Observation of superconducting transition in MTO/STO heteroepitaxial multilayer films

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In recent years, there is a considerable interest in looking for new materials which exhibit superconductivity at 77 K and higher temperatures. Substantial efforts have been made using theoretical modeling, materials informatics, machine learning, and so on to look for materials which could exhibit superconductivity at practically useful temperatures. In recent years, multilayer films and superlattices such as those of $CaCuO_2/SrTiO_3$ and $CaCuO_2/BaCuO_2$ have exhibited superconducting transition but at rather low temperatures. $MgTi_2O_4$ thin films have also recently been found to exhibit superconductivity at 5 K [1].

In the present study, the multilayer structures of spinel-type oxides containing transition metals are investigated. We studied the electrical transport properties of spinel $MgTi_2O_4/SrTiO_3$ multilayer thin films with varying layer thickness and observed the appearance of superconducting transition with varying onset temperatures depending upon the layer thickness. Figure 1 shows the schematic diagram of the designed architecture of the multilayer films. In one of the multilayer films, the onset of superconducting transition temperature is as high as 50 K which is also confirmed from the ac magnetization measurement. The superconductivity in these multilayer films is attributed to the phase transition in these multilayer thin films which is suppressed by the epitaxial strain induced and transferred from one layer to another.

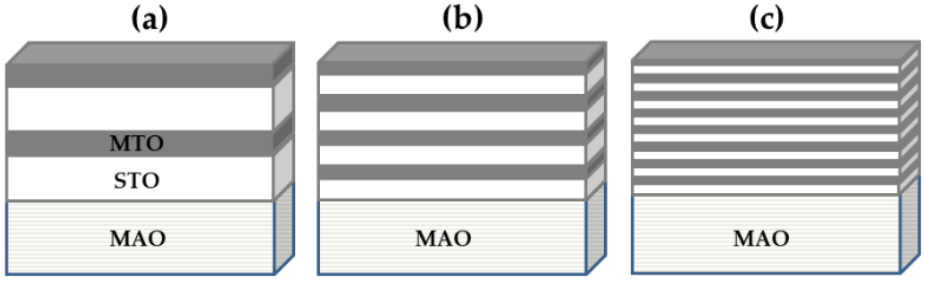

Fig. 1 Schematic diagram of the designed MTO/STO multilayer films. (a) 20 nm/40 nm (b) 10 nm/20 nm and (c) 5 nm/10nm. Outermost layer is covered with MTO layer

Reference

[1] W. Hu et al., Phys. Rev. B **101,** 220510(R) (2020).