Evolution from Interfacial Charge Compensation to Metallic Screening across the Manganite Metal-Insulator Transition

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Abstract

In recent years, the consequences of polar/non-polar heterointerfaces have been heavily explored in oxide interfaces between insulators, where the presence of mixed-valence transition metal ions can introduce an interesting degree of freedom. The nature of the resulting interfacial reconstructions should be qualitatively different for metallic and insulating films, as the electrostatic boundary conditions and compensation mechanisms are distinct. Here, we explore this issue for manganite-titanate interfaces traversing the (La,Sr)MnO3 metal-to-insulator transition, both in terms of their electrical properties (I-V, C-V) and spectroscopically (internal/core-level photoemission, electron energy-loss). A clear crossover is observed, corresponding to reconstructions of the polar discontinuity evolving to metallic screening and interface dipole formation. The total charge observed for the insulating manganite films quantitatively agrees with that needed to cancel the polar catastrophe. As the manganite becomes metallic with increased hole-doping, the total charge build-up and its spatial range drop substantially. Accompanying this transition is a systematic shift in the band alignment, which suggests the role of correlations as this Mott transition is traversed. This work was done in collaboration with Yasuyuki Hikita, Takeaki Hidaka, Takeaki Yajima, Takuya Higuchi, Julia A. Mundy, David A. Muller, and Lena F. Kourkoutis.

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