$$\nu_k[\text{GHz}] = 7.1[\text{GHz/kOe}](\alpha k)[\text{kOe}]. \quad (4)$$

The linear character of the $\nu_k(\alpha k)$ dependence for the peak in the field H_2 allows us to assume that an intersection of the spin-wave and the phonon spectra takes place at the point H_2. Owing to the magnetoelastic interaction existing in the antiferromagnet, magnetoelastic waves are produced in the vicinity of this point; the threshold for these waves is somewhat higher than for the spin waves [7]. An analogous phenomenon was observed in $CsMnF_3$ by Seavey [2]. The correctness of this assumption can be verified by calculating the velocity of sound from the data of our experiment. An examination of the Hamiltonian of the magnetoelastic interaction and the absence of a dependence of the field H_2 on the direction of H in the basal plane, which was established by us, give grounds for assuming that the observed peak is due to the interaction between spin and transverse sound waves propagating along the z axis. According to data obtained by Holden (private communication) on inelastic scattering of neutrons in $MnCO_3$, $\alpha_z = 5.31 \times 10^{-5}$ kOe-cm. Using this value and the result of our experiments, we calculated the velocity of the transverse acoustic oscillations propagating along z, $C_{tz} = 3.8 \times 10^5$ cm/sec. This is 10% larger than C_{tz} for $CaCO_3$, which should have acoustic properties close to those of $MnCO_3$ (there are no published data on the velocity of sound in $MnCO_3$).

It can thus be assumed that the increase of the threshold field (damping) in the field H_2 is due to magnon-phonon interaction.

The nonlinear dependence of the frequency on the wave vector for the second peak (in the field H_1) indicates that this peak is not connected with the acoustic phonons. We cannot explain its origin at present.

The authors are sincerely grateful to P.L. Kapitza for interest in the work, to A.S. Borovik-Romanov for a discussion of the results, and to V.R. Gakel' and N.Yu. Ikornikova for supplying the $MnCO_3$ single crystals. The authors are indebted also to T.M. Holden for communicating the results of his neutron-diffraction research prior to publication.

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FREQUENCY DEPENDENCE OF THE THRESHOLD OF OPTICAL BREAKDOWN IN AIR IN THE ULTRAVIOLET BAND

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ZhETF Pis. Red. 13, No. 8, 433 - 436 (20 April 1971)

Optical breakdown of a gas in the focus of an intense light wave has by now been thoroughly investigated in the infrared and visible bands, at wavelengths 1.06, 0.69, and 0.53 μ. It is known that the breakdown phenomenon is connected both with cascade multiplication of free electrons and with multiphoton processes. It should be noted that the effect of multiphoton processes on the breakdown phenomenon is not completely clear at present. It is therefore of considerable interest to obtain experimental data on optical breakdown in the ultraviolet band, at wavelengths 0.35 and 0.265 μ.

In view of the small frequency difference between ruby and neodymium lasers, and also in view of the appearance of different systematic errors due to different beam divergences, different focusing conditions, etc., it was proposed in [1] to measure the frequency dependence of the threshold field intensity at harmonics of the fundamental radiation.

Using the method of cascade frequency conversion proposed in [2], we can obtain radiation of different wavelengths with sufficiently well controlled beam geometry and pulse-duration ratios.

We used an effectively stabilized system for conversion into the ultraviolet band [3]. We performed relative measurements of the threshold power densities in the ultraviolet band and repeated the measurements performed in [1].

In all the wavelength bands, the breakdown was observed with a quartz planoconvex lens L_1 of focal length 75 mm. The divergence was measured with a long-focus lens L_2 with f = 2.0 m.

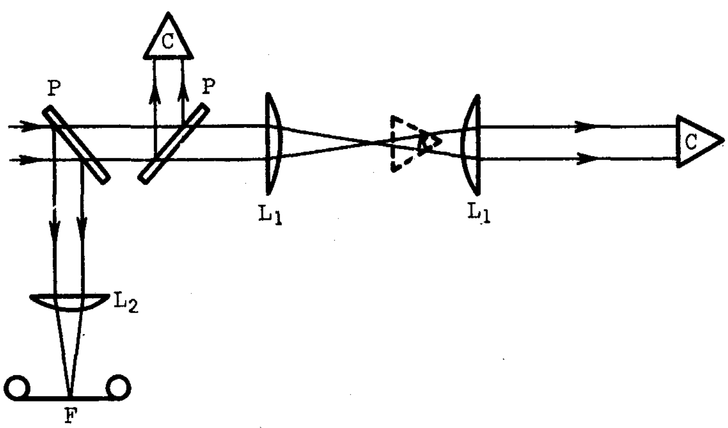
The scheme for measuring the threshold energies is shown in the figure. The threshold energy of the radiation was measured both with the aid of a "coupled" calorimeter and directly with a calorimeter with allowance for losses in the lens, as well as by the procedure of [1].

The use of a lens with a relatively long focus has made it possible to determine the threshold energy accurate to 13% on the basis of the appearance of a small brief spark.

It is known that the squares of the threshold field intensities E_1^t and E_n^t are related as follows

$$[E_1^t/E_n^t]^2 = W_1^t s_n \tau_n / W_n^t s_1 \tau_1 = F_1/F_n;$$

$W_{1,n}^t$ are the threshold energies measured by the calorimeter, $s_{1,n}$ are the areas of the focal spots at the fundamental frequency and at the corresponding



Scheme for measuring the threshold energy density: C - calorimeters, P - quartz beam-splitting plates, L_1, L_2 - quarts lenses with f = 75 and 2000 mm, F - photographic film.

harmonic, $\tau_{1,n}$ is the pulse duration, and $F_{1,n}$ is the threshold power density.

The ratio of the harmonic pulse durations in the case of frequency multiplication was $\sqrt{2}$, and the ratio s_n/s_1 of the corresponding harmonics was 0.7. The diameter of the focal spot was determined from the known formula $d = \alpha f$.

Power density ratio of harmonics	F_1 / F_2	F_1 / F_3	F_1 / F_4
Value of ratio	0.65	1.0	1.7
Error	15 – 20%	20 – 25%	

The table lists the frequency dependences of the relative measurements of the threshold power densities relative to the fundamental harmonic. The absolute measurement of the threshold power density, performed at a wavelength 1.06 μ, agrees within the limits of errors with the value obtained in [1]. Notice should be taken of the good agreement between the ratio of the breakdown threshold power densities for the fundamental and second harmonic with the relative value given in [1].

The data obtained on the frequency dependence of the threshold background agree sufficiently well with the frequency dependence given in [4]. According to our results, the threshold values have a stronger dependence on the frequency. This can be apparently attributed to allowance for the change in the divergence of the harmonics following the cascade conversion, in contrast with [4] where the same value of the divergence was used for all wavelengths. Since [4] does not contain data on the lengths of the crystals and on the coherent interaction lengths, it is impossible to carry out a more detailed comparison of the results.

According to existing notions concerning the development of optical breakdown in gas, the threshold radiation intensity should increase monotonically in proportion to the square of the frequency [5 - 7]. Our experimental results, as well as those of [4], obtained for air at atmospheric pressure, show that this dependence is not monotonic. The threshold intensity decreases noticeably at u traviolet wavelengths.

Assuming that the optical-breakdown process includes an initial stage, namely the appearance of electrons and ions, followed by a "collision" stage, we can, without performing the appropriate calculations, make the following statements concerning the frequency dependence of the threshold breakdown in air:

As shown by estimates, for average experimental fields, the appearance of the initial electrons needed for cascade development can be attributed to multiphoton ionization of the gas molecules. The probability of such a process for molecules (such as H_2, O_2, N_2, CO_2, CO, etc.) increases with decreasing wavelength, at the same field intensity, owing to the decrease in the number of simultaneously absorbed quanta, and has a resonant character. It can alternately be assumed that the required field intensity is decreased while the probability remains constant.

Radiation with $\lambda = 0.265$ μ is unique in the sense that at this frequency there should appear the most probable single-quantum processes of excitation of a discrete electronic spectrum of the molecule, which in turn increases strongly the ionization probability (or decreases the field intensity at which the "priming" electrons appear), i.e., the number of "priming" electrons increases greatly.

For the "collision" stage of breakdown development, we can propose an appreciable influence of the photoionization of the atoms and molecules excited by electron impact, namely, the larger the radiation frequency, the more substantial its influence [8].

Further experimental and theoretical research is necessary to explain the nonmonotonic frequency dependence of the threshold breakdown in gases.

It can be assumed that to obtain more exact relative and absolute data on the frequency dependence of the threshold breakdown in gases it is necessary to perform experiments with single-spatial-mode radiation, so as to avoid the influence of the irregularity of the radiation structure of a multimode laser.

In conclusion, the authors are grateful to A.I. Kovrigin for useful discussions.

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PLASTICITY OF REACTOR-IRRADIATED LiF CRYSTALS

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Submitted 19 March 1971
ZhETF Pis. Red. 13, No. 8, 436 - 439 (20 April 1971)

We examined the possibility of simultaneously improving the strength and plastic characteristics of LiF crystals by the joint action of irradiation, mechanical loading, and cooling.

We investigated the stress-strain diagram of LiF crystals exposed to radiation and mechanical action. The samples, cleaved from one single-crystal ingot, were in the form of parallelepipeds measuring 28 × 3 × 3 mm. The samples were annealed for 8 hours at 650°C and then cooled at a rate of 0.5 deg/min (the dislocation density after annealing was 2×10^{5} cm^{-2}).

The crystals were irradiated in a reactor with a dose 5×10^{14} neutron/cm^2 (in terms of thermal neutrons). The irradiation was effected at the reactor temperature and at 120°K. When irradiated in the reactor, some of the crystals were subjected to transverse compression [1] (stress 250 g/mm^2 in the plastic deformation region). The compression was by means of a spring, the elastic properties of which remained unchanged under irradiation in the employed dose interval. The mechanical load remained applied for two months (the time of decrease of activity).

The stress-strain diagram was registered with a DRP two-coordinate potentiometer.