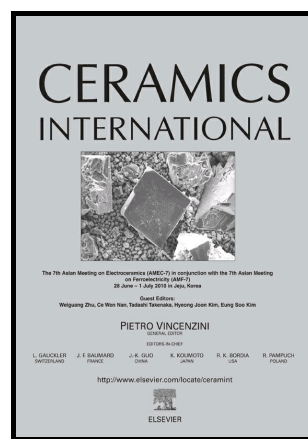


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Magnetocaloric effect in $\text{La}_{1-x}\text{Sr}_x\text{CoO}_3$ undergoing a second-order phase transition

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Abstract

We have prepared rhombohedral $\text{La}_{1-x}\text{Sr}_x\text{CoO}_{3-\delta}$ ($x = 0.2-0.5$) compounds with a mass density $\rho \approx 5.5 \text{ g/cm}^3$. Their magnetocaloric (MC) effect is studied via the magnetic-entropy change (ΔS_m) and relative cooling power (RCP), which are calculated from initial magnetization data recorded at different temperatures. Results reveal that the ΔS_m magnitude is maximum ($\Delta S_{\max}$) around the ferromagnetic-paramagnetic phase transition and dependent on both the applied-field (H) magnitude and Sr content (x). For $H = 50 \text{ kOe}$, $|\Delta S_{\max}|$ can be tuned in the range of $1.6\sim 2.7 \text{ J/kg}\cdot\text{K}$, corresponding to RCP values of $89\sim 141 \text{ J/kg}$. Among the studied $\text{La}_{1-x}\text{Sr}_x\text{CoO}_{3-\delta}$ samples, the samples with $x = 0.3-0.5$ have the largest $|\Delta S_{\max}|$ values. If combining these samples as MC blocks in refrigeration application, the working temperature range of a cooling device could range from 204 to $\sim 280 \text{ K}$, with $|\Delta S_{\max}|$ stable at $\sim 2.6 \text{ J/kg}\cdot\text{K}$ and $RCP \approx 198 \text{ J/kg}$. We have also assessed the phase-transition type and magnetic order and found $\text{La}_{1-x}\text{Sr}_x\text{CoO}_{3-\delta}$ undergoing a second-order phase transition. Magnetic order tends to change from the long-range type to the short-range one when x varies from 0.2 to 0.5 . This is in good agreement with the results obtained from the analysis of critical behavior.

Keywords: Perovskite cobaltites; magnetocaloric effect; second-order phase transition

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