STIMULATED EMISSION OF Ho^{3+} IN CaF_2 at λ = 5512 Å

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There exist at present several ways of obtaining stimulated emission in the middle of the visible band. One of the well known and effective methods is infrared frequency multiplication using nonlinear-optics effects[1, 2]. Another way is to obtain stimulated emission directly by using corresponding transitions of luminescent crystals.

Stimulated emission of the Ho^{3+} ion was obtained earlier[3] in $CaWO_4$ crystals at wavelengths 2.046 and 2.049 μ at 77° K[1)]. The radiation corresponds to the transition $^5I_7 \rightarrow {}^5I_8$, at which the final level of the induced transition is 230 cm^{-1} away from the ground state. In this communication we present some preliminary results of an investigation of stimulated emission of CaF_2 - Ho^{3+} at 77°K and at 5512 Å.

The investigations were made with CaF_2 crystals with Ho^{3+} concentration from 0.003 to 2.0 wt.%. A study of the absorption and luminescence spectra in the temperature interval from 300 to 4.2°K leads to the scheme shown in Fig. 1 for the levels participating in the stimulated emission. The system was excited in bands lying above 18500 cm^{-1} ($^5S_2$, $^4F_4$, $^4F_3$, and others).

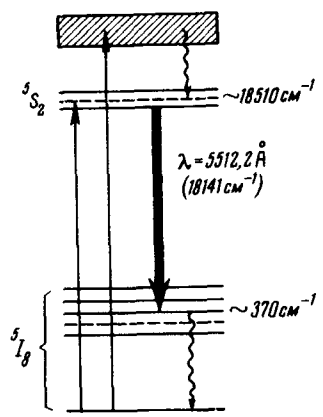


Figure 1. Diagram of the energy levels of Ho^{3+} in CaF_2, which participate in generation at 5512 Å.

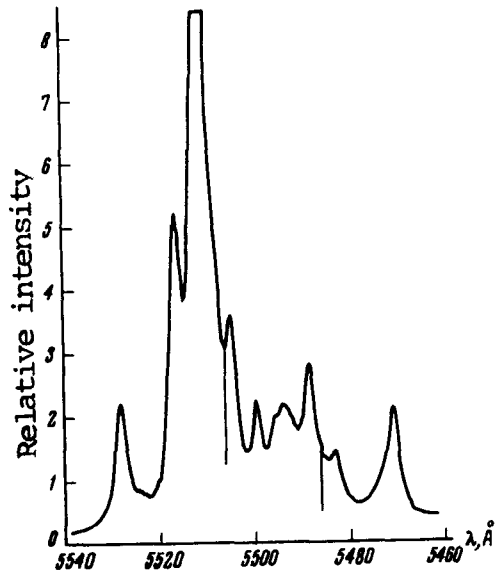
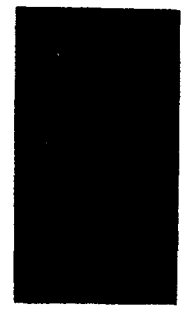


Figure 2. Luminescence spectrum of the transition $^5S_2 \rightarrow {}^5I_8$ of Ho^{3+} ion in CaF_2 at 77°K.



Emission line

5506, 7824 Å

5501, 4686 Å

5497, 5195 Å

Figure 3. Spectrum of stimulated emission of Ho^{3+} in CaF_2 at 77°K. The emission spectrum of an iron arc is shown on both sides of the emission line.

Figure 2 shows the luminescence spectrum of CaF_2 with approximately 0.3 wt.% Ho^{3+}, obtained at 77°K. The stimulated emission corresponds to a transition from the $^5S_2$ level to the Stark component of the $^5I_8$ level, which is approximately 370 cm^{-1} away from the ground level. The stimulated emission spectrum was obtained with a DFS-13 instrument with a 1200 line/mm grating. The instrument dispersion was 1.94 Å/mm. The reference was the spectrum of an iron arc. Exact measurement of the wavelength of the stimulated emission gave a value of 5512.206 ± 0.003 Å (0.612 cm^{-1})[2]. Figure 3 shows the spectrum of stimulated emission of the H^{3+} in CaF_2 at 77°K.

In the investigations we used an elliptical illuminating system with 0.15 light efficiency[5]. The excitation source was a standard IFP-800 xenon lamp. The threshold of the crystal with Ho^{3+} concentration about 0.40 wt.% with plane-parallel ends (length 75 mm, dia. 6.5 mm) was 1200 J.

Dielectric multiple-coating mirrors were deposited on the ends of all crystals. The transmission of the mirrors was 0.12 and 0.7% at the operating wavelength.

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1) Johnson [4] cites the wavelength of stimulated emission of Ho^{3+} in CaF_2 with reference to an unpublished paper

2) All values of the wavelength are indicated without recalculation from vacuum.

LIGHT SPARK IN A MAGNETIC FIELD

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The phenomenon of "light spark," vigorous ionization of a gas induced by a flash of intense light, was investigated recently experimentally[1-3] and theoretically[4-7]. In this article we describe the first results of an investigation of a spark in the presence of an external magnetic field, which can be used both to study the development of the plasmoid of the spark by means of diamagnetic induced signals[7] and to study the interaction between the spark plasma and the magnetic fields, with an aim at confinement against spreading, acceleration in inhomogeneous fields, ejection for filling of magnetic traps[8], etc.

We used for the experiments an ordinary Q-switched laser of construction similar to that described in [9]. The external longitudinal constant magnetic field reached 10 kOe in the described series of experiments. The receiving induction coil encircled the focal region of a lens with focal length $f \simeq 4$ cm. Different coils with $N \sim 2$ - 20 turns and with diameter $2R = 1$ - 3 cm were used.