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Abstracts
For the realization of spintronic device, it is essential to hybridize existing semiconductors with highly spin-polarized magnetic materials. Indium oxide is a wide-band-gap [energy gap $E_g \sim 3.70$ eV] n-type semiconductor, which behaves as an insulator in its stoichiometric form (In$_2$O$_3$). This work is an experimental investigation at the effects of transition metal (TM= Cr, Mn, Fe, Co, and Ni) doping on the structural and magnetic properties of indium oxide. Pure and TR doped In$_{2-x}$TM$_x$O$_3$($0.0 \leq x \leq 1.0$) nanostructure thin films have been successfully prepared by means of chemical solution process onto SiO$_2$/Si(100), Corning 7059 glass and MgO(100) substrates annealed at 600 °C in oxygen atmosphere. The XRD patterns of In$_{2-x}$TM$_x$O$_3$ thin films formed on the Si and glass substrates show that the films feature a cubic bixbyite structure with $a_0=$1.0117 nm, the orientation of the (222) crystal plane was predominant and the films on MgO(100) substrate showed a rocking curve full-wide at half maximum of 0.86 ° and found a "cube-to-cube" orientation relationship; MgO(001) // In$_{2-x}$TM$_x$O$_3$(001) ; MgO[100] // In$_{2-x}$TM$_x$O$_3$[100]. Microstructural characterization on thin film employing FE-SEM and AFM showed a granular structure with a mean grain size between 40 and 60 nm for all substrates and the surface roughness of typical thin films was 6 nm. Magnetic response was measured as a function of magnetic field strength for the In$_{2-x}$TM$_x$O$_3$ thin films on MgO(001) at temperature range of 77 to 300 K. Sharp, square hysteresis loops, indicating a well-ordered ferromagnetic structure, appeared in the magnetization versus magnetic field curves when magnetic field was applied in the plane of the film. This result clearly indicates that the In$_{2-x}$TM$_x$O$_3$ thin films are advantageous not only for practical application to magnetic device but also for physical basic studies on electro-magnetic properties In$_{2-x}$TM$_x$O$_3$ films.