

Highlights

Activity C - Innovative materials with strong interplay of spin, orbital, charge and topological degrees of freedom - 2021

Coupling Charge and Topological Reconstructions at Polar Oxide Interfaces

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In oxide heterostructures, different materials are integrated into a single artificial crystal, resulting in a breaking of inversion symmetry across the heterointerfaces. This approach paved the way for the discovery of numerous unconventional properties absent in the bulk constituents. However, control of the geometric structure of the electronic wave functions in correlated oxides remains an open challenge. Here, we create heterostructures consisting of ultrathin SrRuO₃, an itinerant ferromagnet hosting momentum-space sources of Berry curvature, and LaAlO₃, a polar wide band gap insulator (Figure 1). We demonstrate control of the momentum space topological properties of ultrathin SRO by creating a charge-frustrated interface. Through magneto-optical characterization, theoretical calculations and transport measurements we show that the real-space charge reconstruction drives a reorganization of the topological charges in the band structure, thereby modifying the momentum-space Berry curvature in SrRuO₃ (Figure 2). Our results illustrate how the topological and magnetic features of oxides can be manipulated by engineering charge discontinuities at oxide interfaces.

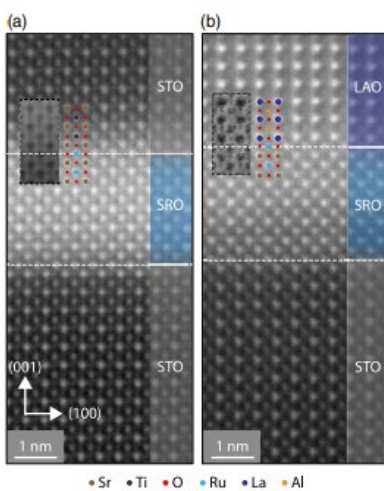


Fig. 1: Atomic characterization. High-angle annular dark-field images of (a) STO/SRO/STO and (b) STO/SRO/LAO heterostructures.

Fig. 2: Anomalous Hall effect. (a) Illustration representing the evolution of the momentum-space topological charges. Upon increasing the charge pinning, the system moves through a Weyl point in the synthetic space spanned by k_x , k_y and the charge pinning parameter γ . (b) The measured anomalous Hall resistivity for SRO films of varying thickness.

