**Effect Of Magnetic Field On Thermoelectric Power Of Anderson Lattice Model: An Application To Colossal Magnetoresistive Manganites (Re1-x Ax MnO3)**

Sunil Panwar

Department of Applied Science, Faculty of Engineering & Technology,

Gurukula Kangri (Deemed to be University), Haridwar-249404, India

*\** Corresponding author: dr.sunilpanwar66@gmail.com

**Abstract.** In the present investigation, by using variational method we have studied the effect of magnetic field on thermoelectric power Q(T) of rare earth manganites doped with alkaline earths namely Re1-x A x MnO3 (where Re = La, Pr, Nd etc., and A= Ca, Sr, Ba etc.) exhibiting colossal magnetoresistance (CMR) phenomena. We have used a two band (l-b) Anderson Lattice model Hamiltonian to study these materials in the strong electron-lattice Jahn- Teller (JT) coupling regime an approach similar to the two- fluid models. We find that Q(T) decreases with increasing magnetic field ‘h’& ‘m’ parameters. In the external magnetic field, the phonon-drag effect is expected to become weaker so that value of Q(T) reduces. We have shown the curves at temperature 150 K & 300 K only. We have also observed the effect of doping concentration ‘*x*’ on Q(T). Q(T) increases as we increase the doping ‘x’. Our results are in good agreement with the available experimental data.

**Introduction**

The anomalous electrical transport and magnetic behaviour of Rare Earth Colossal Magnetoresistive (CMR) Manganites doped with Alkaline Earths namely **Re1-x A x MnO3** (where Re= La, Nd etc. & A = Ca, Ba etc.) with the perovskite structure are mainly characterized by a competition between ferromagnetism and anti-ferromagnetism and between a metallic & insulating behaviour. Metal- insulator transitions are accompanied by a huge change in electrical resistivity (ρ) and are widely observed in doped rare- earth manganites **[1].** The Colossal Magnetoresistance (CMR) or huge drop in ρ in an external magnetic field near the paramagnetic to ferromagnetic transition temperature ‘T c’ of the La 1-x Ca x MnO3 & related mixed- valence manganites has attracted much interest since its discovery **[2,3].** The maximum of CMR very near to T c originates from the mechanism based on the double exchange (**DE**) between Mn ions. It is well known that **DE** correlates the electrical transport to magnetic configuration i.e. magnetic order favours the motion of carriers. However other explanations of the CMR effect have also been advanced & they relate to the phase separation **[4]** & fluctuation **[ 5]** scenarios.

In a recent review, Ramakrishnan et. al **[6]** have presented a new theoretical model of coexisting localized JT polarons and broad band electrons for doped rare earth manganites **Re1-x A x MnO3** and argued that it arises inevitably in the presence of orbital degeneracy and strong JT coupling and claimed that it explains a wide variety of characteristic properties of manganites.

Some time ago, Panwar et al. **[7]** have developed a variational method to study the ground state and thermodynamic properties of heavy fermion systems using Anderson lattice model. Recently, Panwar et al. had used this variational method in the study of the magneto- transport properties like electrical resistivity & thermoelectric power of doped CMR manganites over a fairly wide temperature range at zero &different magnetic fields **[8].** In this paper, we continue to use this variational method to study the thermoelectric power Q(T) of rare earth manganites doped with alkaline earths at different magnetic fields.

We start with a model Hamiltonian in the presence of magnetic field **H** which includes ℓ-b hybridization effects and thus can address the low temperature properties of manganites (e.g. resistivity ,Hall effect) **[6,8 ]** given by-

 → (1)

where, h= g σ H.

 The details of the symbols used in Eq. (1) are given in our previous work in ref. **[8].**

**Results and Discussion**



# (a) (b)

**FIGURE 1**. (a)Variation of thermoelectric power Q (T) with magnetic field parameter ‘h ‘ at x=0.2 (b) with doping ‘x’ at h=0.01, m=0.1 for *U*=5.0,Ejt=0.5, V=0.1, JH=2.0 & JF=0.1

In our calculations, we have taken the unperturbed band of three dimensional solid represented by simple semi-circular density of states Nc σ (ϵk) = (2/ϵk2 ) (which is centred around zero energy ) with band width W=2.0 eV, *U*=5.0 ,E j t =0.5, *JF*= 0.1,*V*= 0.1 , **= -**0.238 eV (for x =0.3) and = 2.0 eV. Doping *x* is varied from 0.1 to 0.5.

 FIGURE 1 shows the variation of thermoelectric power Q(T) with magnetic field parameter h& doping concentration ‘x’. Here it is observed in Fig. (a) that with the application of a magnetic field, Q(T) values reduces at low temperature. In the external magnetic field, the phonon-drag effect is expected to become weaker so that value of Q(T) reduces. Q(T) also increases as doping x is increased in Fig (b). This large value of Q(T) arising from hole localization may occur due to the narrowing of eg band. Q(T) behavior agrees qualitatively with CMR compounds like La0.67 Ca 0.43 Mn O 3 and La 5/8-y Pr y Ca 3/8 Mn O3 with y=0.25,0.35 and 0.42 [8].

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