Magnetic properties in $SrRuO_3$ and $YTiO_3$ thin film

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$SrRuO_3$ has been used as an oxide electrode for all oxide devices due to its low resistivity and structural similarity. The SrRuO3thin film grown on $SrTiO_3$ (001) and $DyScO_3$ (110) substrates was reported to have subtle difference in the crystal structure, i. e., tetragonal vs. orthorhombic structure. The magnetic properties of $SrRuO_3$ thin film have not been studied in detail by others. Bulk $YTiO_3$ is a ferromagnetic Mott insulator and thin film was not reported by others.

We first used the advantage of cubic (110) substrate in order to stabilize high quality thin film for perovskite oxides having orthorhombic symmetry. First, we demonstrated a control of the magnetic easy axis in $SrRuO_3$ thin filmson $SrTiO_3$ (110) substratesbyintroducingtunableanisotropic strain.1 But control of the growth direction of $SrRuO_3$ in this study was rather limited. For example, only orthorhombic a-axis growth could be obtained for $SrRuO_3$ on $SrTiO_3$ (110) substrates. Secondly, we succeeded in making thin film of $YTiO_3$ by using $LaAlO_3$ (110) substrate while even bulk crystal was very difficult to synthesize due to its unusual Ti^{3+} valence state and large orthorhombic distortion.[2]

Next, we used buffer layers to control the magnetism of $SrRuO_3$ thin films. First, we found that miscut STO (001) substrate can stabilize twin-free $CaHfO_3$ buffer layer and the $SrRuO_3$ film grown on top of this buffer layer was of high quality and tensile strain, and had an in-plane magnetic easy axis.[3] Secondly, we used (Ca,Sr)SnO_3 and $CaHfO_3$ buffer on $SrTiO_3$ (110) substrates to change widely the growth orientation as well as the amount of epitaxial strain of $SrRuO_3$ on top of the sebuffer layers.[4] We could obtain various film with different growth orientation such as (100)o, (010), (111) o growth as well as with different amount of strain by using the above buffer layers having different amount of orthorhombic distortion. The magnetic properties were found to change systematically with the change of structural distortion of the $SrRuO_3$ thinfilms.

References

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