World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:18, No:04, 2024

Nature of Polaronic Hopping Conduction Mechanism in Polycrystalline and Nanocrystalline Gd0.5Sr0.5MnO3 Compounds

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Abstract : In the present study, we have investigated the structural, electrical and magneto-transport properties of polycrystalline and nanocrystalline Gd0.5Sr0.5MnO3 compounds. The variation of transport properties is modified by tuning the grain size of the material. In the high-temperature semiconducting region, temperature-dependent resistivity data can be well explained by the non-adiabatic small polaron hopping (SPH) mechanism. In addition, the resistivity data for all compounds in the low-temperature paramagnetic region can also be well explained by the variable range hopping (VRH) model. The parameters obtained from SPH and VRH mechanisms are found to be reasonable. In the case of nanocrystalline compounds, there is an overlapping temperature range where both SPH and VRH models are valid simultaneously, and a new conduction mechanism - variable range hopping of small polaron s(VR-SPH) is satisfactorily valid for the whole temperature range of these compounds. However, for the polycrystalline compound, the overlapping temperature region between VRH and SPH models does not exist and the VR-SPH mechanism is not valid here. Thus, polarons play a leading role in selecting different conduction mechanisms in different temperature ranges.

Keywords : electrical resistivity, manganite, small polaron hopping, variable range hopping, variable range of small polaron hopping
Conference Title : ICCMS 2024 : International Conference on Chemistry and Materials Science
Conference Location : Seoul, Korea, South
Conference Dates : April 25-26, 2024