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Surface structure, growth, and reactivity of selected perovskite oxides

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Ternary oxides with the perovskite structure exhibit an intriguingly rich variety in their physical and chemical properties. The surfaces of these promising materials are equally complex and generally poorly understood. Here we report an overview of surface studies of two perovskite oxides, the prototypical SrTiO₃ in (110) orientation and Sr₃RuO₇, the n=2 member of the Ruddlesden-Popper series.

The surface of the layered compound, Sr₃RuO₇, is structurally quite simple: cleaving in UHV yields a SrO-terminated layer, which is essentially defect-free, except for impurities in the bulk material [1]. The surface is very reactive towards components of the residual gas, however. CO, CO₂, and H₂O adsorb readily and form adsorption complexes [2, 3]. SrTiO₃(110) is polar and exhibits a series of reconstructions that can be controlled by adjusting the chemical potential of its constituents, i.e. by evaporating appropriate amounts of Sr and Ti and annealing in O₂. The (nx1) reconstructions consist of a monolayer of titania with tetrahedrally-coordinated Ti atoms that are arranged in corner-sharing rings [4]. When the Ti chemical potential is increased, the surface switches over to a (2xm) symmetry with a titania layer that is composed of Ti in octahedral coordination. These stoichiometry-dependent, facile structural changes have a profound effect on surface reactivity, and on the homoepitaxial growth of SrTiO₃ during pulsed laser deposition.

- [1] B. Stoger, et al, Phys. Rev. B 90 (2014) 165438.
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- [3] D. Halwidl et al. Nature Mater. (2015)
- [4] Z. Wang et al., Phys. Rev. Lett. Phys Rev Lett 111 (2013) 056101.