The Thermodynamic Interrelationship between Thermal and Elastic Properties of Condensed Phases: A Few Less-Well Known Scaling Relations and Their Applications

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A rigorous description of the thermodynamic stability of condensed phases in terms of pressure (P), volume (V) and temperature (T) coordinates, namely the *equation of state* (EOS) suggests that there exist certain well-defined interrelationships between thermal and elastic properties. Thus for an example, it is well known that the pressure dependence of volume thermal expansivity $(\partial\alpha_V/\partial T)_P$ is related to the temperature variation of isothermal bulk modulus $(\partial B_T/\partial T)_P$ and so on. Despite being so, the actual or for that matter the most generalized representation of this linkage between thermal and elastic quantities is not always obvious; especially due to the fact that thermal and elastic quantities often exhibit diverse functional representations with regard to their temperature and pressure dependencies.

Many a time, the experimental data on thermal and elastic properties taken and analyzed together, reveal certain surprisingly simple correlations over a reasonable range of temperature and or pressure. Albeit appearing empirical at the first sight, these scaling relations have definite thermodynamic basis, which when exploited judiciously can lead to a fully self-consistent thermodynamic framework for an integrated assessment *cum* prediction of thermophysical properties. This talk attempts to present a bird's eye view of this interdisciplinary research area in thermodynamics of materials. A few illustrative case studies are also dealt with.