LASING ON Cr^{3+} IONS IN YTTRIUM ALUMINUM GARNET CRYSTALS

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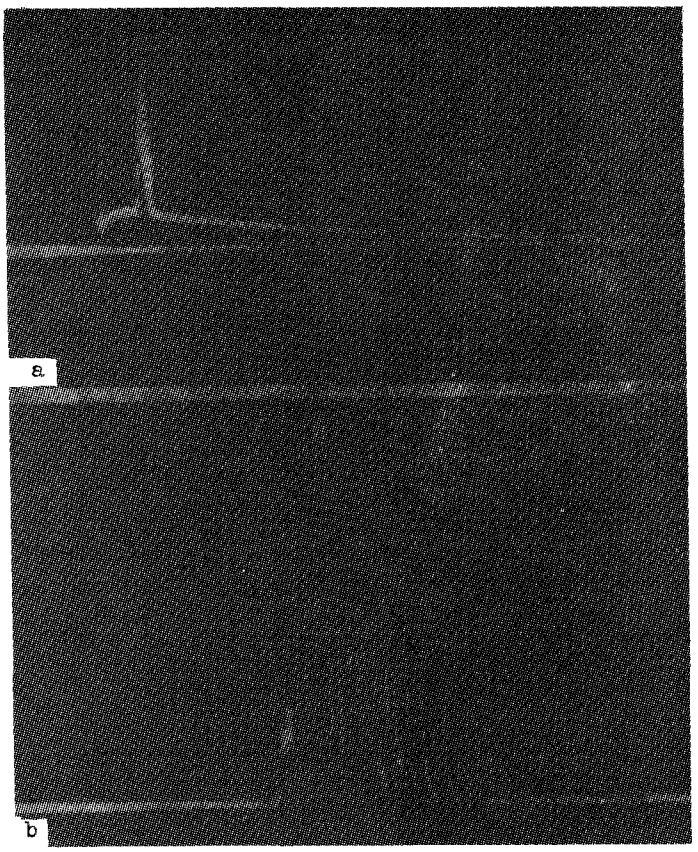
We report here lasing on Cr^{3+} ions in yttrium-aluminum garnet ($Y_3Al_5O_{12}$). We note that there are no published reports of lasing on Cr^{3+} in any matrix other than Al_2O_3 (cf., e.g., the review [1]).

Our earlier investigation of optical absoroption and luminescence of excited Cr^{3+} ions in small YAG samples (0.04 - 2 cm^3) [3] have yielded the complete energy level scheme of the Cr^{3+} ions in this matrix. These data have demonstrated the feasibility, in principle, of a three-level YAG:Cr^{3+} laser.

We measured the dependences of the widths $\Delta\nu$ of the R_1 and R_2 luminescence lines on the pump energy E_p in samples of dimensions on the order of 2 cm placed in an optical resonator. At low pumping, we observed broadening of the R_1 and R_2 lines due to reabsorption. With increasing pumping, the R_1 and R_2 lines broadened, as in the case of ruby [3]. We were unable to obtain lasing with these samples, however, owing to their poor optical quality. On the other hand,



Oscillograms of garnet crystal generation: a - sweep duration 2 msec/div, b - 0.2 msec/div.

measurements of the $\Delta\nu(E_p)$ dependence have made it possible to estimate the parameters of a sample whose threshold energy lies in a feasible pump range.

Lasing was attained in a YAG:Cr^{3+} sample grown specially for this purpose by the method of horizontally directed crystallization [4]. The sample was a cylinder 9.3 cm high and 1.0 cm in diameter; the Cr_2O_3 concentration in it was $\sim$0.5 wt.%. The loss coefficient normalized to the absorption in the R_1 line [5] was determined from data on the pump dependence of the luminescence line width and was found to equal 0.31. Multilayer dielectric mirrors were coated directly on the end faces of the crystal and had reflection coefficients $\sim$100 and 95%. Lasing was realized on the R_1 line at nitrogen temperatures. The lasing wavelength was 6874 Å. The generation threshold was reached at an approximate incident-light energy 300 J on the sample surface. This energy was measured with the calorimeter described in [6]. The laser beam divergence angle did not exceed 2°. The high lasing threshold, and also the appreciable beam divergence, can be attributed to the still inadequate optical quality of the sample and to the non-optimal ratio between its geometrical dimensions, the chromium concentration, and the mirror transparency.

Figure a shows lasing with a spike structure at the luminescence maximum. This structure is quite distinct at a higher sweep rate (Fig. b).

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OBSERVATION OF HIGH-PROBABILITY TWO-PHOTON PHOTOEMISSION FROM METALS IN ELECTROLYTE SOLUTIONS

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There have been many experimental and theoretical investigations of multiphoton photoemission of metals (see the review [1]), indicating that the theoretical value of the photocurrent is lower than the experimental ones by two or three orders of magnitude. The suggested causes of this discrepancy were the sharp polarization selectivity of the photoemission (in the surface-photoeffect model), the spatial inhomogeneity, and the deviation of the statistical characteristics of the radiation field from thermal. There is no detailed comparison of theory with experiment. A direct verification of the theory can apparently be based on the fact that in all the existing surface-photoeffect models