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Debye Approximation Approach to Calculating the Lattice Specific Heat and related Parameters of a Si Nanowire

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Abstract

The Debye approximation model for calculating Gruneisen parameter and lattice specific heat capacity (LSH) **of** bulk crystal is modified to be applicable to **nanosize** solids, such as Si nanowires. All parameters forming the model **including Debye temperature**, Bulk modulus, lattice thermal expansion**,** and lattice volume are calculated according to their **nanosize** dependence. **Result show that** lattice volume and Gruneisen **parameter increase with decreased** nanowires diameter**, whereas** all other parameters **decrease**. The nanosize dependence of lattice thermal parameters **agree with previously** reported theoretical results.

Keywords: Lattice specific heat capacity; Gruneisen parameter; Debye Model; Si Nanowires

1. Introduction

Over the last three decades, **the size of solid-state devices** has been reduced from micro**scale** to **nanoscale**. All physical **and** mechanical properties of solids **vary** according to **their size**. Consequently, **knowledge of the specific heat capacity** is highly recommended, and the effect of body size on specific heat capacity **is gaining increased** attention [1, 2]. The specific heat, **in the treatment of specific heat** which is closely **related to** free energy. [3], the Debye temperature **is defined as;**

$\theta_D = \hbar\omega_D / k_B$ in the Debye model**,** **specific heat capacity** is a key parameter that thermal transport dynamic properties, when the solid size is reduce the, θ_D is no longer constant

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