

## Effects of lattice dispersion and elastic anisotropy on the thermal properties of fcc metals

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**Abstract.** New parameters which separately take into account the effects of elastic anisotropy and phonon dispersion on the lattice specific heat in the case of fcc metals have been evaluated. A new graded mesh method which uses 162-direction approximation in  $(1/16)$  part of the Brillouin zone has been developed to evaluate the two new parameters.

**Keywords.** Dispersion parameter; anisotropy parameter; Brillouin zone; specific heats.

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### 1. Introduction

A detailed discussion of the fundamental lattice dynamical models and their application to the study of the thermophysical properties of crystalline solids are available in literature (Joshi and Rajgopal 1968; Rao 1979; Wallace 1972; Maradudin *et al* 1963). In the lattice dynamical model of Debye (1912), the crystal medium is assumed to be dispersionless and that the crystal is elastically isotropic. The experimental neutron diffraction data (Bacon 1962; Dolling and Woods 1965) and other lattice dynamical models (Satya Prakash 1979; Reissland 1972; Brovman and Kagan 1974) show that both the assumptions made by Debye are not obeyed in real crystals.

The anomalous behaviour of  $\theta$ - $T$  curves gives a qualitative indication of the contribution of the combined effect of dispersion and anisotropy to the lattice specific heat of crystals. The effect of both elastic anisotropy and phonon dispersion have been investigated in the case of cubic crystals (Tolpadi 1979; Singh and Tolpadi 1983). Recently, instead of a  $\theta$ - $T$  plot a quantitative study has been made regarding the effect of dispersion and anisotropy on the specific heat of some bcc metals (Mohapatra and Tolpadi 1988; Mohapatra 1988).

In the present investigation a 162-direction approximation has been developed to determine quantitatively both the effects of lattice dispersion and anisotropy on the specific heat of some fcc metals. The dispersion and anisotropic parameters  $\alpha_d$  and  $\beta_a$  can be defined as (Mohapatra and Tolpadi 1988)

$$\begin{aligned}\alpha_d &= (C_{VM} - C_{VD})/C_{VM} \\ \beta_a &= (C_{VD} - C_{V\theta})/C_{VM}.\end{aligned}\tag{1}$$

Where,  $C_{VM}$  is the model specific heat which includes the effects of both phonon