UNIVERSITI TEKNOLOGI MARA

EFFECT OF Cr^{3+} SUBSTITUTION IN Bio.3Pro.3Cao.4MnixCr^03 AND La^{3+} SUBSTITUTION IN Bio.3-xLaxPro.3Cao.4Mno.9Cro.1O3 ON ELECTRICAL AND MAGNETIC PROPERTIES OF BISMUTH-BASED MANGANITE

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ABSTRACT

Sample of Bio.3Pro.3Cao.4Mni-xCr^03 (0<x< 0.14) and Bio.3-XaxPro.3Cao.4Mno.9Cro.1O3 (0<x<0.2) were prepared by solid-state synthesis method to elucidate the structural, magnetic properties and electrical transport in bismuth based-manganite. For Bio.3Pro.3Cao.4Mni-$_x$Cr$_x$03, *R* versus *T* curve shows that *x=0* sample exhibited a strong insulating behaviour, and Cr^{3+} substitution at x=0.08 induced metal-insulator (MI) transition at MI temperature *(TMI)* of 56 K. For x=0.08 sample can successfully weaken the hybridisation effect through the strong ferromagnetic (FM) interaction. Further substitution of Cr^{3+} for x=0.1 increased the *TMI* to 58 K but decreased to 36 K for x=0.12. Susceptibility versus temperature measurements presented an increase in FM-paramagnetic transition from 66 K (x=0.04) to 125 K (x=0.14) which suggested that Cr^{3+} substitution enhanced the growth of FM phase. Fitting of the experimental data in the metallic region to scattering models suggested that scattering involving a combination of electron-electron, electron-magnon, Kondo-like spin-dependent scattering and electron-phonon interactions are responsible for the observed resistivity behaviour. Fitting in the insulating region indicated that resistivity behaviour followed the variable-range hopping (VRH) model below the charged ordered temperature for *(x=0)* and *TMI <T< TOD/2* for x=0.04-0.14. High temperatures involved small polaron hopping mechanism (SPH). Therefore, the enhanced double exchange mechanism increased the delocalisation of charge carrier and destabilisation of the charged ordering-AFM state. Besides that, *R* versus *T* curve of the Bio.3-xLaxPro.3Cao.4Mno.9Cro.1O3 (0<x<0.2) samples in zero field showed the same trend in increasing of MI transition from 58 K *(x=0)* to 88 K (x=0.2). The increase in both T_c and *TMI* indicates the enhancement of double exchange interaction involving Mn^{3+} and Mn^{4+} as a result of weakened of hybridization effect between Bi^{3+} $6s^2$ lone pair with O orbital due to La^{3+} substitution. Magnetic susceptibility versus temperature measurements showed all samples exhibits ferromagnetic to paramagnetic transition with Curie temperature, T_c. Fitting of the experimental resistivity data below *TMI (T < TMI)* in the metallic region to scattering models suggested the observed resistivity behaviour of all samples are due to combined effect of electron-electron, electron-magnon, Kondo-like-spin-dependent scattering and electron-phonon interaction. Fitting in the insulating region above *TMI (T>TMI)* suggested that resistivity behaviour obeys two different model which are VRH model and SPH model. La substitution in the weak-hybridization Bi-based compound is suggested reduced some types of blocking mechanism effect which may related to reduction of Mn06 octahedral distortion hence increase the movement of charge carrier.

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