Magnetic percolation and giant spontaneous Hall effect in La_{1-x}A_xCoO_3 (A = Ca, Sr, 0.1 \leq x \leq 0.5)

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The spontaneous Hall effect and magnetoresistance ($\Delta R_H$) of La_{1-x}A_xCoO_3 (A = Ca, Sr) are investigated as a function of the doping level x. We find that the Hall resistivity $\rho_{xy}$ of the ferromagnetic cobaltites at $T < T_{Curie}$ is proportional to the magnetization $M$ of the sample, and that for both La_{1-x}Ca_xCoO_3 and La_{1-x}Sr_xCoO_3, the spontaneous Hall coefficient $R_s$ (equiv $\rho_{xy}/M$) is a strong function of the temperature $T$ and the doping level, reaching maximum slightly below $T_{Curie}$ for each doping level, and achieving the largest magnitude near the magnetic percolation threshold x $\sim$ 0.2. In the case of La_{0.8}Ca_{0.2}CoO_3, we obtain a record value of $R_s$ 'approx 1400 x 10^{-9} m^2/A$, exceeding all spontaneous Hall coefficients of known single-phased ferromagnets. In contrast, the longitudinal resistivity of these cobaltites decreases monotonically with increasing magnetic field for all samples, except La_{0.8}Ca_{0.2}CoO_3 that exhibits non-monotonic dependence. The giant spontaneous Hall effect may be attributed to the enhanced spin fluctuations near $T_{Curie}$, and the strong spin-orbit scattering from percolating high-spin Co^{3+} - Co^{4+} conducting clusters in a low-spin Co^{III} non-conducting matrix. Possible correlation between $\Delta R_H$ and $\rho_{xy}$ will be discussed.