

Determination of Temperature Dependence of Elastic Coefficients in Ferroelastics Under 4/m F 2/m Second-Order Phase Transition

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An analysis is made of the effect of the conservation of macrosymmetry in a polydomain crystal on the temperature dependence of the components of the elasticity tensor in crystals with a second-order phase transition 4 / m F 2 / m on the example of BiVO₄. It is proved that the averaged elasticity tensor for two orientation states in the ferroelastic phase corresponds to the symmetry of the paraelastic phase. In order to preserve the macrosymmetry must occur redistribution of the values (an increase of one by decreasing the other) between the components of the elasticity tensor C_{11} and C_{22} , C_{13} and C_{23} , C_{16} and C_{26} , C_{44} and C_{55} , when the spontaneous deformation changes. The arithmetical mean of these components (C_{ij}) has a temperature dependence close to linear, with the exception of the region near the phase transition, which is well approximated by the logarithmic dependence (Fig.1.) The logarithmic dependence near T_c in the paraelectric phase was proposed by Levanyuk et al. [1].

Based on the obtained results of the study, we suggested the following types of temperature dependences of the components of the elastic tensor in the ferroelastic and paraelastic phases, which correspond well to the experimental data [2]:

$$C_{ij}^m(t) = k_1 + k_2 t + k_3 \ln(T_c - t), \quad (1)$$

$$C_{ij}^t(t) = k_4 + k_5 t + k_6 \ln(t - T_c). \quad (2)$$

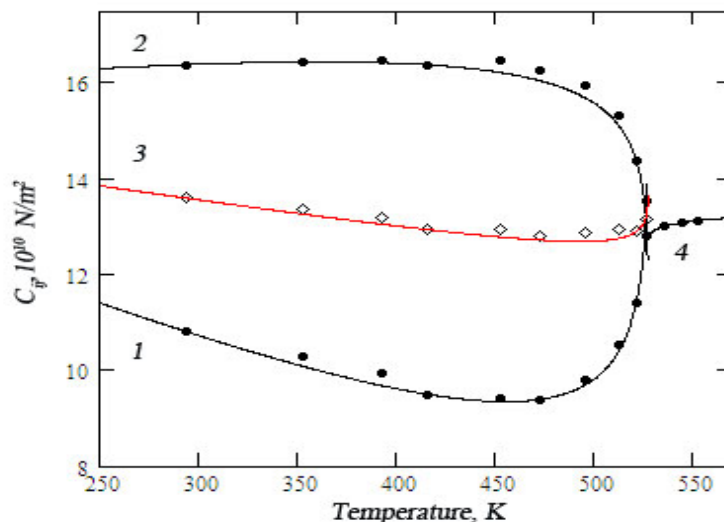


Fig.1. Temperature dependence of the elastic coefficients in BiVO₄ crystal; C_{11}^m (1), C_{22}^m (2), C_{11u} (3), C_{11}^t (4).

References

1. A.P. Levanyuk, K.A. Minaeva, B.A. Strucov. Sov. Phys. Solid State **10**, 1919 (1969).
2. L.P. Avakyants, A.V. Chervyakov, V.S. Gorelik, and P.P. Sverbil. Journal of. Russian Laser Research, **25**, 535(2004).