ELECTRIC TRANSPORT CHARACTERISTICS OF $Sr_2FeMoO_{6-\delta}$ CERAMICS WITH STRUCTURALLY INHOMOGENEOUS SURFACES

Kalanda N[1*], Demyanov S[1], Yarmolich M[1], Petrov A[1], Sobolev N[2]

[1] Scientific-Practical Materials Research Centre of the NAS of Belarus, 220072 Minsk, Belarus
[2] i3N, Departamento de Física, Universidade de Aveiro, 3810-193, Aveiro, Portugal
** Corresponding author: kalanda@physics.by*

One of the most important properties for applications of half-metals $Sr_2FeMoO_{6-\delta}$ with a double perovskite structure as spintronic devices is the electric charge transport there. In this way, an important task is to study the features of the mechanisms of electric transport in such structures. To investigate these properties, two series of samples of strontium ferromolybdate powder obtained by the citrate-gel method and pressed at a pressure of 4 GPa and T = 800 K were prepared: an unannealed series (SFMO – I) annealed at T = 700 K and $p(O_2)$ = 10 Pa for t = 3 h (SFMO – II) (Fig. 1).

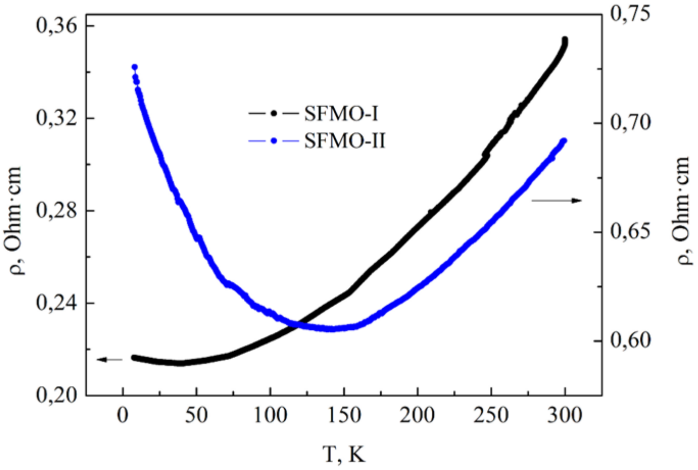

Figure 1: Temperature dependence of the resistivity for the SFMO–I and SFMO–II samples

The temperature dependence of the SFMO-I resistivity exhibits metallic behavior at temperatures above 36 K and a slight increase in the resistivity at T ≤ 36 K. The SFMO-II sample at T = 300 K has a higher electrical resistivity ρ = 0.692 Ohm·cm, which decreases with a decreasing temperature to 133 K with its subsequent increase to 4.2 K (Fig. 1). Despite the fact that the sample exhibits a change in the sign of dρ/dT from positive to negative, it can be assumed that there is a metallic type of conductivity in SFMO – II near the metal – insulator transition. The expression for the electrical resistivity in the temperature range 4.2-300K was written in the form: $\rho(T) = \frac{1}{\sigma_0 + A_w T^{k/2}} + A_p T^n$. When approximated by this function, good agreement was found between the experimental data and the theoretically calculated values.

Resistivity is determined by various mechanisms of electric charge scattering on structural inhomogeneities located both in the bulk of the grain and on its surface. The reason for this is the inhomogeneity of the electron density distribution due to the presence of different valence Mo/Fe cations, anti-structural defects, etc. In this case, charge transfer occurs under conditions of the presence of various kinds of structural disorder. This indicates the need to take into account the processes of weak localization caused by the quantum interference of conduction electrons. In the disordered magnet $Sr_2FeMoO_{6-\delta}$ in the low-temperature region, the probability of electron-electron interaction increases due to diffusion rather than ballistic motion of electrons with multiple elastic scattering by structural inhomogeneities.

The work was supported by the European project H2020–MSCA–RISE–2017–778308 – SPINMULTIFILM