Signature of Quantum Transport in ferromagnet $SrRuO_3$(111)

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Weyl semimetals are attractive candidates for a variety of applications in electronics, spintronics, and quantum computing because they have unique electrical characteristics such the linear dispersion relation, chiral anomaly, and Fermi arcs. The presence of $SrRuO_3$ (SRO) films on (111) surfaces has been predicted to exhibit emergent phases, such as the **Haldane quantum Hall state**[1,2]**, Weyl semi-metallic state**[3], etc. Our research aims to find such signs of quantum transport, particularly weyl fermionic transport in the case of expitaxial $SrRuO_3$. High-quality epitaxial SRO thin films was grown on atomically terminated $SrTiO_3$ (111) substrates through RHEED-assisted PLD. The characterization of the films was carried out using a combination of magnetic, XRD, and magnetoresistance/Hall transport techniques.

The findings of our work demonstrate that the growth conditions have a significant effect on the Residual Resistivity Ratio (RRR) values, which are indicative of ruthenium vacancies in the films. Although changes in RRR have minimal effects on magnetic properties, they significantly impact the transport regime. There seems to be clear relation between RRR and its corresponding transport data. Notably, thin (111)-oriented SRO films exhibits remarkably **high positive as well as linear MR and consistent Hall transport behaviour**, which makes them a very strong candidate for further research as a Weyl semimetal.[4].

References:

[1] D.Xiao et. al Nat. Commun. 2, 596 (2011).
[2] L. Si et. al PRL 119, 026402 (2017).
[3] Y. Chen et. al Phys. Rev. B 88, 1251100 (2013).
[4] K. Takiguchi et. al Nat. Commun. 11, 4969(2020).