Metal-to-Insulator Transition in Antiferromagnetic $SrCrO_3$ Thin Films

Simon Jöhr[1], Annabella Drewanowski[1], Jonathan Spring[1], Alberto Carta[2], Andreas Suter[3], Anna Zakharova[3], Cinthia Piamonteze[3], Claude Ederer[2], and Marta Gibert[4]

[1] *University of Zurich, Zurich, Switzerland*
[2] *ETH, Zurich, Switzerland*
[3] *Paul Scherrer Institut, Villigen, Switzerland*
[4] *Technical University of Vienna, Vienna, Austria*

Perovskite transition metal oxides are widely studied fascinating materials that have been the subject of numerous reports. This is especially true for the first-row transition metals, with the exception of the chromium family $ReCrO_3$ (where Re is a divalent rare earth), which remains only rarely studied. This is mainly explained by the presence of Cr^{+4} (characterized by two electrons in the nearly triply degenerate t_{2g} orbitals), whose stabilization is difficult and typically requires high synthesis pressures [1, 2]. Among this family of materials, the physical properties of $SrCrO_3$ (SCO) (first synthesised in 1967 [1]) are still debated nowadays. It is suggested to be metallic and antiferromagnetic (AFM) in its ground state, a phase coexistence that is rare and poorly understood [3]. Therefore, our study aims to grow and characterize SCO thin films and to address its debated properties.

Here we report the successful growth of high-quality epitaxial SCO thin films by off-axis RF magnetron sputtering. A very low but finite amount of oxygen was required to obtain the desired Cr^{+4} valence state in the films, which is verified by x-ray absorption spectroscopy (XAS). The SCO thin films have been grown on a variety of substrates imposing a broad range of strains (from -0.68% to 3.38%). Transport measurements on SCO films have revealed a metal-to-insulator transition upon application of tensile strain. This result, in agreement with previous work [4], is explained by DFT+U calculations [5]. In order to directly probe the existence of a magnetic phase in SCO films, we performed muon spin relaxation experiments. These measurements have revealed a clear magnetic transition in SCO thin film at low temperatures. These measurements represent the first direct observation of a metallic-AFM phase coexistence in SCO thin films. Magnetotransport measurements will also be presented.

References

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