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Inverse Exchange Bias and Anomalous Magnetization Behavior in Negative Magnetization Compounds, La1-xPrxCrO3

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The La1-xPrxCrO3 compounds with x = 0.8, 0.85, and 0.87 exhibit the intriguing negative magnetization (NM) state below the compensation temperature, TCOMP. While only positive magnetization is found for x = 0.9 compound below its magnetic ordering temperature. An anomalous dc magnetization behavior is observed for these compounds. A maximum dc magnetization is found for x = 0.8 compound, after that it starts to decrease, shows a minimum at x = 0.87 followed by an increase with the largest magnetization for x = 0.9 compound, thus indicating an anomalous dc magnetization behavior. Polarized neutron depolarization (Pf) is found to follow the following order: P_f^(0.9)〖>P〗_f^0.8 〖>P〗_f^0.85>P_f^0.87 and thus has provided the magnetic domain-level understanding of observed anomalous dc magnetization behavior. More interestingly, inverse/positive exchange-bias (EB) is observed for the NM compounds in the negative magnetization state (T< TCOMP). The Rietveld refinement of the neutron diffraction data reveals that Cr moments in all compounds orders in Gy type antiferromagnetic fashion. We have fitted the dc magnetization data using Cooke's model, and the internal magnetic field/polarized Pr moment (MPr) and MCr are estimated. The internal field acting on the Pr3+ sublattice by the ordered Cr3+ moment is found to be negative for x = 0.8, 0.85, and 0.87 compounds and positive for x = 0.9 compound, and thus explains the presence and absence of NM in the compounds, respectively.

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