PHOTOPLEOCHROISM OF IRRADIATED GASE CRYSTALS

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The layered crystallic structure and different mechanisms of current transition in two interperpendicular crystallographic direction evoked anisotropy of photosensitivity GaSe and InSe monocrystals.

These crystals are characterized by many optic transitions in the near of fundamental absorption, which intensity strongly depended from mutual displacement of crystals optic axises «C» and electrical vector of exciting light E.

Coefficient of photopleochroism characterizing of order anisotropy of photoactive optic transition [1], is determined from value of photosignal (i_\perp and i_\parallel) at two orthogonal polarization of falling light E_\perp C and E_\parallel C by formula:

\[ P = \frac{i_\parallel - i_\perp}{i_\parallel + i_\perp} \times 100 \% \]  (1)

Where C is optic axis of GaSe monocrystals, which is perpindicular to surface layer. Investigations showed [2], that in non dopped GaSe and InSe crystals anisotropy of photoconductivity is related its specific zone structure and spectral contour P is determined by selection rule for optic transition in critical point of Brulluen zone[3].

Observed divergence of experimental value of dichroism, photopleochroism and system anisotropy of recombination radiation in near of exiton transition in GaSe and InSe is related with influence of non controlling cells defects, carrying out center of recombination[4]. It was detected [4], that growth and stabilisation of coefficient photopleochroism in GaSe, may be reach, with leading determined number dopped no izovalent atoms. Cause of «improvement» packing of plaing role center of recombination is related treatment defect of levels. At present work are presented experimental results of investigations of influence electron radiation ability to creat cell defects in layered semiconductors to spectral cortur of coefficient of photopleochroism.

Samples for investigation was been growthed by Bridgman method and have natural skol is perpendicullar to surface layer, that allowed to carry out polarization investigation and realized CaSe E_\perp C and E_\parallel C.

In fig. 1 is presented typical spectral distribution of photocurrent for one of the samples GaSe at room temperature, when E falling irradiation is parallel (curve 1) and is perpendicular (curve 2).
to "C" axis. As see photocurrent at polarization E||C for all frequencies exciting photons is more, than at E⊥C.

Spectral contour of photocurrent for different samples is the same at photon energies $h\nu > eV$, when photocurrent is related with interzone photoactive absorption of light.

Structure of lower energetical part, where occurs photoactive absorption in admixtures, although significant polarisation photo current is kepted, only value of photocurrent enoughly is sensitive to technological preparation and working of samples[3].

Spectr of coefficient photopleochroism calculated from[1] is presented in fig1 and as see, corresponded with spectr of fotoconductivity. Numerical value of $P_i$ is more in the region of exitons absorption and changed in wide interval (0,2-0,6) of differend crystals GaSe. Form of fotocurrent by indicatrix presenting the dependence of photocurrent from angle $\varphi$ between vectors E and C is presented in fig.2 at exciting of sample by photons energy 2.0 eV. As see from fig.2, photocurrent in GaSe is depended from angele between E and C by periodical law and angular dependence $i_\varphi$ may be is described by expression

$$i_\varphi = i_{II} \cos^2 \varphi + i_{I} \sin^2 \varphi \quad (2)$$

Presented azimutal dependence of photocurrent corresponded Malu's law, that established correleted anizotropy of crystallic cell and photocurrent.

Exciting of samples by electron beam created cell defect and to lead to any change photoelectrical characteristic in the dependence of doze. Observed growt photosensivity in both ortogonal light polarisation at irradiation in the during 3-5min, by electron with 4-5Mev power, that is agreement with results [5].

Simultaneously increasing of $i_\perp$ and $i_\parallel$ lead to decreasing of $P_i$ (fig.3, curve2). Azimutal dependence for this case is presented in fig.2 (curve 2) and as see significant no changed and expressed by formula (2).

At long time irradiation in the during 1-2h, photosensivity in decreased and is become lower, than non irradiation crystals.

Form of indicatrix of photocurrent is presented in fig.2 (curve 3) and as see it kepted form and azimutatal dependence photocurrent may be described by expression(2). Decreasing of photocurrent in both ortogonal polarisation light at long time irradiation accompanied stabization and growth of photopleochroism coefficient.

From spectral distribution photopleochroism presented fig.3 (curve 3) followed, that irradiation to lead to increasing of value $P_i$ but form of spectr is no changed.

Thus, doze dependence $P_i$ for GaSe is non monotoneous character. For description of doze dependence of photopleochroism of GaSe is necessary to accept electron irradiation lead to
formation of cell defect in cation position into layer. Concentration of this radiation defect is
determined by irradiation dose.

At small dose concentration of radiation, defect is in significant, distance between them is much,
that they “do not feel” each other.

In result defects created by irradiation increased of concentration of center photosensitivity
independent polarisation light fotocurrent increased and P_i, is decreased.

At much doze of irradiation, concentration of formatted defects is became more threshold and
defects formatted infinite clusters, interacted with each other.

This lead to increasing of weak van-der-Vaals bond inter layer. Increasing of inter layer
interaction treated non controlled structural defects, presented in non irradiated crystals.

It is necessary to note, that stabilisation and increasing of coefficient of photopleochroism in
dopped monocrystals GaSe consequently formation of infinite clusters dopped admistures at
theeshold concentration N=10^{18} \text{ sm}^{-3} [6]

Thus, irradiated GaSe crystals at determined doze occurs increasing of interaction between
layers in the account displacement of radiation defect inter layer. May be assumed, that defects
metalls atoms formated «small bridge» between layers, that and these slide stopped of
monolayer having real non irradiated crystals A^{III}B^{VI}.

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Fig. 1 Spectra of photoconductivity (1,2) and photopleochroism (3) GaSe at 77K. 1) E\text{II C} 2) E\text{ LC}

Fig. 2 Azimuthal dependence of photocurrent non irradiation (1) irradiation (2) the during 3min. (2), 90min.(2) GaSe samples.

Fig. 3 Spectra of photopleochroism the same samples in Fig. 2