netic field on the creation or (and) annihilation of the photocurrent carriers. It is known that light causes production of excitons in molecular crystals. Thermal ionization and recombination of the excitons produces the current carriers. A very probable cause of the increase in photocurrent in the magnetic field is the influence of this field on the lifetime of the excitons prior to their vanishing without formation of carriers ("annihilation").

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## EFFECT OF A FOCUSED RUBY-LASER BEAM ON THE RUBY

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Investigations of the interaction between light from a powerful laser and a substance that exhibits resonant absorption at the lasing frequency is of interest because multi-stage and multi-quantum transitions are facilitated in such a system. We have investigated the effect of a focused ruby-laser beam on a ruby. The ruby crystal was polished in the form of a cube 0.8 cm on edge and placed in the focus of the beam of a pulsed-Q laser of $\sim 10^7$ W power (breakdown takes place in air). The beam inflicted damage on the crystal in the form of a chain of ring-like microscopic fractures with local formations in the center. The chain of fractures was aligned along the axis of the laser beam (Fig. 1; the laser beam direction is indicated by the arrow, and the beam was focused on the center of the crystal).

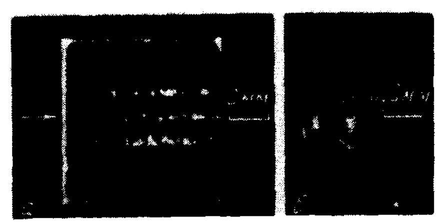

Fig. 1. a - Traces of microscopic fractures in ruby crystal after three laser pulses. Magnification 3x; b - two individual fractures from the track (magnification 30x).

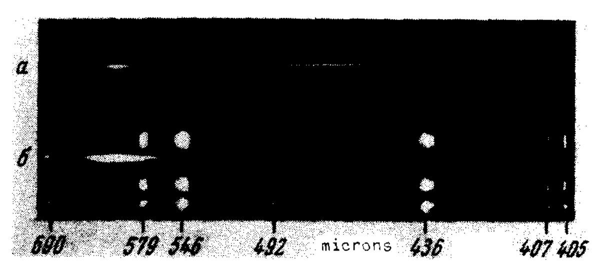


Fig. 2. Ruby glow spectra at different radiation power: a - $\sim 10^6$ W, b - $10^5$ W (total energy larger than in a).

The damage was accompanied by an intense flash of light with a continuous spectrum.

At a lower power, $\sim 10^6$ W, no damage to the crystal occurred, but glow, consisting of two broad bands with maximum at ~ 630 and ~ 450 nm was observed from the ruby (Fig. 2a).

At $\sim 10^5$ W power (without pulsed Q), the blue band disappeared, leaving only the orange band (Fig. 2b). A similar orange glow was observed and partially investigated in ruby excited by a mercury lamp [1].

We propose that an important role is played in these phenomena by absorption from the $^2E$ level of ruby.

At high power, as a result of multiple quantum absorption from the $^2E$ level, $Cr^{3+}$ ionization is possible. In this case the electrons fall in the conduction band of the corundum, are accelerated by the field, and produce breakdown in the crystal. The cracking of the crystal is a result of this breakdown.

At lower laser power, the following excitation mechanism is possible.

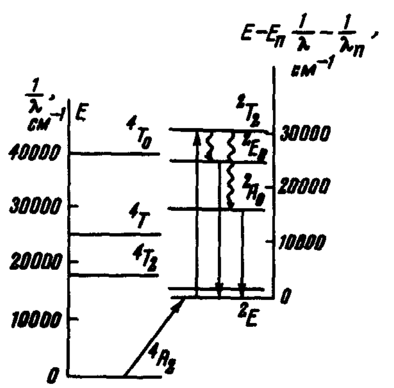

Fig. 3. Ruby level scheme with proposed transitions.

According to the level scheme proposed for ruby by Sugano and Tababe [2] (Fig. 3), two-quantum transitions are possible from the $^2E$ level to the $^2T_2$ level, with subsequent relaxation to the levels $^2E_0$ and $^2A_0$. A radiative transition from these levels to the $^2E$ level can produce the observed luminescence band of the ruby.

When a ruby sample cooled to 77°K was irradiated by a ruby laser, neither glow nor ruby damage was observed. It is known that the ruby $R_1$ line narrows down at this temperature to 1 $cm^{-1}$ and shifts by 10 $cm^{-1}$. In this case there is no absorption at the $^2E$ level, since the generation wavelength does not coincide with the wavelength of the $R_1$ line.

If the ruby sample is placed in such a way that the focus of the laser beam is close to the surface, then flashes having line spectrum are produced on both surfaces of the sample at the instant of irradiation. A similar spectrum is obtained when the ruby is replaced by corundum.

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[1] A. Misu, J. Phys. Soc. Japan 19, 2260 (1964).
[2] S. Sugano and J. Tanabe, J. Phys. Soc. Japan 13, 880 (1958).