Resonant soft x-ray scattering study on relationship between ferromagnetism and robust 2D skyrmion in $SrRuO_3$ film

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In future spintronics applications, the magnetic skyrmion has been appreciated as a promising platform for the new type of magnetic storage. In this context, many of 3*d* and 4*d* transition metal-oxides (e.g., $La_{1-x}Sr_xMnO_3$, $La_{1-x}Ca_xMnO_3$, $SrRuO_3$ etc), which show ferromagnetism, have been widely studied to explore the skyrmions. Recently, topological hall effect (THE) has been demonstrated in ultrathin epitaxial $SrRuO_3$ (SRO) thin films, suggests the existence of skyrmion in this system [1,2]. Nevertheless, it is still in early stage to understand the relationship between THE and skyrmion, in particular in this 2D like ultra-thin film. Here, by using O *K*-edge resonant soft x ray scattering under a magnetic field (~0.5 Tesla), we studied magnetic exchange energy of oxygen 2*p* band, which is hybridized with the ferromagnetic 4*d* Ru in 4 u.c. SRO film grown on $SrTiO_3$ substrate. We observed that the onset of oxygen's exchanges is coincident with the reported THE in this system. Furthermore, we observed a change in the 2D magnetic scattering pattern as a function of temperature, suggesting a magnetic domain evolution related with THE. We believe that these findings would give a clue to understand the relationship between THE and skyrmion. More details will be discussed in the presentation.

References

[1] Matsuno, J. et al, Science advances, 2, e1600304, (2016)

[2] Preprint at https://arxiv.org/abs/1810.01615 (2018)