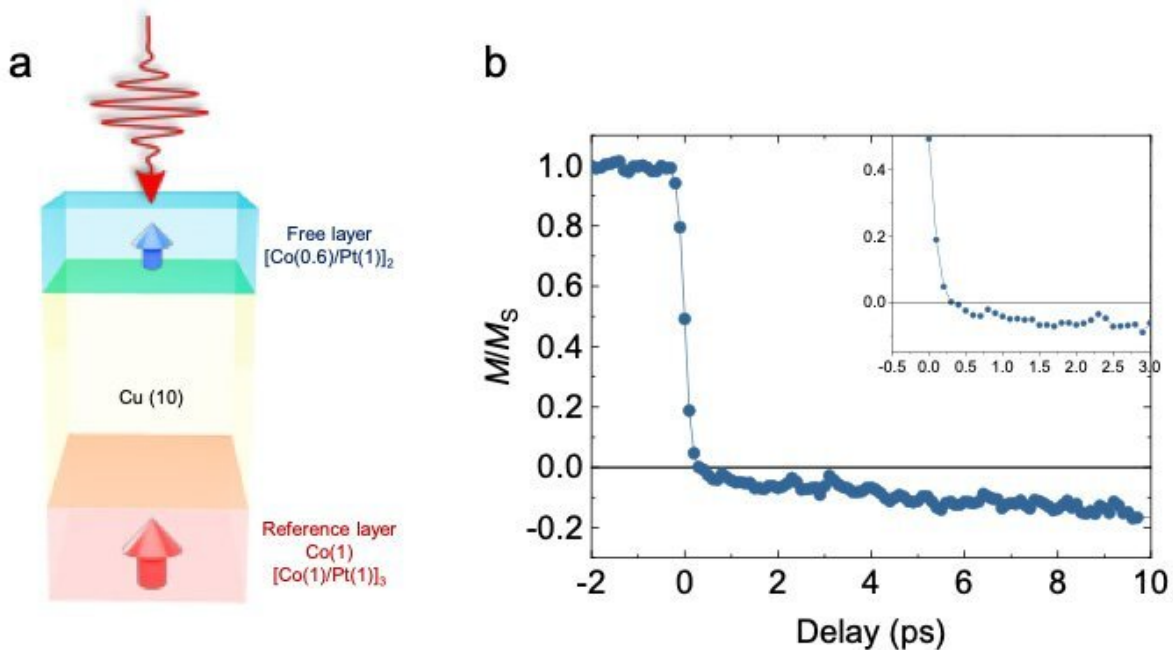


Sub-picosecond magnetization reversal in rare-earth-free spin valves

March 10 2023



A: Sample stack of a spin valve consisting of the reference layer (bottom, red layer), a Cu spacer (middle, yellow layer) and the free layer (top, blue layer). Values in parentheses are the layer thicknesses in nanometres. B: Magnetization dynamics of the free layer in the studied spin valve. Credit: Junta Igarashi and Stéphane Mangin

Researchers at the Université de Lorraine in France and Tohoku University in Japan have demonstrated a sub-picosecond magnetization

reversal in rare-earth-free archetypical spin valves. Their discovery was published in the journal *Nature Materials* on March 9, 2023.

Manipulating [magnetic materials](#) without using magnetic fields is of paramount importance for many applications, such as non-volatile memory. Two decades ago, it was discovered that a magnetization reversal could be induced by a charge current. A decade later, a much faster, sub-picosecond control of the magnetization was achieved by shining femtosecond light pulses. This process became known as all-optical magnetization switching. However, only a few specific rare-earth-based material systems containing antiparallel alignment in magnetic sublattices experience such [ultrafast](#) phenomena.

In their work, the research group demonstrated sub-picosecond optical control of magnetization in rare-earth-free archetypical spintronic structures, consisting of [Pt/Co]/Cu/[Co/Pt], at ultrafast timescales.

Furthermore, they observed magnetization reversal from parallel alignment, which was previously unseen and unexpected in ultrafast magnetism. Like the discovery of magnetization reversal by a charge current two decades ago, this breakthrough has the potential to drastically extend the bandwidth of common [spintronic](#) devices. This can be done by exploiting common spintronics phenomena in a strongly out-of-equilibrium context.

"Our findings provide a route for ultrafast magnetization control by bridging concepts from spintronics and ultrafast magnetism," says Dr. Junta Igarashi of the Université de Lorraine (JSPS Overseas Research Fellowships, an alumnus of Tohoku University) and first author of the paper.

Professor Stéphane Mangin of the Université de Lorraine, also serving as a visiting professor at the Center for Science and Innovation in

Spintronics (CSIS), Tohoku University, added, "Our findings are a milestone in the development of ultra-fast spintronics and could open the way to new applications for ultra-fast and energy efficient memories."

More information: Junta Igarashi et al, Optically induced ultrafast magnetization switching in ferromagnetic spin valves, *Nature Materials* (2023). [DOI: 10.1038/s41563-023-01499-z](https://doi.org/10.1038/s41563-023-01499-z)

Provided by Tohoku University

Citation: Sub-picosecond magnetization reversal in rare-earth-free spin valves (2023, March 10) retrieved 11 May 2024 from <https://phys.org/news/2023-03-sub-picosecond-magnetization-reversal-rare-earth-free-valves.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.