

Study of CMR effect and magnetic order in perovskite (La, Pr, Nd)MnO_{3+δ} (δ ≈ 0.09, 0.12) compounds.

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In the present work, magnetoresistance and magnetic properties of bulk polycrystalline specimen of La_{1-x}Pr_xMnO_{3+δ} (x=0.00-1.00) and La_{1-y}Nd_yMnO_{3+δ} (y=0.00-0.50) perovskite type compounds were investigated by LFMR(T) (H≈2kG) and χ_{ac} (T) (80<T<300 K) measurements. The compounds were synthesized by solid state reaction using high purity La₂O₃, Pr₆O₁₁, Nd₂O₃, MnO₂ in air. Series of pressed samples with different x, y were exposed to oxidative conditions (P_{O₂}=0.21, 1 bar T=900°C/100h) after sintering at high temperature, in order to achieve a high and homogeneous O₂ distribution in the specimen.

The χ_{ac} (T) measurements show that both the Pr-, as well as the Nd-doped specimen exhibit FM transitions at T<150 K. In the long range FM state established at low doping (x,y≤0.20) the Curie temperatures, T_C, and the spontaneous susceptibility decrease monotonously with the dopant concentration. The values of T_C are systematically lower for the Nd-doped samples. These variations indicate progressive weakening of the long range FM state resulting by increasing distortion introduced by the smaller radii of the ions (r_{Nd³⁺}=1.27Å < r_{Pr³⁺}=1.30Å substituted at A-site for La. For intermediate dopant concentrations (0.20<x<0.80 and 0.20<y<0.50) the spontaneous χ_{ac} (T) shows an unusual thermal dependence. Two consecutive FM type transitions are clearly recognized, indicating the competition between FM double-exchange and AFM super-exchange interactions [1]. χ_{ac} (T) measurements on similarly treated powders show qualitatively same magnetic ordering behavior, thus ruling out phenomena of oxygen inhomogeneity in specimen. Finally, at still higher Pr-, and Nd- doping only the transition from PM to Canted-AFM state is observed.

The LFMR(T) measurements for specimen in the low doping regime (x,y≤0.20) show broad peaks close to the corresponding FM transitions. These peaks shift to lower T with increasing x, y as expected for the DE originating intrinsic phenomenon of CMR. The LFMR(T) for specimen with x>0.20 displays two successive broad peaks, supporting the existence of two FM phases, in good agreement with the χ_{ac} (T) measurements.

References

- [1] V. Dyakonov, et al, Phys. Rev. B **77**, 214428, (2008)