The physical properties of submicron and nano-grained $la_{0.7}Sr_{0.3}MnO_3$ and $Nd_{0.7}Sr_{0.3}MnO_3$ synthesised by sol–gel and solid-state reaction methods

ABSTRACT

$La_{0.7}Sr_{0.3}MnO_3$ (LSMO) and $Nd_{0.7}Sr_{0.3}MnO_3$ (NSMO) possess excellent colossal magnetoresistance (CMR). However, research work on the neodymium-based system is limited to date. A comparative study between LSMO and NSMO prepared by sol–gel and solid-state reaction methods was undertaken to assess their structural, microstructural, magnetic, electrical, and magneto-transport properties. X-ray diffraction and structure refinement showed the formation of a single-phase composition. Sol–gel-synthesised NSMO was revealed to be a sample with single crystallite grains and exhibited intriguing magnetic and electrical transport behaviours. Magnetic characterisation highlighted that Curie temperature (TC) decreases with the grain size. Strong suppression of the metal–insulator transition temperature (TMI) was observed and attributed to the magnetically disordered grain surface and distortion of the MnO6 octahedra. The electrical resistivity in the metallic region was fitted with theoretical models, and the conduction mechanism could be explained by the grain/domain boundary, electron–electron, and electron–magnon scattering process. The increase in the scattering process was ascribed to the morphology changes. Enhancement of low-field magnetoresistance (LFMR) was observed in nano-grained samples. The obtained results show that the grain size and its distribution, as well as the crystallite formation, strongly affect the physical properties of hole-doped manganites.

Keyword: CMR; Hole-doped; LFMR; Manganites; Single crystallite