Unified description of elastic and acoustic properties of cubic media: elastic instabilities, phase transitions and soft modes

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Elastic properties of all cubic materials are classified with the use of a stability triangle in a 2D subspace of elastic parameters [1]. The behavior of bulk modulus *B*, shear modulus (C_s), Poisson's ratio (σ_P) and anisotropy parameter (η) is studied in the vicinity of characteristic lines of this triangle – mechanical stability borders and lines of acoustic anomalies. The low symmetry phases [2], the ferroelastic domains and the related soft modes are found for symmetry breaking phase transitions ($C_S = 0$, $\eta = 0$). The corresponding slowness surfaces for softening and the remaining modes are presented. The existence of the only possible longitudinal soft modes is predicted in two corners of the stability triangle. Anomalous behavior of the Debye velocity is found at the symmetry breaking borders of the stability triangle. Examples of the predicted behavior are given for the mixed valent compounds [3] and for alloys undergoing the martensitic phase transitions [4].

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