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Magnetic properties of rare-earth orthochromites at low temperature

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Content :

Magnetic properties of Ru doped $YbCrO_3$ as a function of temperature and magnetic field have been investigated to explore the intriguing magnetic phenomena in rare-earth orthochromites. Field-cooled magnetization reveals a broad peak around 75 K and then becomes zero at about 20–24 K, due to the antiparallel coupling between Cr^{3+} and Yb^{3+} moments. An increase of the Ru^{4+} ion concentration leads to a slight increase of compensation temperature Tcomp from 20 to 24 K, but the Néel temperature remains constant. A larger value of the magnetic moment of Yb ions gives rise to negative magnetization at low temperature. Simulation of temperature dependent magnetization data, below TN, based on the three (two) magnetic sub-lattice model predicts stronger intra-sublattice exchange interaction than that of inter-sublattice. Thermal hysteresis and Arrot plots suggest first order magnetic phase transition. Random substitution of Ru^{4+} ion reduces the magnetic relaxation time. Weak ferromagnetic component in canted antiferromagnetic system and negative internal magnetic field cause zero-field-cooled exchange bias effect. A maximum value of magnetocaloric effect is found around the antiferromagnetic ordering of Yb^{3+} ions. Antiferromagnetic transition at about 120 K and temperature induced magnetization reversal lead to normal and inverse magnetocaloric effects in the same material.

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