



PRESS RELEASE (2026/10/28)

How an ultrathin metal layer enhances spin-related signals and opens a door for potentially better spintronics

Measurements of two spin-related effects may offer insights into how interface engineering could help advance energy-efficient spintronic technologies

Fukuoka, Japan—Researchers at Kyushu University have found that an ultrathin layer of iridium manganese (IrMn) can improve two spin-related signals in a structure made of a magnetic insulator and a platinum film. By examining how spin currents are generated and absorbed, the team gained key insights into how the intermediate layer improves spin transfer. The findings could inform the development of ultra-low-power devices for computing and energy harvesting.

Spintronics is a more complex approach to conventional electronics that uses electron spin, in addition to electrical charge, to process and transmit information. For decades, researchers have been investigating various ways to use spin-related phenomena in computing, data storage, and energy harvesting.

One such phenomenon is the spin Seebeck effect (SSE), in which a temperature difference across a magnetic material generates a spin current that can be converted into electricity. Another one is spin Hall magnetoresistance (SMR), where a metal's electrical resistance changes depending on the relative orientation of the electrical current and the magnetization of a neighboring magnetic layer. If harnessed effectively, the SSE could provide a way to recover energy from heat that would otherwise go unused, and SMR could prove useful for data storage and computing.

However, spin currents tend to weaken as they travel through materials, which limits the potential of both effects. The two depend on what's called spin mixing conductance, which describes how efficiently spin passes across the boundary between a magnetic and a non-magnetic material. Previous studies demonstrated that inserting ultrathin layers at this boundary can improve spin-related signals associated with spin mixing conductance, but the precise underlying mechanisms remained unclear.

To address this, a research team led by [Professor Hiromi Yuasa](#) from the [Faculty of Information Science and Electrical Engineering](#) at Kyushu University, examined how an IrMn layer influences both SSE and SMR. Their findings were published in the journal [Materials Today Physics](#) on September 30, 2026.

The researchers fabricated structures made of yttrium iron garnet (YIG), IrMn, and platinum (Pt), varying the thickness of the intermediate IrMn layer between 0 and 1 nm. In this design, YIG served as the magnetic insulator, while Pt converted spin currents into electrical signals. Measuring both SSE and SMR allowed the team to compare spin pumping, which transfers spin angular momentum from the magnetic YIG layer, and spin absorption, where spin

current is absorbed at an interface.

The results showed that the 0.3 nm-thick IrMn layer produced the strongest responses in both the SSE voltage and SMR. The spin mixing conductance calculated from the two effects also agreed well, supporting the conclusion that IrMn enhances spin pumping and spin absorption through related interfacial mechanisms. At this thickness, IrMn is expected to form island-like structures rather than a continuous film. This morphology may influence spin transfer at the interfaces, although further research is needed to determine the contributions of the individual interfaces.

Overall, these findings provide a way to improve spin transfer by controlling the thickness and structure of an intermediate layer. This could help researchers develop spin-based technology to convert heat into electricity. “A potential application of this work is battery-free information devices, which pose no risk of battery explosions. By harnessing spin Seebeck power generation, these ultra-low-power devices could operate without an external power supply or energy storage,” says Yuasa.

In the future, spintronics could pave the way for widespread energy-efficient communications, as Yuasa concludes, “Our research could contribute to sustainable computing technologies based on novel principles, supporting the development of an unprecedentedly advanced information society.”

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For more information about this research, see “Role of ultrathin IrMn layer between $\text{Y}_3\text{Fe}_5\text{O}_{12}$ and Pt in enhancement of spin Seebeck effect and spin Hall magnetoresistance”, Amirah Zahrin, Shuto Sahara, Yuichiro Kurokawa, Hiroki Hanamoto, Hiromi Yuasa, *Materials Today Physics*, <https://doi.org/10.1016/j.mtphys.2026.102247>

About Kyushu University

Founded in 1911, [Kyushu University](#) is one of Japan's leading research-oriented institutions of higher education, consistently ranking as one of the top ten Japanese universities in the Times Higher Education World University Rankings and the QS World University Rankings. Located in Fukuoka, on the island of Kyushu—the most southwestern of Japan's four main islands—Kyushu U sits in a coastal metropolis frequently ranked among the world's most livable cities and historically known as Japan's gateway to Asia. Its multiple campuses are home to around 19,000 students and 8,000 faculty and staff. Through its [VISION 2030](#), Kyushu U will “drive social change with integrative knowledge.” By fusing the spectrum of knowledge, from the humanities and arts to engineering and medical sciences, Kyushu U will strengthen its research in the key areas of decarbonization, medicine and health, and environment and food, to tackle society's most pressing issues.

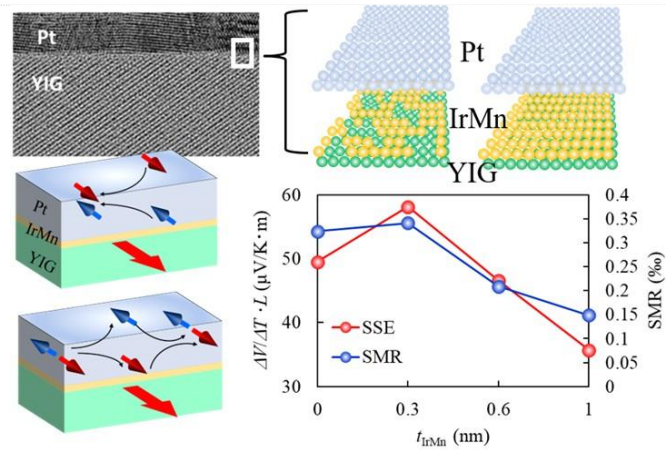


FIG.1 Control of spin current propagation efficiency via island-like IrMn Insertion. Hinoki roots contain aromatic compounds and can be used to produce essential oils. A thin IrMn layer is deposited on a YIG magnetic substrate, followed by a Pt layer. When the designed thickness of IrMn layer is less than one atomic layer, leading to an island-like structure, the propagation of the spin current increases. (Hiromi Yuasa/Kyushu University)

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