

It was shown earlier [3] that under conditions of the second regime there was observed generation of low-energy ion currents (energy 40 eV, current ~ 2 A, ion density 2×10^{12} cm $^{-3}$ at a plasma density 2×10^{13} cm $^{-3}$).

From a comparison of the time of flight of the particles with velocity v over the length of the system L ($\tau \sim L/v$, $L \sim 70$ cm) with the average time (τ') between neighboring jumps of the phases we can draw a conclusion concerning the model on which the proposed acceleration mechanism is based. If $\tau \sim \tau'$ (which is characteristic of oscillations of the first regime) it can be assumed that the acceleration of the ions is effected by the electric field of the ion-acoustic wave with fixed phase. If $\tau > \tau'$ (second oscillation regime of the LF oscillations), then the acceleration of the ions can be explained by using the stochastic-acceleration model (wave with random phase). The velocity of the accelerated particles is then given by [4]

$$v = \frac{4e^2}{M^2} \frac{kE^2\omega r^3 \Delta t}{(1 + \omega^2 r^2)^2}, \quad (2)$$

where e and M are the charge and mass of the ion, k the wave number, ω the oscillation frequency, E the electric field intensity, and Δt and τ the flight and correlation times.

The corresponding calculation of the field intensity for our case ($\omega \sim 3 \times 10^6$ sec $^{-1}$, $\Delta t \sim 8 \times 10^{-6}$ sec, $\tau \sim 2 \times 10^{-6}$ sec, $v \sim 9 \times 10^6$ cm/sec) yield $E \sim 15$ V/cm. The experimentally determined value is $E \sim 20$ V/cm, which confirms the possibility of the assumptions made above.

Thus, we have investigated the LF oscillations and the mechanisms of energy transfer from the electron beam to the plasma ions in the second regime of an intense plasma-beam discharge.

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FRACTIONIZATION OF CARBON ISOTOPES IN THE SYNTHESIS OF DIAMONDS FROM GAS

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The synthesis of diamonds from gas occurs in the region of metastability of diamond and is based on the orienting action of the surface forces of the primer on the nucleation processes [1, 2]. The growth of the priming diamond powders (natural and synthetic diamond) revealed a previously unknown phenomenon, namely anomalously large fractionization of stable isotopes of carbon.

The synthesis was from methane at 1000 - 1050°C and 0.2 - 0.5 Torr. The methane was purified before the experiment. The substrates were diamond powders with dimensions up to 1 μ . The growth was by a cyclic method, namely, the synthesis was stopped after a definite time and the priming diamond powder was rid of the overgrown non-diamond carbon, after which the growth cycle was repeated.

The isotopic composition of the carbon was investigated mass-spectroscopically. All the carbon of the diamond or the graphite was converted into carbon monoxide [3]. The error, estimated at the 0.95 confidence level, was $\pm 0.05\%$. The reproducibility error was $\pm 0.02\%$. The experimental results were processed in accordance with the formula

$$\delta C^{13} = \left[\frac{(C^{13}/C^{12})_{\text{sam}}}{(C^{13}/C^{12})_{\text{st}}} - 1 \right] 100\%.$$

The ratio C^{13}/C^{12} in the standard was 1123.72×10^{-5} . The value of δC^{13} for the initial methane was -4.62% . A control investigation has shown that the process of preliminary purification of the methane does not change its isotopic composition.

The results of the experiments are listed in the table, the first column of which gives the character of the substrate, and the second the added growth of the new phase. In the third column are given the values of δC^{13} obtained directly in the experiment, and the last column gives the values of $\delta_1 C^{13}$ calculated for the grown new phase.

Substrate	Incr. wt. %	$\delta C^{13}, \%$	$\delta_1 C^{13}, \%$
Nat. diamond	-	-0.86	-
do.	60	-1.29	-1.73
Synthetic diamond	-	-3.07	-
do.	48	-2.56	-1.40
Lampblack	-	-2.31	-
do.	25	-3.17	-6.61

Were there no fractionization of the carbon isotopes, then the newly-formed solid phase would have the same value of δC^{13} as the initial methane, i.e., -4.62% . Then the experimentally measured quantity δC^{13} , for a substrate of synthetic diamond overgrown by 48%, would be -3.56% . At the same time for lampblack overgrown 25% by nondiamond carbon, we would have obtained $\delta C^{13} = -2.27\%$.

It should be concluded from the results that in the case of growth from the gas there is fractionization of the carbon isotopes, and the overgrown diamond becomes enriched with the heavier carbon isotope, whereas the overgrown non-diamond carbon is enriched with the lighter isotope, compared with the initial methane. A specially performed experiment has shown that the non-diamond carbon produced on diamond has $\delta C^{13} = -6.6\%$, i.e., the same as in the case of growth on a non-diamond substrate. Thus, in the synthesis from gas the effects of fractionization are opposite in sign for diamond and for graphite. This is obviously connected with the synthesis mechanism itself.

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NONSTATIONARY GENERATION OF SOLUTIONS OF ORGANIC DYES IN PICOSECOND OPTICAL PUMPING

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The establishment of stationary laser generation is preceded by the following transient processes: a) deviation of the inverted population of the working level from the stationary value - kinetic nonstationarity; b) nonstationarity due to the finite time of formation of the half-width of the resonator mode - spectrum nonstationarity; c) nonstationarity due to the finite rate of relaxation of the active centers over the states participating in the transition.

In the case of optical pumping by picosecond pulses, we can expect all the aforementioned nonstationarities to be manifest to the greatest extent.

We report here observation of nonstationary processes of type (a) and (b) in the generation of lasers based on solutions of organic dyes.

The work was based on comparison of the generation spectra obtained by varying the pump pulse duration from 30 nsec to several times ten picoseconds. To vary the pulse duration we placed alternately in the resonator of a ruby laser with an RL2B $10 \times 120/180$ element an inertial modulator based on Vaphthalocyanine in dimethylsulfoxide (nanosecond regime) and a modulator based on a solution of tricyanine dye in ethanol (picosecond regime).

We investigated several types of dye solutions generating in the spectral region 7100 - 9100 Å [1].

Generation spectra of solutions of cyanine dye-1 [1]:
 1 - picosecond optical pumping, 2 - nanosecond optical pumping; the optical density of the solution increases from a to c, base of the resonator is $l = 15$ mm.

