Hall Mobility in Lead Selenide and its Analysis in MathCad Computer Environment

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Abstract - **This thesis demonstrates that current carriers in an experimental crystal diffuse on the thermal vibrations of lattice by means of regression analysis of experimental data for Hall mobility of PbSe crystals**.

Keywords - **Hall mobility, line of regression, statistical characteristics, the thermal vibrations of lattice.**

I. INTRODUCTION

Hall mobility Ucs of PbSe semiconductor crystals, which are widely used in solid electronic engineering, represent an important kinetic property which often determines practical importance of these crystals in solid electronics manufacturing.

II. ELEMENTS OF THE THEORY

In this thesis Hall mobility and its dependence on the crystal temperature T was experimentally measured in three crystal samples alloyed with donor N_d and acceptor N_a dopants in concentration of $N_d, N_a \approx 10^{18} cm^{-3}$ within the temperature range between 100 and 400 K.

As a result of regression analysis in MathCad computer environment we obtained experimental values of Hall mobility logarithm dependence on temperature logarithm set down in vector form in ordered file and are given in Table 1.

Table 1

$\ln Ucs^{\langle 0 \rangle} := \ln(T)$ $\quad \ln Ucs^{\langle 1 \rangle} := \frac{(\ln Uc1 + \ln Uc2 + \ln Uc3)}{3}$

$\ln Ucs^{T} =$

	0	1	2	3	4	5
0	4.605	4.787	4.942	5.075	5.193	5.298
1	9.201	8.895	8.569	8.312	8.059	7.808

Dependence of Hall mobility experimental values logarithm on temperature is demonstrated in Figure 1.

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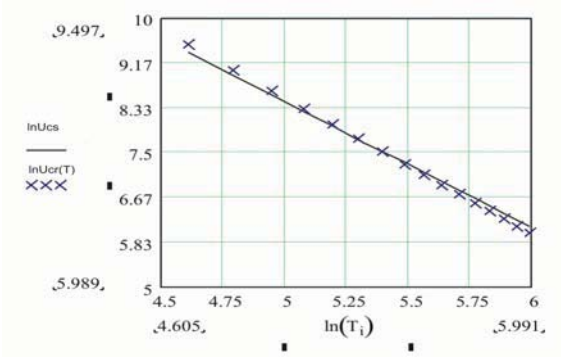

Fig.1

Regression analysis of this Figure in MathCad computer environment shows that experimental data can be described to a high precision with the following line of regression:

$$\ln Ucs(T) = a + b * \ln(T), \text{ Where}$$

$$a = \text{int}ercept(\ln Ucs^{(0)}, \ln Ucs^{(1)}),$$

$$b = slope(\ln Ucs^{(0)}, \ln Ucs^{(1)}).$$

Statistical characteristics of these calculations have the following values:

$$corr(\ln Ucs^{(1)}, \ln Ucs^{(2)}) = 0.997,$$

$$mean(\ln Ucs^{(1)}) = 7.401, \quad mean(\ln Ucs^{(2)}) = 7.401.$$

III. Conclusions

The results prove the high confidence of the developed calculations. Thus, it is proved that Hall mobility in PbSe crystals is described by the following analytic formula:

$$Ucs(T) = \exp(a) \cdot T^{b}, \text{where } a = 20.152, \quad b = -2.343.$$

Such dependence of Hall mobility on the temperature indicates that in the crystals studied in this thesis, current carriers diffuse on the thermal vibrations of lattice, and there is almost no diffusion of ionized impurities according to the kinetic theory of crystals properties.

REFERENCES

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