

PRESSURE-INDUCED MAGNETIC PHASE TRANSITIONS IN $\text{Pr}_{1-x}\text{Sr}_x\text{MnO}_3$ MANGANITES ($x = 0.48 - 0.85$)

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The crystal and magnetic structures of manganites $\text{Pr}_{1-x}\text{Sr}_x\text{MnO}_3$ ($x = 0.48 - 0.85$) have been studied by means of neutron diffraction at high pressures up to 4.8 GPa in the temperature range 16 – 300 K using sapphire anvil high pressure cells with the DN-12 spectrometer at the IBR-2 high flux pulsed reactor (Dubna, Russia).

At ambient conditions $\text{Pr}_{1-x}\text{Sr}_x\text{MnO}_3$ compounds ($x = 0.48 - 0.85$) have a tetragonal crystal structure of the $I4/mcm$ symmetry (for $x = 0.85$ this structure stabilizes at $T < 260$ K) and different magnetic properties for particular x values. $\text{Pr}_{0.52}\text{Sr}_{0.48}\text{MnO}_3$ exhibits a ferromagnetic state below $T_C = 290$ K. $\text{Pr}_{0.5}\text{Sr}_{0.5}\text{MnO}_3$ at $175 \text{ K} < T < T_C = 265 \text{ K}$ exhibits an intermediate ferromagnetic (FM) state followed by the onset of the A-type antiferromagnetic (AFM) state at $T_N \approx 175$ K which is accompanied by a phase transformation to the orthorhombic structure (sp. gr. $Fmmm$). In $\text{Pr}_{0.44}\text{Sr}_{0.56}\text{MnO}_3$ at $T_N \approx 215$ K the onset of the orthorhombic A-type AFM state occurs. $\text{Pr}_{0.15}\text{Sr}_{0.85}\text{MnO}_3$ transforms to the C-type AFM state at $T_N \approx 260$ K.

Under high pressure, in $\text{Pr}_{0.52}\text{Sr}_{0.48}\text{MnO}_3$ the onset of the A-type AFM state ($T_N \approx 250$ K) accompanied by the structural transformation from the tetragonal to the orthorhombic structure of $Fmmm$ symmetry was observed. In $\text{Pr}_{0.5}\text{Sr}_{0.5}\text{MnO}_3$ at high pressures a suppression of the intermediate FM state and the noticeable increase of the FM – A-type AFM transition temperature from $T_N \approx 175$ up to 230 K occur. In $\text{Pr}_{0.44}\text{Sr}_{0.56}\text{MnO}_3$ at high pressures a tetragonal C-type AFM phase ($T_N \approx 125$ K) appears and the phase separated state is formed, consisting of its mixture with the initial orthorhombic A-type AFM phase ($T_N \approx 220$ K) [1]. In $\text{Pr}_{0.15}\text{Sr}_{0.85}\text{MnO}_3$ the initial C-type AFM state remains stable under high pressure. The stability of different magnetic states of $\text{Pr}_{1-x}\text{Sr}_x\text{MnO}_3$ under high pressure is discussed in terms of the model phase diagram of manganites with doping level $x > 0.5$ [2].

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References

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[2] G. Venketeswara Pai, Phys. Rev. B **63**, 064431 (2001).