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G. A. Smolenskiĭ. Phase Transitions in Certain Magnetically Ordered and Ferroelectric Crystals. Investigation of phase transitions is one of the central problems of contemporary physics. Substantial progress has been made in this field during recent years. The thermodynamic theory of second-order phase transitions has been improved and developed, a scaling theory has been created, specific models have been calculated, including the Ising model, the productive notion of the "soft" mode is being developed successfully, critical indices have been determined for various substances, etc.

It is therefore interesting to accumulate experimental data from study of phase transitions in various crystals. This paper briefly illuminates the results of studies of phase transitions in certain magnetically ordered substances and ferroelectrics.

It is known that a compensation point is observed, in accordance with Neel's theory, in rare-earth ferrimagnetics with garnet-type structure. This point is not a critical point in the absence of a magnetic field. But when an external magnetic field is applied, induced phase transitions appear near the compensation point. A theoretical analysis of this problem was carried out first for an isotropic ferrimagnetic, and then with consideration of magnetic anisotropy.

Two induced phase transitions were observed in terbium iron garnet in[1]. As the temperature was raised, a transition occurred from one collinear ferrimagnetic phase to a noncollinear (antiferromagnetic) phase and then to another collinear ferrimagnetic phase. These transitions are accompanied by sign reversal of magnetic birefringence, and light scattering by fluctuations of the magnetic moment is observed.

Another example of the phase transitions studied is the spin reorientation in rare-earth orthoferrites with rhombic structure of the perovskite type. At temperatures above 10°K, only the magnetic moments of the iron ions form a magnetically ordered structure. These substances belong to the class of weak ferrimagnetics. At high temperatures, the magnetic-moment vector is directed along the c axis, and the antiferromagnetism vector along the a axis. As the temperature is lowered, a continuous transition occurs in many of these crystals, with the magnetic-moment vector stabilizing along the a axis and the antiferromagnetism vector along the c axis. K. P. Belov et al. showed that second-order phase transitions correspond to the beginning and end of the reorientation range. Investigation of the spin mode corresponding to joint oscillations of the magnetic-sublattice vectors in the a—c plane showed that the frequency of these oscillations drops to zero at the beginning and end of the reorientation range. The appearance of a "soft" spin mode results from the change in magnetic symmetry and not from a change in crystallographic symmetry, as is the case in ferroelectrics.

Studies of the elastic and magnetoelastic properties of various orthoferrites were investigated in[2] in the frequency range 50 – 1500 MHz. It was shown that the velocity and damping of elastic waves decrease noticeably in the reorientation range along certain crystallographic directions, owing to the coupling of the elastic waves with the soft spin mode.

Experiments were also carried out with magnetostrictive excitation of a high-frequency magnetic field at the fundamental and second-harmonic frequencies by elastic waves. Effective excitation was observed only in the spin-reorientation range.

It was necessary to consider not only the magnetoelastic energy, but also the piezomagnetic energy in order to explain the experimental data on the basis of a thermodynamic analysis.

In contrast to classical ferroelectrics, no distinct phase transition is observed in ferroelectrics of complex composition with perovskite-type structure, such as $RbMg_{1/3}Nb_{2/3}O_3$. This gave rise to the term "ferroelectric with smeared phase transition." A relaxation type of dielectric polarization is observed in the region of the phase transition in ferroelectrics of this group[3]. These and other experimental facts can be explained if it is assumed that the smearing of the phase transition is governed by composition fluctuations. In this view, different regions of the crystal (of linear dimension ~ 100 Å) have different Curie points. It is assumed that the relaxation is due to: 1) motion of the boundaries between polar and nonpolar phases or 2) the production and vanishing of polar regions. The latter mechanism was calculated in[4], in which the Debye theory was generalized to the case in which the number of relaxors varies with temperature (with a maximum at the average Curie point T_{av}). It is then possible to explain a number of experimental facts, including the experimentally observed temperature dependence of ϵ: $1/\epsilon = A + B(T - T_{av})^2$.

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V. L. Ginzburg. Surface Excitons of the Electron-Hole Type. It is obvious even from highly general considerations that various surface states (levels) whose populations correspond to the appearance of excitations or quasiparticles (surface phonons, excitons, magnons, electrons at surface levels, etc.) can exist on the surfaces of solids and liquids. It is also natural to assume the possibility of observing surface (i.e., two-dimensional or quasi-two-dimensional) analogs of ferromagnetism, ferroelectricity, superconductivity, superfluidity, etc.

Unfortunately, the investigation of this circle of problems is usually very complex because of the difficulty of obtaining sufficiently perfect surfaces or homogeneous surface layers, because of masking of surface phenomena by bulk effects, and for certain other reasons. As a result, clarification of numerous questions has dragged out over decades; an example is found