# EXTERNAL FIELD INFLUENCE ON THE ORDER-DISORDER TYPE FERROELECTRICS

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S u m m a r y

In the microscopic model approach a theory is developed considering the effect of such external factors as pressure and electric field on the ferroelectrics of order-disorder type. In particular, we analyze major microscopic mechanisms of external pressure influence on interparticle (short and long range) interactions in hydrogen bonded ferroelectric crystals of the $KD_2PO_4$ type. Major expressions for thermodynamic, dielectric, elastic, and piezoelectric characteristics of these crystals, obtained within the framework of the proposed modifications of the proton ordering model. We show that pressures of different symmetries give rise to qualitatively different changes in the phase transition character in the system. It is illustrated that within the proton ordering model a quantitatively satisfactory description of available experimental data for the pressure dependences of the physical caracteristics of the crystals can be obtained.

A four-state microscopic model is proposed for a description of the sequence of phase transitions in ferroelectric crystals with orientational ordering of ionic group (e.g. DMAGaS-DMAAlS type), where a coexistence of ferroelectric and antiferroelectric orderings as well as reorientation of dimethylammonium (DMA) groups are taken into account. An interaction between the DMA groups is considered in the dipole-dipole approximation. Thermodynamic characteristics of the system (spontaneous polarization, occupancy of orientational states, dielectric susceptibility, phase diagrams) are derived in the mean field approximation by means of the Hubbard operator representation. The ferroelectric phase suppression under the hydrostatic pressure is explained taking into account the single-ion anisotropy field (difference between energies of orientational states of DMA groups). The obtained results coincide well with experimental data.

The proton ordering model for description of thermodynamics and dielectric properties of glycinium phosphite (GPI) crystals as functions of temperature and electric field magnitude is developed. The developed approach allows one to interpret the field induced shift of the paraelectric-ferroelectric phase transition to lower temperatures with magnitude proportional to the second power of the field applied perpendicularly to the ferroelectric axis as the result of coexistence of ferroelectric and antiferroelectric orderings along the different axes. A theoretical description of the observed dielectric anomalies, given on the basis of the microscopic model considering the proton ordering as well as the phenomenological Landau free energy approach, is in good agreement with the experiment.

A simple four-sublattice order-disorder model is proposed for description of phase transitions and dielectric properties of the Rochelle salt crystal. Symmetry properties of the lattice and spatial orientations of effective dipoles connected with asymmetric structure units in the elementary cell are taken into account. An effect of the transverse electric field on spontaneous polarization, shifts of the phase transition points and dielectric susceptibility anomalies is studied.

Modification of the two-sublattice Mitsui model is elaborated which takes into account the piezoelectric coupling with shear strain $\varepsilon_4$. In the framework of the modified model we explored the piezoelectric and elastic properties of Rochelle salt, as well as the influence of the longitudinal electric field $E_1$ and shear stress $\sigma_4$ on its physical properties.