Quantum corrections to conductivity and anisotropy in LSMO thin films at low temperatures

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Abstract

The low-temperature magnetotransport properties of manganite thin films are characterized by the occurrence of resistivity minima, ρ_{min}, below 60 K whose origin and especially role of disorder has not yet been explored in detail. In order to contribute to the clarification of the physical mechanism giving rise to the resistivity minimum in these systems, an appropriate concentration (20% and 30%) of nanoscaled nonmagnetic ZrO_2 particles are introduced as a secondary phase into $La_{2/3}Sr_{1/3}MnO_3$ thin films. We present the quantum corrections to conductivity in $La_{2/3}Sr_{1/3}MnO_3$ thin films with ZrO_2 nano-particles. As impurities increases, the upturn of resistivity enhances. The interesting results were analyzed by perturbation/quantum correction theory and a model which deviates from the traditional concept of localization was established, where the conductivity originates from the "impurity band". Using the tight-binding scaling theory of localization model, we change the density of impurities and tune the degree (intensity) of disorder, making the state of disorder change from weak localization to strong localization in 2 dimensional (2D) and 3 dimensional (3D) cases. The HR-TEM/ABF/HAADF images also confirm our conclusion that indicates the coexistence of 2D and 3D behavior in one system.

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