We have calculated the phase diagram also for the case of cubic anisotropy. If the magnetic field is directed along preferred directions of the cubic lattice, then the phase diagram is similar to those given above. For example, the phase diagram is similar to diagram I (Fig. 1) if H is parallel to the light axis [111], and similar to diagram II (Fig. 2) if H is parallel to [110 or [100].

We note also that the case of uniaxial anisotropy in iron garnets is of interest in itself. It is convenient to study the behavior of the sublattice magnetizations in a magnetic field with the aid of the Faraday effect, using thin plates. It is known [5] that strong uniaxial anisotropy frequently appears when such plates are processed.

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FEASIBILITY OF SUPERRADIANCE IN THE REGION OF THE VACUUM ULTRAVIOLET IN BREAKDOWN OF DIATOMIC MOLECULAR GASES BY ULTRAVIOLET LIGHT PULSES

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Pulsed excitation of inversion in a gas discharge is one of the few promising methods of obtaining lasing in the vacuum-ultraviolet region [1, 2]. The presently used excitation of diatomic molecular gases [2] by powerful short ($T \sim 10^{-9}$ sec) current pulses has a number of shortcomings (difficulty of producing "traveling-wave" inversion in the gas, low pressures of the working gas, impossibility of obtaining an excited-particle density higher than $N^* \sim 10^{13} - 10^{14}$ cm^{-3}). We consider below the possibility of obtaining vacuum-ultraviolet lasing by breaking down gases N_2 or H_2 with a powerful ultraviolet laser pulse. The inversion is then produced in the following manner: As shown in [3], at light fluxes $Q \sim 13$ W/cm^2, the breakdown region propagates with the velocity of the laser pulse, forming a long spark (plasma with low degree of ionization), with characteristic dimensions $l \sim 10^2$ cm, $s \sim 10^{-3}$ cm, $v = sl = 10^{-1}$ cm^3. The average electron energy $\langle \mathcal{E} \rangle$ in the plasma produced by the breakdown is of the order of (10 - 15)I, where I is a characteristic energy close to the ionization potential. We note that inasmuch as the excited states produced in the presence of the laser-pulse field decay as a result of multiphoton ionization [4], the neutral molecules are in the ground state in the breakdown region. The laser pulse is followed by an inverse-wave propagating at the speed of light. This wave is connected with the excitation of the neutral molecules by the hot electrons.

The deformation of the electron distribution function $f(\mathcal{E}, t)$ following the passage of the laser pulse can be approximately described, in the energy region $\mathcal{E} > I$, by the equation

$$(df/dt) - I(d/d\mathcal{E})[\nu_i(\mathcal{E})f] = 0, \quad (1)$$

where $\nu(\mathcal{E})$ is the frequency of the inelastic collisions of the electrons with the neutrals. The solution of (1) is

$$f(\mathcal{E},t) = (1/I\nu(\mathcal{E}))F[t + (1/I)\int(d\mathcal{E}/\nu(\mathcal{E}))]. \quad (2)$$

Here F is a function determined by the initial $f(\mathcal{E}, 0) = f_0(\mathcal{E})$. The total number of excitations at the upper working level is

$$N^* = n_0 \int_0^\infty dt \int_I^\infty d\mathcal{E}\, \nu^*(\mathcal{E}) f(\mathcal{E},t), \quad (3)$$

where n_0 is the initial electron density and $\nu^*(\mathcal{E})$ is the effective frequency of excitation of the given level. In the energy region $\mathcal{E} > I$, the function $f_0(\mathcal{E}) = (\beta/2I)\exp(-\sqrt{\beta\mathcal{E}/I})$ [3], where $\beta = 2I\gamma$ is the constant of development of the electron cascade in the laser-pulse field of intensity E_0 and frequency ω, and $\alpha = (1/6)(e^2E_0^2/m\omega^2)$.

In the case when $\nu(\mathcal{E})$ and $\nu^*(\mathcal{E})$ for H_2 are practically constant in the energy range from 50 to 400 eV [5]), we obtain from (3)

$$N^* = (2n_0/\beta)(\nu^*/\nu)[3 + 3\sqrt{\beta} + \beta]\exp(-\sqrt{\beta}). \quad (4)$$

For $\beta \sim 0.1$, which corresponds to $\langle\mathcal{E}\rangle \sim 15$ I, $\nu^*/\nu \sim 0.1$, and an electron density $n_0 = 10^{16}$ cm^{-3} (the energy absorbed by the plasma in a volume $s\ell = 0.1$ cm^3 is ~ 0.1 J in this case), N* is of the order of 10^{16} cm^{-3}. In view of the fact that the lower vibrational levels are weakly populated when the molecule is excited with high-energy electrons [1], the population inversion is close to 10^{16} cm^{-3}. The gain corresponding to an inversion of 10^{16} cm^{-3} is of the order of 10^2 - 10^3 cm^{-1}. At such high values of the gain, the induced decay of the levels in many times more intense than either the spontaneous decay or the electron thermalization. Almost all the excited molecules produce stimulated emission, resulting in a pulse of duration $\tau \sim (\beta\nu)^{-1}$, whose form duplicates the inversion wave. At $\nu \sim 10^{13}$ sec^{-1}, the pulse duration is $\sim 10^{-12}$ sec; for a quantum energy ~ 10 eV, the energy in the pulse is $\sim 1.6 \times 10^{-3}$J, and the flux density is $Q \sim 1.6 \times 10^{12}$ W/cm^2.

We note that the indicated feasibility of superradiance of vacuum ultraviolet is of interest also for the diagnostics of laser plasma.

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