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Approach to stacking superlattice layers points to high-performance spintronic devices FREE

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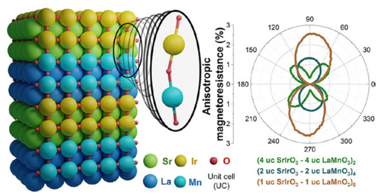
Alternating polar and nonpolar layers with electrons of different energy levels leads to structures with modifiable magnetic properties.



High-performance spintronic devices require the ability to tune magnetic characteristics like magnetic anisotropy and topological spin texture. An emerging approach involves using interfacial engineering to tailor magnetic orders and create materials with novel magnetic properties. One new study has found a way to stack layers in materials and control these features.

Huang et al. present findings from recent work modifying various magnetic properties by atomically stacking electrons from different energy shells in a superlattice. Using a polar-nonpolar structure made of layers of $LaMnO_3$ and $SrIrO_3$, the group modified the magnetization, tilt of the ferromagnetic easy axis, and symmetry transition of the anisotropic magnetoresistance of the $LaMnO_3/SrIrO_3$ structures.

The findings provide a deeper understanding of physics at strongly correlated oxide interfaces while also providing a new path forward for high-speed spintronics.

"Our work demonstrated that the novel interfacial spin-orbit coupling can be utilized to largely tune the magnetic-related properties, including both magnetic anisotropy and magnetotransport properties, when stacking different magnetic material precisely," said author X. Renshaw Wang.

First-principles calculations showed the new magnetic behaviors of the superlattices are described by the introduction of additional interfaces of 3d energy shell electrons from manganese and 5d shell electrons from iridium. The symmetry transition of the anisotropic magnetoresistance was explained by the lattice's Rashba spin-orbit coupling, a type of spin-orbit coupling in an inversion asymmetric structure.

The group hopes their work inspires others to explore the potential of interface-based approaches for tailoring magnetism and magnetotransport. They next look to investigate the behavior of similar structures fabricated with ferrite and cobaltite.

Source: "Tailoring magnetic order via atomically stacking 3d/5d electrons to achieve high-performance spintronic devices," by Ke Huang, Liang Wu, Maoyu Wang, Nyayabanta Swain, M. Motapothula, Yongzheng Luo, Kun Han, Mingfeng Chen, Chen Ye, Allen Jian Yang, Huan Xu, Dong-chen Qi, Alpha T. N'Diaye, Christos Panagopoulos, Daniel Primetzhofer, Lei Shen, Pinaki Sengupta, Jing Ma, Zhenxing Feng, Ce-Wen Nan, and X. Renshaw Wang. C, *Applied Physics Reviews* (2019). The article can be accessed at https://doi.org/10.1063/1.5124373.