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Correlation between electron mobility and static dielectric permittivity of n-InSb

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Numerical calculations of the static dielectric permittivity- dependent electron mobility due to different types of elastic scattering mechanisms for n-type InSb were carried out. The calculated static dielectric permittivity increases by increasing donor concentration. The temperature dependence of the electron mobility from 10 K up to 300 K has been demonstrated. Generally, the electron mobility shows peak behavior in this range of temperature. The direct correlation between the electron mobility and the static dielectric permittivity at 300 K was investigated. The dependence of the electron mobility on donor concentration was discussed when the static dielectric permittivity is assumed to be varying and when it is assumed to be a constant. The difference in behavior was noticed particularly at high donor concentrations.

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Structure and thermal properties of Si, Ge and Sn nanoparticles

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A formula to calculate lattice volume in nanoscale size crystals free of fitting parameters is derivedin the form;

$$\Delta d_{mean}(r) = \Delta d_{mean}(r_c)\left[exp\left\{\frac{-2(S_m(\infty)-R)}{3R\left(\frac{r}{r_c}-1\right)}\right\}\right]^{\frac{1}{2}} \quad \text{---------- (1)}$$

$\Delta d_{mean}(r_c)$ is the maximum increase in the mean bond length, for $r \to 3h$ where h is the surface first layer height of atoms and is calculated according to the fitting relation, $h = 1.429 d_{mean}(\infty) h = 1.429 d_{mean}(\infty)$. For Sn values of h and melting entropy $S_m(\infty)$ $S_m(\infty)$ are 0.402 nm 11.702 (Jg-atom^{-1}K^{-1}) respectively and RR is gas constant. Size dependent mean bond length can be calculated using the relation $d_{mean}(r) = h - \Delta d_{mean}(r)$. Knowing $d_{mean}(r)$, the size dependent lattice parameter a(r) can be calculated according to the relation $d_{mean}(r) = \frac{a(r)}{4}\sqrt{3}$ and then the lattice volume V(r), r is the nanoparticles radius. The bulk state for this relation as $(r \to \infty)(r \to \infty)$ give values of $d_{mean}(\infty)$ for Si, Ge, and Sn interested in this work. From the values of V(r), calculated according to Eq. 1, the nanoscale size dependence of melting temperature $T_m(r) T_m(r)$ for Sn as an example will be calculated and compared to that of the reported experimental data.

$$\frac{T_m(r)}{T(\infty)} = \left(\frac{V(r)}{V(\infty)}\right)^{\frac{2}{3}} \exp\left(-\frac{2(S_m(\infty)-R)}{r}\right) \quad \text{---------- (2)}$$

$T(\infty)T(\infty)$ and $V(\infty)V(\infty)$ are bulk melting point and lattice volume, for Sn their values are 505 K and 34 $A^{\circ 3}A^{\circ 3}$ respectively. Size dependent values are also calculated for Si and Ge, for Si they are fitted well with that of reported experimental data. From the size dependent melting temperature $T(r)\,T(r)$ and mean bond length $d_{mean}(r) d_{mean}(r)$, the size dependent lattice thermal expansion LTE $\alpha(r)\,\alpha(r)$ for Sn, Si and Ge are calculated according to the following modified relation.

Biography

M S Omar is a Professor of solid state physics in the University of Salahaddin-Erbil, Iraqi Kurdistan in Iraq. His PhD is from University of Bath, England, 1985 with a thesis title "Crystal Growth and Characterization of I-IV$_2$-V$_3$ Semiconductor Compounds and alloys based thereon". Since then, he is leading a group working on structure and physical properties of semiconductors. He supervised 20 MSc and 7 PhD student's research projects. In the last twelve years, he is involved in working on structure and thermal properties of nano-scaled crystals, particularly group IV, III-V binary group and GaN nanowires. His present work is on structure parameters and melting temperature of low scaled nanocrystals of solids. He and with his group, published more than 50 scientific articles in national and international journals.

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