Grain size effect on the electrical and magneto-transport properties of nanosized $Pr_{0.67}Sr_{0.33}MnO_3$

ABSTRACT

In this study, nanosized of $Pr_{0.67}Sr_{0.33}MnO_3$ prepared via sol-gel method followed by heat treatment at 600–1000 °C in intervals of 100 °C were synthesized. The structure, surface morphology, electrical, magneto-transport and magnetic properties of the samples were investigated. Rietveld refinements of X-ray diffraction patterns confirm that single phase orthorhombic crystal structure with the space group of Pnma (62) is formed at 600 °C. A strong dependence of surface morphology, electrical and magneto-transport properties on grain size have been observed in this manganites system. Both grain size and crystallite size are increases with the sintering temperature due to the congregation effect. Upon increasing grain size, the paramagnetic-ferromagnetic transition temperature increases from 278 K to 295 K. The resistivity drops and the metal-insulator transition temperature shifted from 184 K to 248 K with increases of grain size due to the grain growth and reduction of grain boundary. Below metal-insulator transition temperature, the samples fit well to the combination of resistivity due to grain or domain boundaries, electron-electron scattering process and electron-phonon interaction. The resistivity data above the metal-insulator transition temperature is well described using small polaron hopping and variable range hopping models. It is found that the negative magnetoresistance also increases with larger grain size where the highest %MR of – 26% can be observed for sample sintered at 1000 °C (245 nm).

Keyword: Sol-gel; Grain size; Electrical; Paramagnetic-ferromagnetic transition; Magnetoresistance