This filtering breaks the symmetry constraints imposed by the bulk platinum, creating strong spin currents with the required spin orientations.

Beyond this specific application, the team's results demonstrate that surface engineering can transform a familiar material's ability to host spin currents. This ability could be used to explore and control a wide range of spin-dependent phenomena.

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REFERENCES

1. H. Chen *et al.*, "Ultrastrong unconventional spin current via noncollinear spin-orbit filtering," *Phys. Rev. X* **16**, 031060 (2026).



Credit: H. Chen *et al.* [1]