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Growth and characterization of Fe_3O_4/Nb:$SrTiO_3$ heterostructure

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Transition metal oxides are interesting materials to study the complex interaction between electron spin, charge, and orbital ordering. One such oxide is the cubic spinel ferrimagnetic magnetite (Fe_3O_4), exhibiting high Curie temperature ($\sim$860 K) and a characteristic Verwey transition at 120 K leading to an abrupt increase in its resistivity. The half-metallic ground state (100% spin polarization) with the magnetic moment of $4.05\mu_B$/f.u. makes Fe_3O_4 a promising material for application in spintronics devices. However, for realization of such applications it is important to comprehend these properties in the form of thin film heterostructure on semiconducting substrates [1].

Here we study the morphology, electric, magnetic, magneto-electric coupling and magneto-transport properties of Fe_3O_4/Nb:$SrTiO_3$. Studies like, charge screening-control of the Verwey transition, interfacial capacitance, magnetic depth profile, and ferroelectric ordering are of special interest. The Fe_3O_4 films are grown in an oxide molecular beam epitaxy system. We use x-ray diffraction and reflectometry for the structural characterizations, and atomic force microscopy (AFM) for the morphology of thin film. Magnetic and transport properties of the heterostructure are studied using SQUID magnetometer and physical property measurement system, respectively. We use polarized neutron reflectometry technique to study the depth profile of magnetization in the heterostructure.

[1] X. Wang, et. al., J. Mater. Sci. Technol. (in-press) (2018).

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