Abnormal Deformation Properties of some Single Crystals of Tetragonal System

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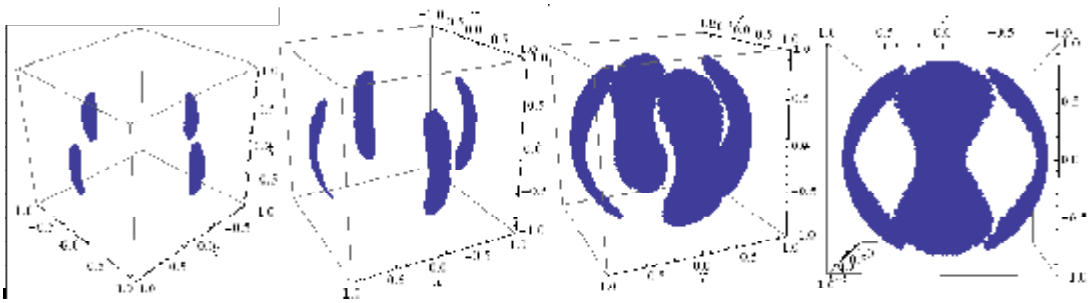
One of the most informative parameters in classical theory of elasticity is Poisson's ratio which by definition is equal to relation of transverse relative compression to longitudinal relative elongation with uniaxial crystal tension. For isotropic materials Poisson's ratio is a scalar quantity and lies in the range of $0 \le \mu \le 0{,}5$ [1]. The negative values of Poisson's ratios are mostly observed in certain crystallographic directions. Absolute auxeticity, i.e., $\mu < 0$ in all crystallographic directions is extremely rare, and, as a rule, occurs close to phase transition points [2].

To analyze the regularities of origination of the abnormal deformations, we have created a program that permits to calculate the negative values of Posson's ratios in all possible directions, to choose the negative values of μ and their respective directions and to build the indicating auxeticity surfaces of single crystals. By way of example, Fig. 1 shows the indicating surfaces of $(NH_4)H_2PO_4$, KH_2PO_4, RbD_2AsO_4 and RbH_2AsO_4 single crystals.



$(NH_4)H_2PO_4$ KH_2PO_4 RbD_2AsO_4 RbH_2AsO_4

Fig. 1. Indicating auxeticity surfaces.

These crystals are characterized by a spontaneous electric polarization (ferroelectrics), a spontaneous deformation (ferroelastics) and an extremely low ultrasonic wave propagation velocity (~330 m/s). It is established that for all crystals the negative values of Poisson's ratios are concentrated in crystallographic directions [100], [010], $[\bar{1}00]$ and $[0\bar{1}0]$ - axial auxeticity.

1. L.D.Landau, E.M.Lifshits, *Theory of Elasticity* (Moscow: Nauka, 1965), 203p.
2. D.A.Konyok, K.V.Wojciechowski, Yu.M.Pleskachevsky, and S.V.Shilko, Materials with Negative Poisson ratios (Review), *Mechanics of Compositional Materials and Structures* **10** (1), (2004), 35.