

THERMOSTIMULATED CONDUCTIVITY IN ZnGa_2Se_4

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Thermostimulated conductivity and trap levels were investigated in ZnGa_2Se_4 monocrystals. It was shown that the quick recombination mechanism is realized in ZnGa_2Se_4 monocrystals.

Tetragonal compounds with the common chemical $\text{A}^2\text{B}_2\text{C}_4$ formula attract an attention owing to their perspective for use in semiconductor devices. These compounds are characterized by the high photosensitivity, dazzling luminescence, weak dependence of their properties on external factors, high stability of time characteristics. Moreover, complex chemical composition, presence of two types atoms in cation sublattice form a rich spectrum of the local centers in the gap band. However, their nature and energy spectra in fact have not been investigated. That is why, complex investigation of their physical properties is actual.

It is known that the method of thermostimulated conductivity (TC) is widely used for definition of the recombination mechanism, spectrum of local states and parameters of traps in wide-band semiconductors. In spite of some works [1-4] dedicated to investigation of optical spectra of ZnGa_2Se_4 , spectra of local states in practice have not been investigated. There is only one work [5] which presents results of TC in ZnGa_2Se_4 . Authors of the work [5] observed the TC maximum at 120K with the broadened edge in the high temperature range and supposed that trap centers are distributed quasicontinuously.

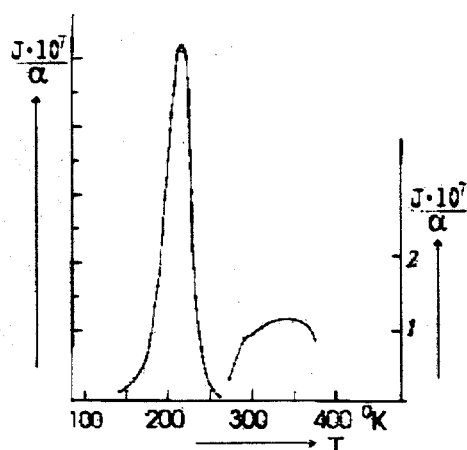


Fig. 1. Spectrum of the thermostimulated conductivity in ZnGa_2Se_4 .

In this paper the results of TC investigation in ZnGa_2Se_4 are presented with the purpose of determination of the spectrum of local states and the recombination mechanism.

For realization of TC measurements the monocrystalline samples of ZnGa_2Se_4 were obtained by the gas transport reactions method. The crystal of iodine was used as a transporter. Lattice parameters $a=5.496\text{Å}$, $c=10.99\text{Å}$, $c/a=2$ were determined by the X-ray method.

In the fig.1 the TC spectrum of ZnGa_2Se_4 is represented. In TC spectrum the maximum at 219K and wide line in the interval 240÷400K with the maximum at 346K is observed.

In common case for clearing up of the recombination mechanism relationships $\delta'=T_2/T_1$ and $\delta''=T_2/T_M$ are used, where T_M is the temperature at the maximum of TC, T_1 and T_2 are temperatures where the conductivity reaches half of its value on growing and falling down wings of the TC maximum [6]. In the case, when the condition $\delta>\delta''$ is fulfilled, the quick mechanism of recombination is realized, if $\delta'<\delta''$ then the slow mechanism is realized and in case $\delta'=\delta''$ the mixed mechanism of recombination is fulfilled. In the case of the quick mechanism of recombination, when the quasiequilibrium exists between trap levels and conduction band, the condition is performed

$$\delta \geq e^{-1}(1+2kTm/E_1) \quad (1)$$

where $\delta=(T_2-T_M)/(T_2-T_1)$, E_1 is the depth of the trap levels. Analysis of the TC maximum at 219K showed that conditions $\delta'>\delta''$ are performed, that is the quick mechanism of recombination exists in ZnGa_2Se_4 . Therefore by use of the formula (1) we estimated the depth of trap levels as 0.24 eV.

Presence of the wide TC maximum in the range 240÷400 K with the maximum of 346 K testifies that the gap band in ZnGa_2Se_4 has a few near disposed trap levels in this range of temperature.

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ZnGa₂Se₄ MONOKRİSTALLARINDA TERMOSTİMULƏ KEÇİRİCİLİYİ

ZnGa₂Se₄ monokristallarında termostimulə keçiriciliyi (TSK) tədqiq olunmuşdur və tələ səviyyələri təyin edilmişdir. Göstərilmişdir ki, ZnGa₂Se₄ monokristallarında sürətli rekombinasiya mexanizmi realizə edilir.

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ТЕРМОСТИМУЛИРОВАННАЯ ПРОВОДИМОСТЬ В ZnGa₂Se₄

Исследованы спектры термостимулированной проводимости монокристаллов ZnGa₂Se₄. Определены глубина залегания ловушечных уровней. Показано, что в ZnGa₂Se₄ реализуется быстрый механизм рекомбинации.

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