Tailoring oxide thin films by ion beam

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Complex oxides host a multitude of novel phenomena in condensed matter physics, such as various forms of multiferroicity, colossal magnetoresistance, quantum magnetism and superconductivity. Defect engineering via ion irradiation can be a useful knob to control these physical properties for future practical applications. Two prominent effects are disorder and uniaxial strain. Particularly, the uniaxial strain, manifesting as the elongation of the out-of-plane lattice spacing, is not limited to available substrates, the conventional and well-known strain engineering approach. In this talk, I will introduce the basics of ion irradiation and its applications to oxide thin films, including the modification of magnetic properties of $NiCo_2O_4$ [1], $SrRuO_3$ [2], the magneto-transport properties of rare-earth nickelates [3] and $SrRuO_3$ [4] and the structural properties of $BiFeO_3$ [5]. It is worth to note that ion beam technology has been well developed for microelectronics. Once the principle of concept is approved, the approach can be easily scaled up and integrated to the industry production line.

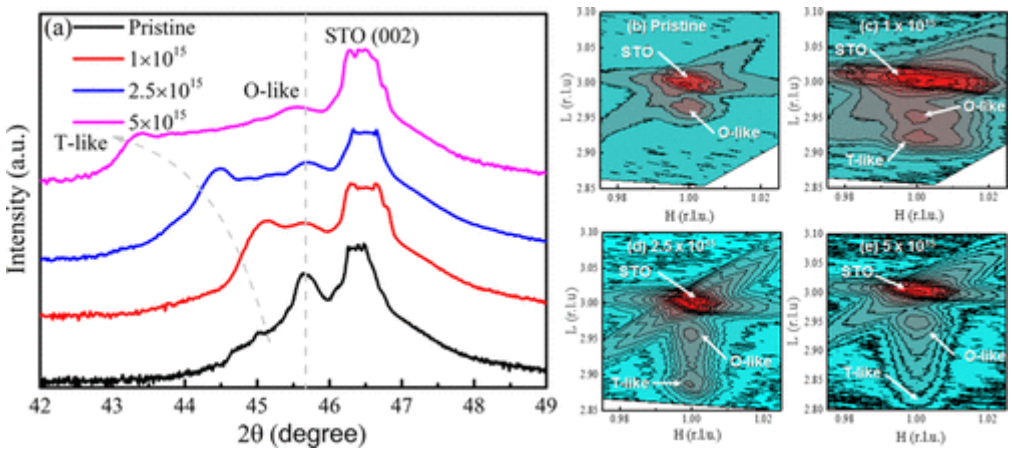

Figure 1. Ion irradiation induced lattice expansion in SrRuO3 films along the out-of-plane direction: (a) θ–2θ scans around the (002) reflection of SRO thin films on STO substrates under different He fluences. (b–e) Corresponding RSMs around the (103) reflections of SRO films.

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