Electron Mobility in Cadmium Sulfide

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Usually the charge carrier scattering models in cadmium sulfide are considered in the relaxation time approximation. However, these models have essential shortcoming: a) they contradict the special relativity according to which the charge carrier would interact only with the neighboring crystal region; b) they contradict the atomistic hypothesis according to which the charge carrier interacts (and transfers the energy respectively) only with one atom but not simultaneously with many atoms which are situated in different points of space. From the other hand in [1-3] the short- range models of carrier scattering were proposed for $A^{II}B^{VI}$ and $A^{III}B^{V}$ semiconductors (zinc blende and wurtzite structure) in which the above mentioned shortcomings were absent. The purpose of the present paper is to use of short-range models to describe the electron scattering on the various crystal lattice defects taking into account the complex structure of optical vibrations in wurtzite CdS.

The CdS samples with defect concentration $1.68\times10^{16} \div 8.7\times10^{17}$ cm^{-3} were investigated. For the charge carrier scattering on the nonpolar optical and acoustic phonons, neutral defects and static strain potential the interaction radius of the short-range potential is limited by one unit cell. For the charge carrier scattering on the ionized impurity, polar optical and piezoelectric (piezoacoustic and piezooptic) phonons the interaction radius of the short-range potential is founded in a form $R = \gamma\sqrt{3a_0^2 + c_0^2}/2$ (a_0, c_0 - lattice constants, γ – the respective adjustable parameters). To calculate the conductivity tensor components the method of the exact solution of the stationary Boltzmann equation was used [4].

The temperature dependence of the electron mobility in the range $30 \div 300$ K in wurtzite cadmium sulfide is calculated. The influence of the different scattering mechanisms on the charge carrier mobility is considered. The scattering parameters γ for different scattering modes are determined. The temperature dependence of the electron Hall factor is calculated.

1. O.P. Malyk. Physica B:Condensed Matter. 2009. **404**. 5022-5024.
2. O.P. Malyk. Diamond Relat. Mater. 2012. **23**. 23-27.
3. O.P. Malyk. Can. J. Phys. 2014. **92**. 1372-1379.
4. O.P. Malyk. WSEAS Trans. Math. 2004. **3**. 354- 357.