Heat capacity and dielectric properties of multiferroic $SmFeO_3$

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Samarium ferrite $SmFeO_3$ (SFO) belongs to the family of rare-earth orthoferrites with a perovskite-like crystal structure (Pnma / Pbnm, $D^{16}{}_{2h}$). SFO has a high magnetostriction coefficient, high temperatures of magnetic ordering T_{NC} ~ 670 K and spin reorientation $T_{SN} \approx$ 480 K, which make it a potential candidate for magnetoelectric applications. Recently, the increased interest of researchers to this material is associated with the discovery in it of improper ferroelectric polarization at T_C = 670 K [1]. The coincidence of the Curie and Neel points ($T_C = T_N$) gives grounds to attribute this compound to second-order multiferroics, in which the ferroelectric (FE) phase is induced by the magnetoelectric (ME) interaction [2].

In this work, we studied the heat capacity and dielectric properties of $SmFeO_3$ microcrystalline and nanostructured ceramics obtained by the solid phase method, which was preceded by sintering treatment of the synthesized mixture at Bridgman anvils at room temperature in a wide range of temperatures between 300-800 K, including phase transitions. On the temperature dependences of the heat capacity C_p (Fig. 1.) and the dielectric constant ε, anomalous behavior is observed characteristic of the phase transition at temperatures $T_{NC} \approx 675$ K, $T^* \approx 558$ K, $T_{SN} \approx 465$ K.

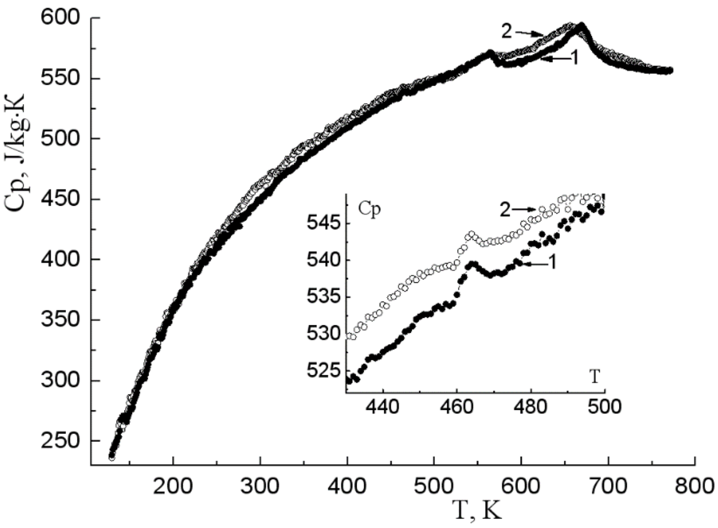

Figure 1. Temperature dependence of the heat capacity of microcrystalline (1) and nanostructured $SmFeO_3$ (2).

It has been established that the mechanical activation leads to a substantial smearing of the antiferromagnetic-ferroelectric transition and a shift of the phase transition temperature to the region of low temperatures. It is noted that the shift of the phase transition of the mechanically activated sample to the low temperature region may be due to a decrease in the crystallite size (size effect). It is shown that the defect structure can play a dominant role in the formation of the physical properties of ceramics. A phase transition was found at T^* = 558 K, which has a frequency-dependent character typical of ferro-relaxors.

1. J.-H. Lee, Y.K. Jeong, J.H. Park, et al., *Phys. Rev. Lett.* **107**, 117201 (2011).
2. A.P. Pyatakov, A.K. Zvezdin *Phys. Usp.* **55**, 557 (2012).