Zero-bias Giant Rashba Spin-Orbit Coupling at Complex Oxide Interfaces

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Following the second law of thermodynamics, the Landauer's principle dictates a fundamental physical limitation for the switching energy of a complementary metal oxide–semiconductor (CMOS). A primary solution in breaking this limitation is to utilize the spin-orbit coupling (SOC) effect, as it allows easy manipulation of spin currents. However, this SOC effect is often quite weak, especially in the absence of external voltage biases. Here, a four-fold SOC enhancement at zero bias voltage and pronounced SOC evolution is reported in correlated $LaAlO_3$-$SrTiO_3$ heterostructures buffered by a carrier modulating $LaFeO_3$ layer. An entirely new approach has been used to provide evidence of generating Rashba SOC. Correlating the magnetotransport data with first-principles calculations and high-resolution electron microscopy, the results reveal its origin which lies in the asymmetric hybridization of the interfacial wavefunctions. The results open hitherto unexplored avenues of generating and controlling Rashba coupling to design next-generation two-dimensional electron system based spin-orbitronic devices.