



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

Name of the Student : DOKALA RAVI KIRAN

Roll Number : 186121101

Programme of Study : Ph.D.

Thesis Title: **Magnetic and Electronic Structure of few Perovskites in the form of Bulk and 2D-Superlattices**

Name of Thesis Supervisor(s) : Prof. SUBHASH THOTA and Dr. PANKAJ KUMAR MISHRA

Thesis Submitted to the Department/ Center : PHYSICS

Date of completion of Thesis Viva-Voce Exam : 13<sup>th</sup> OCTOBER 2023

Key words for description of Thesis Work : Magnetic Phase Diagram, 3d-4f spin-orbit correlation, Heterostructure

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SHORT ABSTRACT

Complex oxide systems with the perovskite structure are becoming highly significant for modern day magneto-electronic devices because of their unique magnetic and transport properties. Mainly, perovskites with 3d-4f transition metal-rare-earth perovskites have gained widespread attention due to the strong interplay between the lattice, electron spin, orbit, and crystal structure. The present work provides a glimpse of growth of such systems using pulsed laser deposition technique and their electronic/magnetic structure in the form of 2D superlattice structures. In particular, the current work deals with the superlattices of  $[\text{Pr}_{0.7}\text{Ca}_{0.3}\text{MnO}_3/\text{SrTiO}_3]_{15}$  and  $[\text{Pr}_{0.5}\text{Ca}_{0.5}\text{MnO}_3/\text{SrTiO}_3]_{15}$  on (001) oriented  $\text{SrTiO}_3$  and  $\text{LaAlO}_3$  single crystal substrates. Elastic strain induced electronic reconstructions at the interface enhanced the interlayer ferromagnetic interactions in the case of  $x = 0.3$  superlattices on  $\text{SrTiO}_3$  exhibiting the highest  $H_K \sim 9$  kOe and  $K_1 \sim 8 \times 10^5$  erg/cc. Tunable spin-flopped transition ( $\sim 30$  kOe), significant negative exchange-bias field ( $H_{\text{EB}} \sim 2.5$  kOe), huge coercive field ( $H_C \sim 22$  kOe) and large NM ( $\Delta M \sim 280$  emu/mole) are the unique characteristic features of the Ce incorporated  $\text{YCrO}_3$  polycrystals. The H-T phase diagram, clearly distinguishes three prominent regions below the  $T_N$  ( $\sim 150$  K), viz (i) long-range canted AFM + weak FM phase ( $\Gamma_4 (G_Z, F_y, A_x)$ ), (ii)  $\Gamma_{24}$  mixed phase and (iii) robust  $\Gamma_2 (F_Z, G_y, C_x; F_Z^R, C_x^R)$  AFM + FM phases. Extensive magnetization measurements reveal the existence of orbital-ordering in  $\text{Pr}_{0.45-x}\text{Yb}_x\text{Sr}_{0.55}\text{MnO}_3$  accompanied by antiferromagnetic (AFM) Néel temperature,  $T_N$  at as low as 158 K below the high- $T_C$  (302 K) ferromagnetic (FM) phase. Irreversible metamagnetic transitions from the AFM-FM phase occurs for a specific composition Pr40 ( $x = 0.05$ ) till  $T \leq 220$  K. The admixture of metastable states of AFM and FM is quite robust in the investigated system whereas AFM state is mediated by  $\text{Yb}^{3+}$  ions, while, the FM state arising by field driven thermo-magnetic kinetics. In the  $\text{Gd}_{0.9}\text{Ce}_{0.1}\text{CrO}_3$ , overall magnetization  $M(T)$  undergoes a second transition at the low temperatures associated with spin-flip transition triggered by the critical field,  $H_C = 200$  Oe at  $T_{\text{SF}}$  (10 K). The system exhibits better magneto-entropy value  $-\Delta S_M = 42$  J/Kg-K which is higher than the previously reported  $\text{GdCrO}_3$  values. The reduction in the Cr-O-Cr bond angle through the substitution of  $\text{Ce}^{3+}$  at the  $\text{Gd}^{3+}$  site deduce such betterment in the magnetic entropy value. The presented works find potential utility in the fields of magnetoelectronic, thermo-magnetic sensors and spintronic device applications.