Tunable magnetic properties and large magnetocaloric effect of non-stoichiometric $LaMnO_3$ nanoparticles

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$LaMnO_3$ nanoparticles (NPs) with various particle sizes of 28-101 nm have been studied the structural characterization, and magnetic and magnetocaloric properties. Rietveld refinements revealed that all NPs crystallized in the rhombohedral structure, with varied structure parameters dependent on the particle size (D). Magnetization (M) measurements indicate a large difference in magnitude between zero-field-cooled and field-cooled magnetizations at temperatures (T) below ferromagnetic-paramagnetic (FM-PM) phase transition, particularly for the samples with D = 36-43 nm, which are ascribed to spin-glass-like behaviors and magnetic inhomogeneity. We also found the possibility of tuning the FM-PM phase transition temperature (T_C) from 77 to 262 K, which is dependent on D, and W as well. Under an applied field H = 50 kOe, the maximum magnetic entropy change ($|\Delta S_{Max}|$) achieved around T_C can improve from 4 $J \lessdot kg^{-1} \lessdot K^{-1}$ for D = 43 nm to 6.4 $J \lessdot kg^{-1} \lessdot K^{-1}$ for D = 101 nm, corresponding to relative-cooling-power (RCP) values of 241~286 $J \lessdot kg^{-1}$. We also analyzed carefully the data of $M(T, H)$, and magnetic entropy change ($|\Delta S_m|$) versus T and H based on theoretical models to further understand the magnetic properties and phase-transition type.

Keywords: Perovskite manganites, Nanoparticles, Magnetic and magnetocaloric properties