

ANOMALOUS REFRACTION OF LIGHT IN GaSe LAYERED CRYSTALS

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For the first time, in GaSe layered crystals obtained by the Bridgman method for want of falling of radiation by the He-Ne laser is perpendicular to a surface of samples, a light refraction anomaly has been observed. The anomaly appears in splitting (without scattering) of radiation which past through crystal on two rays under angles of 13° and 70° to a direction of an incident radiation. This effect appears on samples prepared only from a certain parts of the ingots grown up on reproduced technology.

The supposition is expressed that this effect is connected with disorientation of a group of layers with respect to normal ones in a defined part of a ingot during growth because of availability of a temperature gradient in the temperature profile of the metallurgical furnace.

For the first time, in GaSe layered crystals, a light refraction anomaly has been observed experimentally. As can see from Fig. when a He-Ne laser light is incident perpendicularly to the surface of the samples, contrary to passing always along the incoming direction, it splits (without scattering) into two rays making angles of 13° (θ) and 70° (γ) with the incident direction, respectively. Intensity of the second ray (refracted under 70°) is rather lower than for the first one. The behavior of the outgoing rays is similar to that of the refracted rays from a prism made of GaSe with refraction angle 7° and refractive index is equal to 2.8. Experiment shows that the linear dispersion of the samples is of the order 47 nm/mm.

The investigated GaSe crystals were grown by the Bridgman method. Samples were obtained by cleaving the ingots along the plane of the layers into slices of 1 cm^2 areas and few micrometer thick. This anomaly appears only in certain parts of the ingot, whereas the other parts exhibit the usual properties of the GaSe crystal.

To become sure about the reproducibility of this anomalous effect, the synthesis and growth process of the ingots were repeated again under the same experimental conditions to produce new samples, where some of them exhibited the same anomaly. This shows that, it is quite possible to obtain some samples possessing the above-mentioned features.

To find out whether the investigated samples are merely GaSe, their structure and also some of their physical properties such as absorption, photoconductivity and etc. were studied by both the X-ray and Nd:YAG and Rhodamine 6G dye lasers. X-ray structure analysis shows that these samples possess hexagonal structure with the lattice constants $a = 3.73 \text{ \AA}$ and $c = 15.88 \text{ \AA}$ which belong to ϵ -type GaSe [1]. Study of the physical properties of these samples shows that, their characteristics are practically similar to those of the usual GaSe crystal [2-4].

To our opinion, the reason for the existence of this anomalous effect in some of the GaSe samples can be due to disorientation of a group of layers width respect to normal ones (the thickness of each layer $\sim 0.8 \text{ nm}$ [5]) during the growth process which can in turn be due to the existence of a particular temperature gradient in the growth furnace giving the possibility to reproduce this anomaly. To elucidate the exact mechanism responsible for this anomaly needs further investigation, which is being carried out at the moment.

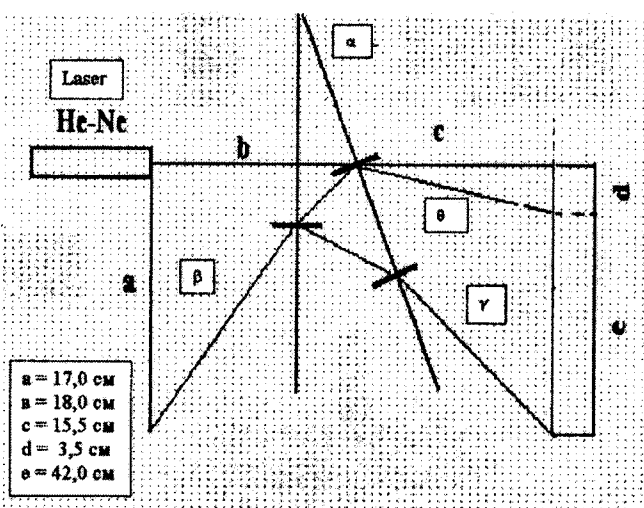


Fig. The optical scheme of experiment of the anomaly refraction of light in GaSe layered crystal.

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GaSe LAYLI KRİSTALLARDA ŞÜANIN ANOMAL SINMASI

İlk dəfə olaraq Bricmen üsulu ilə alınmış laylı GaSe kristallarda, He-Ne lazerindən nümunənin səthinə perpendikulyar istiqamətdə şüa düşdükdə anomal sınma aşkar edilmişdir. Anomallıq kristaldan keçən şüanın düşən şüa ilə 13° və 70° bucaq əmələ gətirən iki şüaya bölünməsində özünü göstərir. Müşahidə olunan effekt, ancaq təkrar olunan texnologiya ilə alınmış kristalların mərkəzi hissəsindən hazırlanmış nümunələrdə müşahidə olunur.

Fərz olunur ki, bu effekt kristal közərdilən sobada profil boyunca temperatur qradienti hesabına müəyyən hissədə layları bir hissəsinin standart laylara nəzərən fərqli istiqamətlənməsi hesabına baş verir.

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АНОМАЛЬНОЕ ПРЕЛОМЛЕНИЕ СВЕТА В GaSe СЛОИСТЫХ КРИСТАЛЛАХ

Впервые в GaSe слоистых кристаллах, полученных методом Бриджмена, при падении излучения от He-Ne лазера перпендикулярно к поверхности образца обнаружено аномальное преломление света. Аномалия проявляется в расщеплении (без рассеивания), прошедшего через кристалл излучения, на два луча под углом 13° и 70° к направлению падающего излучения. Наблюдаемый эффект проявляется на образцах, приготовленных только из центральной части слитков, выращиваемых по воспроизводимой технологии.

Высказано предположение, что этот эффект связан с дезориентацией группы слоев, относительно обычной, в определенной части слитка в процессе роста кристалла из-за наличия температурного градиента в температурном профиле металлургической печи.