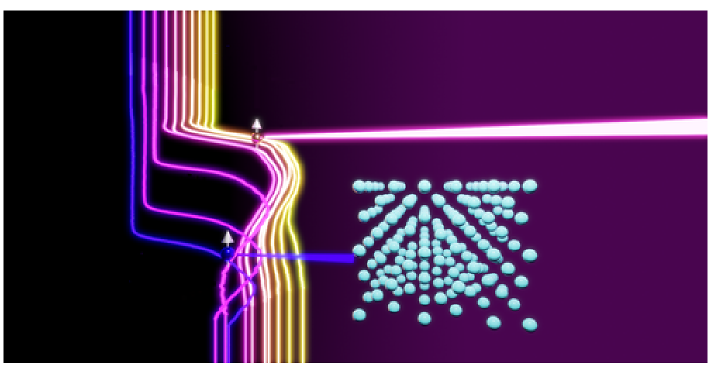
A Ferromagnet That Easily Sheds Spins

Researchers demonstrate room-temperature spin transfer across an interface between an iron-based ferromagnet and a semiconductor, opening a route to creating novel spintronic devices.

By **Rachel Berkowitz**

Integrating materials with magnetic and semiconducting properties into a single device can allow researchers to control the system's electrons and spins. Only three elements—iron, cobalt, and nickel—possess the room-temperature ferromagnetism needed for developing the magnetic component of such a device. But typically the surface properties of these elements and their alloys make them poor transfers of spin carriers. Now Yuichiro Ando of Kyoto University in Japan and his colleagues have fabricated an iron-based alloy that circumvents this obstacle [**1**].

Most materials that are spin polarized at room temperature have a high work function, meaning significant energy is required to remove electrons from their surfaces. Thus, to develop spintronic devices that operate efficiently at room temperature, new materials are needed that can easily transport spin-polarized electrons into adjacent layers.



Credit: Yuichiro Ando/Kyoto University

To create such a material, Ando and his colleagues grew thin films of the alloy iron gadolinium (FeGd) doped with varying concentrations of Gd. They then measured the work function and spin polarization of each film. The team found that doping altered the film's work function, with an alloy containing 20% Gd having a work function of 3.0 eV, compared to 4.9 eV for pure iron. Growing the alloy on top of a silicon semiconductor film, the team showed that this ~40% work-function reduction was sufficient to enable efficient room-temperature transfer of spin carriers across the interface between the two materials.

The researchers says that the spin-transfer properties of their alloy could be further improved by careful positioning of individual atoms at the magnet-semiconductor interface. An improved version of their alloy could find use in spin-based devices including lasers, light-emitting diodes, and transistors.

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REFERENCES

1. N. Yamashita *et al.*, "Realization of efficient tuning of the Fermi level in iron-based ferrimagnetic alloys," **Phys. Rev. Mater. 6, 104405 (2022).**