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Role of lamb and horizontal acoustic waves in microscopic mechanism of structural phase transitions in crystal plates

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Microscopic theory of structural phase transitions based on the cooperative Jahn-Teller effect is considered for finite size crystal samples in the shape of a plate. In these samples one size – thickness 2h – is significantly smaller than two others. In such crystal plate the electron and phonon spectra are different from ones of the regular 3-dimensional crystal. The vibrational spectrum difference is in the focus of attention in this presentation. This difference is especially big for the long wave acoustic vibrations with the wavelength $\lambda \geq 2h$. Structural phase transitions are caused by the intersite electron interactions mediated by the crystal acoustic and optical vibrations – virtual phonon exchange. If the major contribution to these interactions is related to the acoustic vibrations, the theory modifications caused by sample surfaces are especially significant. The theory peculiarities for crystal plates are connected with the existence of the Lamb (symmetric LS and antisymmetric LA) and horizontal (symmetric SH and antisymmetric AH) vibrational modes. The mutual orientation of the crystal symmetry axes and the crystal plate surface (crystal cut type) is of primary importance in defining the acoustic wave family most significant in the mechanism of structural phase transition. Thermodynamic and dynamic aspects of the cooperative Jahn-Teller effect in tetragonal symmetry crystal plates with the major role of the Lamb waves or horizontal waves in the mechanism of the ferroelastic phase transition are under discussion.

Biography

Michael Kaplan is a physics and chemistry researcher and educator. From 2005 he is a tenured professor of Simmons College (Boston, USA). His expertise is related to the structural phase transitions, acoustic and magnetic properties of materials, ferroelectricity, non-destructive testing of materials, ultrasound, multiferroics, smart materials. He is co-author (with Benjamin Vekhter) of a book Cooperative Phenomena in Jahn-Teller Crystals (Plenum Press, 1995), co-editor (with George Zimmerman) of a book Vibronic Interactions: Jahn-Teller Effect in Crystals and Molecules, NATO Science Series (Kluvers Academic Publishers, 2001), author and co-author of about 300 refereed articles and 40 patents registered in Germany, UK, France, Japan, USSR, USA.

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