Low remperature heat capacity and phase transition parameters of strontium and barium ferromolybdates

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The results of low temperature heat capacity and phase transition study of strontium and barium ferromolybdates $Sr_{2-x}Ba_xFeMoO_{6-\delta}$ with $x = 2.0$ (I), $x = 1.6$ (II), $x = 1.0$ (III) and $x = 0.8$ (IV) are represented. Barium addition to the $Sr_2FeMoO_{6-\delta}$ leads to decrease of Curie temperature, and, hence, to higher values of negative magnetoresistance, saturation magnetization and to significant magnetocaloric effect at room temperature [1].

The temperature dependences of heat capacities of solid solutions were measured in the range (5 – 370) K using the vacuum adiabatic calorimeter TAU-1 0 («Termis», Moscow, Russia) [2]. The relative expanded uncertainty of the measurements was determined to be 0.4 % in the range (20 – 370) K, 1% in the range (10 – 20) K and 2% in the range (5 – 10) K. There were reproduc ible anomalies on the heat capacity curves of samples I, II and III at temperature higher than 240 K. It was explained by transition from ferromagnetic to paramagnetic state of compounds. There were no anomalies on the heat capacity curve of sample IV below 370 K. Curie temperatures corresponded to excessive heat capacity maximum in the phase transition region and obtained from the temperature dependences of magnetization were agreed within (1 – 2) K. It was found that Curie temperatures nonlinearly decrease, and excessive enthalpies and entropies of phase transitions nonlinearly increases with an increase in the barium content in the samples (with the increase in x). It was found that the Debye cube law does not hold for the heat capacities of solid solutions at temperatures below 15 K. These anomalies were most likely caused by non-cooperative magnetic transformations and indicated the realization of the superparamagnetic state in double perovskites. Standard thermodynamic functions of the samples were calculated in the range (0 – 370) K from the data obtained.

Acknowledgment

The work was funded: by State research program "Physical Materials Science, New Materials and Technologies", by of H2020 - MSCA - RISE2017 - 778308 - SPINMULTIFILM Project.

References

[1] N. Kalanda et al, Vacuum. (2020), 1:6.
[2] A.V. Blokhin et al, J. Chem. Eng. Data (2006), 1377.