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Interfaces between strongly correlated oxides : controlling charge transfer and induced magnetism by hybridization[1]

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At interfaces between conventional materials, band bending and alignment are controlled by differences in electrochemical potential. Applying this concept to oxides in which interfaces can be polar and cations may adopt a mixed valence has led to the discovery of novel two-dimensional states between simple band insulators such as $LaAlO_3$ and $SrTiO_3$. However, many oxides have a more complex electronic structure, with charge, orbital and/or spin orders arising from correlations between transition metal and oxygen ions. Strong correlations thus offer a rich playground to engineer functional interfaces but their compatibility with the classical band alignment picture remains an open question. In this talk we will show that beyond differences in electron affinities and polar effects, a key parameter determining charge transfer at correlated oxide interfaces is the energy required to alter the covalence of the metal-oxygen bond. Using the perovskite nickelate ($RNiO_3$) family as a template, we have probed charge reconstruction at interfaces with gadolinium titanate $GdTiO_3$ using soft X-ray absorption spectroscopy and hard X-ray photoemission spectroscopy. We show that the charge transfer is thwarted by hybridization effects tuned by the rare-earth (R) size. Charge transfer results in an induced ferromagnetic-like state in the nickelate (observed by XMCD), exemplifying the potential of correlated interfaces to design novel phases. Further, our work clarifies strategies to engineer two-dimensional systems through the control of both doping and covalence.

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