USE OF A LASER OPERATING IN THE SPIKE MODE TO OBTAIN A HIGH-TEMPERATURE PLASMA

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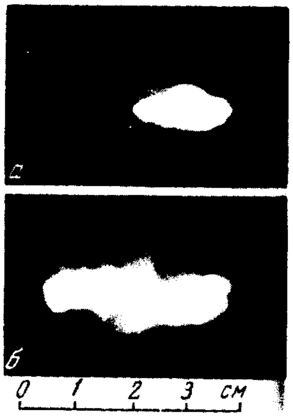
Submitted 24 February 1966
ZhETF Pis'ma 3, No. 8, 316-318, 15 April 1966

To ionize a gas and to produce a high-temperature plasma with the aid of a focused light beam it is customary to use the radiation from a monopulse laser, which yields powerful light pulses of duration 10^{-7} - 10^{-8} sec [1,2]. This procedure is restricted to very short action of powerful light radiation on the gas, determined by the duration of the laser pulse. Yet for certain applications, for example to accelerate chemical reactions, it may be of interest to obtain longer action of the electromagnetic field of the light wave on the plasma. To this end we have experimented with ionization of air with the aid of radiation from a laser operating in the spike mode, with total generation duration of about one millisecond.

The neodymium-glass laser used in our investigation yielded light pulses with energy 800 - 1400 J. Neodymium-glass rods of 45 mm diameter and 600 mm long were used, with 2 and 4% concentration of Nd_2O_3. An elliptic illuminator with six conjugate ellipses and straight pump flash lamps was used.

The average laser radiation power, at a flash duration 0.8 - 1.2 msec, was 1 - 2 MW, but, taking into account the off-duty factor between spikes, the maximum radiation power could reach 10 - 30 MW. If this radiation is focused in air with a lens of focal length f = 100 mm, we can obtain a power density 1 - 3 GW/cm^2 and a field intensity of the order of 10^7 V/cm, so that a high-temperature plasma is produced in air.

The figure shows photographs of plasma glow at the focus of the lens, for laser outputs 1100 (a) and 1400 J (b). We see that with increase of radiation energy the glowing region stretches in the direction of the beam axis, up to 20 - 30 mm. The glow region grows in this case from the focus toward the lens. The glow-region boundary barely moves in the opposite direction. This indicates that the plasma produced by the gas breakdown is optically opaque and that the laser emission of 1.06 μ wavelength is absorbed in the thin front layer of the cloud.



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