Abstract:

MRS Fall Meeting - Boston, Massachusetts - December 1-6, 2024

Interfacial charge-transfer in 3*d*/5*d* oxide heterostructures

D. Fuchs,[1] A. K. Jaiswal,[1] F. Wilhelm,[2] A. Rogalev,[2] and M. Le Tacon[1]

[1]Karlsruhe Institute of Technology, Institute for Quantum Materials and Technologies, Kaiserstr. 12, 76131 Karlsruhe, Germany;
[2]European Synchrotron Radiation Facility (ESRF), F-38043 Grenoble, France;

Symposium NM05

The synthesis of artificial oxide heterostructures and superlattices has gained increasing interest during the last decade due to the ability of epitaxial growth with atomic precision. The combination of different complex oxides not only results in the possibility of tuning the intriguing phenomena of the bulk constituents via lattice strain and symmetry change but also often generates new exotic phases at the interface of the correlated electron systems. Interfacial charge-transfer (ICT) between two different oxide layers, such as in the seminal experiments on $LaAlO_3/SrTiO_3$ heterostructures, seems to be most prominent for these observations. Besides the combination of 3*d* perovskites, which generally display strong electron correlation, heterostructures consisting of 5*d* perovskites additionally display distinct spin-orbit coupling, which might be useful for *e. g.*, spin manipulation in spintronic devices. In the following, we have studied systematically the ICT in 5*d* $SrIrO_3$ (I) heterostructures in combination with the 3*d* perovskites $LaMnO_3$ (M), $LaFeO_3$ (F), $LaCoO_3$ (C) and $NdNiO_3$ (N). High quality heterostructures [I*i*X*i*]*m* (X = M, F, C, N) with a layer thickness of *i* monolayers each and a periodicity of *m* were prepared on (001) oriented $SrTiO_3$ substrates by pulsed laser deposition. The ICT was studied by measurements of the Hall resistance and x-ray absorption spectroscopy at the Ir $L_{3,2}$ edge. For all the samples an electron transfer from the $5d^5$ I to the neighbored $3d^n$ layer X was observed. The ICT was found to be confined to the first layer with respect to the interface and systematically increases with increasing n up to $n = 6$ amounting to $\Delta n \approx 0.35$ electrons. For $n = 7$ (X = N) ICT reduces again. The increase of Δn with n can be well understood assuming the alignment of oxygen states at the interface due to the continuity of the common oxygen matrix by the corner sharing I and X octahedra [1], whereas the reduced ICT for X = N is likely explained by hybridization effects in the N layer, lowering Δn significantly with respect to $LaNiO_3$[2].

References

[1] Z. Zhong and P. Hansmann, *Phys. Rev. X* **7** (2017) 011023
[2] M. N. Grisolia et al., *Nature Physics* **12** (2016) 484