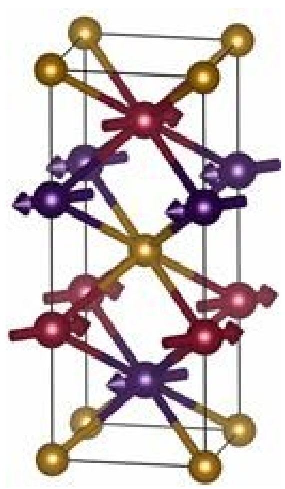
Antiferromagnets prove their potential for spin-based information technology

January 29 2018



Crystal structure of Mn2Au with antiferromagnetically ordered magnetic moments. Credit: Libor Šmejkal, JGU

Within the emerging field of spin-based electronics, or spintronics, information is typically defined by the orientation of the magnetization of ferromagnets. Researchers have recently been also interested in the utilization of antiferromagnets, which are materials without macroscopic magnetization but with a staggered orientation of their microscopic magnetic moments. Here the information is encoded in the direction of the modulation of the magnetic moments, the so-called Néel vector. In principle, antiferromagnets enable much faster information-writing and are very stable with respect to disturbing external fields. These advantages, however, also imply a challenging manipulation and read-out processes of the Néel vector orientation. Up to now, this had been possible using the semimetal copper manganese arsenide CuMnAs only, a compound featuring several disadvantages concerning applications.

As published in the online science journal *Nature Communications*, scientists at the Institute of Phyics at Johannes Gutenberg University Mainz (JGU) were now able to demonstrate current-induced switching of the Néel vector also for metallic thin films of a compound consisting of manganese and gold, Mn2Au, which orders antiferromagnetically at high temperatures. In particular, they measured a ten times larger magnetoresistance as observed for CuMnAs. The surprising magnitude of this effect is explained by extrinsic scattering on excess gold atoms, as deduced from calculations done by Libor Šmejkal, who in the framework of a collaboration with the Czech Academy of Sciences is currently conducting his Ph.D. project in the group of Professor Jairo Sinova at Mainz University.

"These calculations are very important for the understanding of our experimental work mainly performed by Stanislav Bodnar, who is a Ph.D. student in our group. We identified Mn2Au as a prime candidate for enabling future antiferromagnetic spintronics," explained PD Dr. Martin Jourdan, project leader of the study. "Aside from the large magnetoresistance of this compound, other important advantages are its non-toxic composition and the fact that it can be used even at higher temperatures."

More information: S. Yu. Bodnar et al. Writing and reading antiferromagnetic Mn2Au by Néel spin-orbit torques and large anisotropic magnetoresistance, *Nature Communications* (2018). [DOI: 10.1038/s41467-017-02780-x](https://doi.org/10.1038/s41467-017-02780-x)

Provided by Universitaet Mainz