Mineral Physics I
Chapter 3. Lattice vibration

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What is the lattice vibration?

q Crystals: periodic collections of oscillators

  Ø Atoms in a lattice vibrate around their equilibrium positions.

q Bonding among atoms: exchange of kinetic energy among vibrating atoms

  Ø Waves along periodic atomic arrays

    ü **Lattice vibration**

Importance of lattice vibration

q Internal energy of solids

  Ø $E = E^{static} + E^{vib}$

    ü E^{static}: the ground state energy with a fixed lattice

    ü E^{vib}: the additional energy due to lattice vibration

q A number of physical properties of crystalline solids can be explained by E^{vib}

  Ø Although $E^{static} \gg E^{vib}$ in general

The structure of Chapter 3

q Contents

1. Boltzmann distribution
2. Equipartion law and Dulong-Petit law
3. Quantum one-dimensional harmonic oscillator
4. Vibrational energy of the lattice
5. Phase and group velocities
6. Dispersion relation
7. Debye model
8. Thermal expansion

q The argument in Chapter 3: physically more advanced than Chapter 1 and 2

à The explanation is given from the fundamental physics

Ø No "background" section