It must be noted in this connection that the described relations between ΔR and ΔX are not valid for phenomena where, unlike the size effects, the quantization of the energy levels of the electron in the magnetic field is essential. Indeed, in the case of another frequency-independent effect, namely quantum oscillations of the surface impedance, the nonmonotonic variation of $\Delta R(H)$ and $\Delta X(H)$ are proportional. This follows from the theoretical analysis [7] and was verified by us experimentally. Oscillations of the impedance of indium single crystals, periodic in the reciprocal field, were observed at H = 8 - 10 kOe, and the oscillograms of R and X had no noticeable phase shift.

There are no theoretical calculations as yet for the size-effect line shape, since these calculations entail noticeable difficulties. It is possible, however, that the observed connection between ΔR and ΔX in the size effect can be explained by starting directly from the properties of the equations for current distribution in metal, without calculating the line shapes for different concrete cases.

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GENERATION IN GaAs UNDER TWO-PHOTON OPTICAL EXCITATION OF NEODYMIUM-GLASS LASER EMISSION

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To produce a population inversion in a medium using a three-level scheme, the pump photon energy should be larger than the energy difference between the working levels. Operating in an analogous scheme is a semiconductor laser with optical pumping [1], in which the energy of the exciting photon exceeds the energy width of the forbidden band.

We have succeeded in exciting with GaAs emission a neodymium-glass laser (with modulated Q) when the energy of the pump photon, equal to 1.17 eV ($\lambda = 1.06\mu$), was considerably smaller than the energy width of the forbidden band in GaAs, which amounts to 1.51 eV ($\lambda = 8200$ Å) at T = 77°K. In other words, the energy of one exciting photon was not enough to transfer the electron from the valence band of GaAs to the conduction band. However, at large light-flux densities incident on the sample, excitation is possible as a result of nonlinear optical

effects, for example two-photon absorption, and also as a result of the absorption of a harmonic of the pump light which is generated in the semiconductor.

The source of optical pumping was a neodymium-glass Q-switched laser with power up to 7 MW (light-pulse energy 0.5 J of duration 70 nsec). The n-type GaAs crystal measuring 5 x x 5 x 10 mm with impurity concentration 1.7 x 10^{17} cm^{-3} and mobility 4400 cm^2/V-sec was secured on a massive cold finger 6, which was placed in liquid nitrogen (Fig. 1). On one of the faces of sample 4, the radiation from the pump 1 was focused by means of a cylindrical lens 2. Two other faces of the sample, perpendicular to the indicated face, were finished with high precision to form a plane-parallel cavity. The radiation from one of the faces (5) was fed to spectrograph ISP-51 (7), where it was photographed, and the radiation of the other face struck screen 3, and was also photographed.

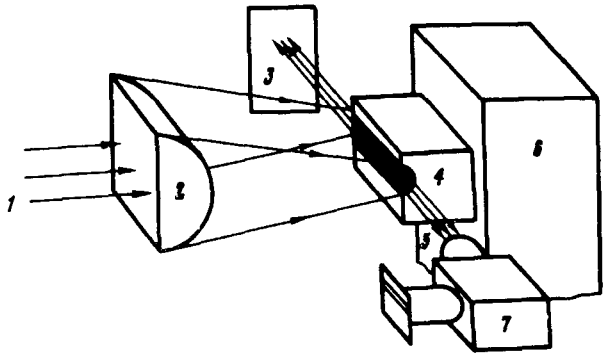

Fig. 1. Block diagram of setup

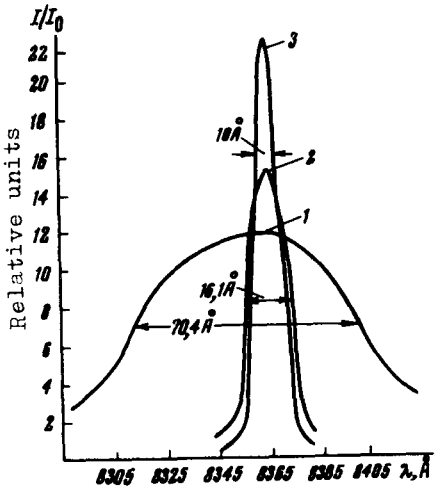

Fig. 2. Spectral emission lines of GaAs for different values of the pump power p. The ordinate scales for the different curves are not the same: the maximum of curve 3 is many times larger than that of curve 1.

Figure 2 (curve 1) shows the spectral emission line of the GaAs crystal at an excitation power density of approximately 6 MW/cm^2. At such a pumping energy, the width of the emission line was 70 Å. With increasing excitation power density to 8 MW/cm^2, the spectral line decreased to 16 Å (curve 2), and its spectral intensity increased abruptly. At a pump flux density 16 MW/cm^2, generation at a wavelength λ = 8365 Å was observed. The width of the spectral generation line was 10 Å (curve 3). The radiation directivity pattern, determined from

the ratio of the spot diameter on the screen to the distance from the screen to the sample, was approximately 4°. Processing of the photographs of the radiating face of the sample has shown that the generation was produced by a layer of thickness up to 1 mm. Thus, just as in the case of excitation of GaAs by the Stokes component of Raman scattering of light of a ruby laser in liquid nitrogen [1], a relatively large volume of the semiconductor participates in the generation. The generation efficiency, determined from the ratio of the GaAs emission energy to the energy of the pump optical pulse was approximately 0.1%.

Work is now in progress on the clarification of the physical picture of the excitation of GaAs. Attempts to observe a second harmonic of the pump frequency under the conditions described in [2] have not yet led to positive results.

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SELECTIVE EXCITATION OF RARE-EARTH ION CENTERS IN CRYSTALS

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Most solid lasers use presently as the active medium crystals doped with rare-earth ions (TR). As is well known, several types of optical centers, differing in structure, can exist simultaneously in these crystals. The relative concentrations of these centers depend on the over-all TR concentration and on several technological conditions. Each type of center has in this crystal specific properties and manifests itself separately in the lasing action. Therefore, in order to synthesize crystals with desirable types of TR centers, it is necessary to have a method for analyzing these centers. Such well-known methods as electron paramagnetic resonance, the Zeeman effect, and piezospectroscopic analysis make it possible to establish in many cases the symmetry of the crystalline field and yield some information on the energy level scheme of the given ion. In our papers delivered at the Symposium on Spectroscopy of Crystals Containing TR and Elements of the Iron Group (Moscow State University, 3 - 6 February 1965), we developed and employed a method for analyzing TR^{3+} centers in CaF_2 crystals (type I) from the concentration dependences of the optical spectra - the method of concentration series. This method makes it possible to separate from the total absorption spectrum the spectra belonging to different types of centers. However, this method does not make it possible to carry out an exhaustive analysis of the luminescence spectra.

In this communication we describe a method for the analysis of the Stark structure of luminescence spectra of crystals with TR ion impurity by selective excitation of the luminescence of the individual types of the centers. To carry out such an analysis, the excitation