Impact of pressure on the Griffiths phase and exchange-bias in the disordered cobaltite $Gd_{0.5}Sr_{0.5}CoO_{3-\delta}$

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The exchange bias (EB) effect and an appearance of the Griffiths-phase (GP) were found in half-doped cobaltite $Gd_{0.5}Sr_{0.5}CoO_{3-\delta}$ exhibiting a significant quenched disorder due to the ion size mismatch between Sr and Gd. The disorder weakens the ferromagnetic (FM) interactions between Co ions, leading to low transition temperature $T_C = 90$ K. A clear GP behavior was detected in the temperature range between T_C and the Griffiths temperature $T_G = 225$ K. It was found that, the EB exists in $Gd_{0.5}Sr_{0.5}CoO_{3-\delta}$ for entire temperature range below $T_G = 225$ K, in contrast to the limited, low-temperature EB observed so far in perovskite cobaltites. Pressure leads to a decrease of T_C with a coefficient of $\mathrm{d}T_C/\mathrm{d}P = 1$ K/kbar and dramatically suppresses GP, resulting in a rapid decrease in T_G at a rate of $\mathrm{d}T_G/\mathrm{d}P$ = -3.6 K/kbar. Similarly, the EB field does not change significantly in the FM phase but it promptly collapses with pressure in GP. Pressure effectively eliminates local structure deformations that are responsible for magnetically ordered clusters existing above T_C. Pressure-induced transition from the high-spin Co^{3+} state to the low-spin state is mainly responsible for the observed decay of the Griffiths phase and simultaneous EB collapse, as well as, for a decrease in T_C under pressure.