foregoing the unequivocal conclusion that the increase of T_c in our samples is connected with the appearance of the exciton mechanism of superconductivity. To realize this superconductivity mechanism it is necessary that the dielectrics used to coat the particles have pronounced exciton bands lying much lower than the Fermi surface ($\hbar\Omega_e \lesssim 1 - 2$ eV) [5]. We do not know whether such exciton bands exist in tin oxide, which consists of SnO_2 and SnO. In addition, the increase of T_c in our samples is possibly connected with the pairing of the conduction electrons on the particle surface as a result of the phonons of the dielectric [7]. In this case the relation (2) remains valid, except that Θ_e must be replaced by Θ_D of the dielectric (of the tin oxide).

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CONCERNING THE STRUCTURE OF NEODYMIUM LASER RADIATION

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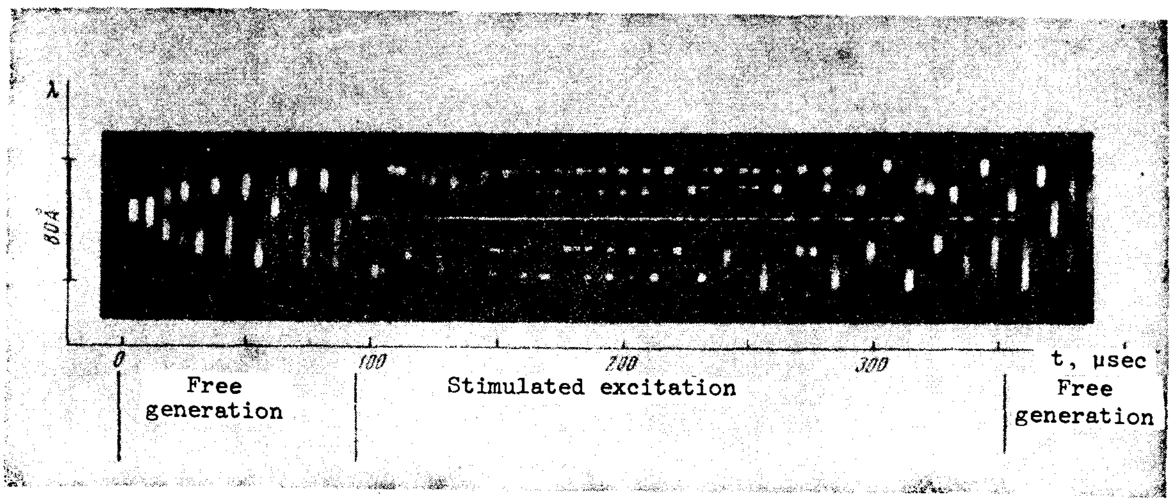
1. The inhomogeneously broadened luminescence band of Nd^{3+} in glass is usually represented as an aggregate of homogeneously broadened lines of Lorentz shape, corresponding to the emission spectra of the individual ions, between which nonradiative exchange (migration) of the excitation energy is possible. Such an idealization is convenient, but does not correspond to reality. We show in the present paper that in the case of monochromatically stimulated radiation the gain band becomes depleted not only within the limits of the homogeneous broadening near the radiation frequency, but also at a number of other frequencies. Such a frequency-selective coupling between parts of the luminescence is due apparently to the multicomponent structure of the working transition ${}^4F_{3/2} \to {}^4I_{11/2}$, which is obscured by the inhomogeneous broadening. It can be assumed that the spontaneous structuring of the emission spectra in non-monochromatic quasistationary generation is due to a considerable degree to these effects.

2. The observation of the mutual relations between different parts of the gain band of the active medium was carried out in the following manner. Excitation of predominantly quasistationary generation at a preferred frequency ν_0 was stimulated for some time in a free running laser. The structure produced in the gain band was revealed by the appearance (or change) of the line structure excited in the generation spectrum far from the frequency ν_0. The stimulated excitation was effected by a matched introduction of a radiation beam

from an auxiliary laser into the resonator of the investigated laser [1]. Quasi-stationary generation of the auxiliary laser was ensured by using a nonlinear mercury mirror as one of the resonator mirrors [2]. The reduction of the spectrum width to 1 Å and the continuous tuning of the radiation wavelength of the auxiliary laser in a range ±50 Å were effected with the aid of a Fabry-Perot interferometer with a base of 5×10^{-3} cm. The configuration of the resonator elements of both lasers (mirrors with curvature radii 2 m at a distance of 1 m on wedge-like substrates, active elements with beveled end faces) was chosen such as to exclude the influence of the inhomogeneities of the field distribution and of the mode selection on the course of the generation. Because of this and because of the presence of weak saturating absorption in the active medium (KGSS-3 glass, 20 mm in diameter and 260 mm long) [3], free multimode generation of the investigated laser occurred in a regime of regular undamped spikes. Within the limits of resolution of the diffraction spectrograph, the generation spectra did not reveal as a rule any line structure, and the spectra were in the form of solidly smeared-out broad bands - see the initial and final sections of the spectrum scan in the figure.

3. Under stimulated excitation, a dc intensity component is produced in the interval between the spikes of the investigated-laser radiation and corresponds to the excitation, while the spectrum undergoes the following changes: At first, generation stops in the region directly adjacent to the frequency of the stimulated excitation; a dip is produced in the spectrum in this place, as shown in the central section of the scanned spectrum in the figure. Then, in spectral regions far from the region of the stimulated excitation, a structure is produced, corresponding to the structuring of the gain band. This structure becomes more pronounced, the higher the excitation intensity; the character of the structure as a whole is independent of the changes in the excitation frequency within the limits of the generation-region width. The dependence of the structure on the external-excitation intensity can be traced in the attenuating part of the excitation pulse. It is seen in this period that at first the broad dips in the remote regions of the band become equalized, and a shallow structure remains in their place during a certain time. The sharpness of this structure and the width of the regions in which it appears decrease with decreasing intensity of the stimulated excitation. The structure ceases to be noticeable when the excitation becomes so weak that the central dip of the generation spectrum disappears, and the dc component corresponding to the excitation disappears from the intensity. The pure spike generation regime is then restored anew.

4. As one of the causes of the observed phenomenon, as already noted, we can propose the multi-component character of the structure of the working



transition of the Nd^{3+} ion. Indeed, the luminescence of the Nd^{3+} in the glass corresponds to a transition from two sublevels of the Stark splitting of the $^4F_{3/2}$ level into six sublevels of the split multiplet $^4I_{11/2}$. Thus, the luminescence spectrum consists of 12 homogeneously broadened lines, and the maxima of the band in the 1.06 and 1.09 μ regions correspond to transitions to 4 and 2 sublevels, respectively, of the Stark splitting of the $^4I_{11/2}$ level [4]. Owing to the variations of the local surrounding of the Nd ions in the glass (inhomogeneous broadening), the emission spectra of each ion differ randomly in magnitude of the splitting and in the position of the lines on the frequency scale. Therefore when an ensemble of ions radiates, any one frequency can correspond to transitions between different sublevels of different ions. In addition, it can be assumed (in analogy with crystals) that, owing to variations in the surroundings, the magnitude of the homogeneous broadening of the emission lines of each ion are also different.

When monochromatic radiation of frequency ν_0 acts on the active medium (or when quasistationary generation is self-excited at this frequency), all the exciting ions whose emission spectra contain lines coinciding, within the limits of their homogeneous broadening, with the frequency ν_0, become deactivated with definite probabilities. The gain band then becomes depleted in the vicinity of the mean value of the homogeneous broadening near the frequency ν_0 and at the frequencies of all the remaining possible transitions of the centers that radiate at the frequency ν_0. The band structuring produced in this manner corresponds to the structuring of the generated-radiation spectra.

It is typical that the observed structure is irregular with respect to the period. A structure with relatively small period and narrow lines appears against the background of a grosser structure, predominantly in the regions adjacent to the region of the stimulated excitation. This points to a considerable scatter of the splitting of the working sublevels and confirms the assumption that the homogeneous broadening depends on the local variations of the surrounding of the Nd ions.

It can be assumed that allowance for the phenomenon observed in the present investigation will make it possible (together with allowance for the spatial competition, selection, and self-synchronization of the modes) to give a more complete description, than the one presently available [5], of the mechanism of occurrence and development of the structure of the quasistationary radiation of lasers using active media and inhomogeneous broadening of the luminescence band.

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