REVIEW OF RESULTS OF THEORETICAL APPROACHES TO PHONON ENGINEERING OF THERMODYNAMIC PROPERTIES FOR DIFFERENT QUANTUM STRUCTURES

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Summary: Application of nano-structures requires a knowledge of their fundamental physical (mechanical, electro-magnetic, optical, etc.) characteristics. Thermodynamic properties associated with phonon displacements through the nanosamples are particularly interesting. Independent of the type of lattices, the thermodynamics of their subsystems (electrons, excitons, spin waves, etc.) is determined when the subsystem is in thermodynamic equilibrium with phonons. Phonons are collective mechanical oscillations of molecules or atoms and represent the most important system of excitations. Besides, the acoustical characteristics as well as conductive and superconductive properties etc. could not be realistically explained without phonons. In this paper we will try to observe the difference between the characteristics of different nano-crystalline structures: ultrathin films, composite films, i.e. superlattices, nanorods and quantum dots, we were interested in whether the quantum size effects (quantum confinement), quantum (de)coherence and influence of boundary conditions, strengthen or weaken in nanosamples. Finally, this paper describes how the dimensional confinement of phonons in nanostructures leads to modifications in the electronic, optical, acoustic, superconducting and thermodynamic properties of quantum.

Thermal properties of nanostructures have recently attracted a lot of attention. The influence of size effects on thermal conductivity is becoming extremely important for device design and reliability. On the basis of the calculated dispersion law and distribution of phonon states in nanoscopic crystals, free energy and entropy will be calculated. Internal energy as well as heat capacitance will also be analyzed.

Keywords: phonons, Green’s function, ultrathin films, superlattices, quantum wires–nanorods, quantum dots, energy spectra, thermodynamic behavior, specific heat, thermal conductivity.

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