CORPUSCULAR DIAGNOSTICS OF HIGH-CURRENT NANOSECOND DISCHARGE OF THE LOW-INDUCTANCE VACUUM SPARK TYPE WITH LASER INITIATION

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Interest in high-current pinch discharges of the low-inductance vacuum spark type is associated with the micropinching mode, in which the highest plasma densities and temperatures are achieved, leading to the generation of intense X-ray radiation and the formation of multiply charged ions. In this case, in the X-ray spectra obtained for high-current low-inductance vacuum spark pinching modes with a current of $I \geq 100$ kA and a period of $T \approx 5 \div 10$ μs, as a rule, there is radiation from ions of the highest charge levels up to helium-like states. However, such high charges are usually not observed in ion emission spectra.

The search for optimal modes for the emission of multiply charged ions led to the study of vacuum spark discharges with laser initiation, which are distinguished by a high rate of creation of the initial plasma in the discharge gap, the influence of the laser radiation characteristics on the nature of the pinching and the possibility of obtaining emission spectra with high ion charge [1−3].

This paper presents the experimental results of a study of ion flows generated in an ultrafast ($dI/dt \approx 10^{12}$ A/s) high-current (up to 90 kA) laser-induced discharge of the vacuum spark type with the creation of laser plasma on a high-voltage (up to 20 kV) electrode at different voltage polarities. These studies were carried out using a time-of-flight magnetic ion mass spectrometer and continue a series of experiments started earlier with current in vacuum spark up to 40 kA [4] with the aim of developing a compact laser-spark source of fast multicharged ions. The scheme of the experiment is presented in Fig. 1.

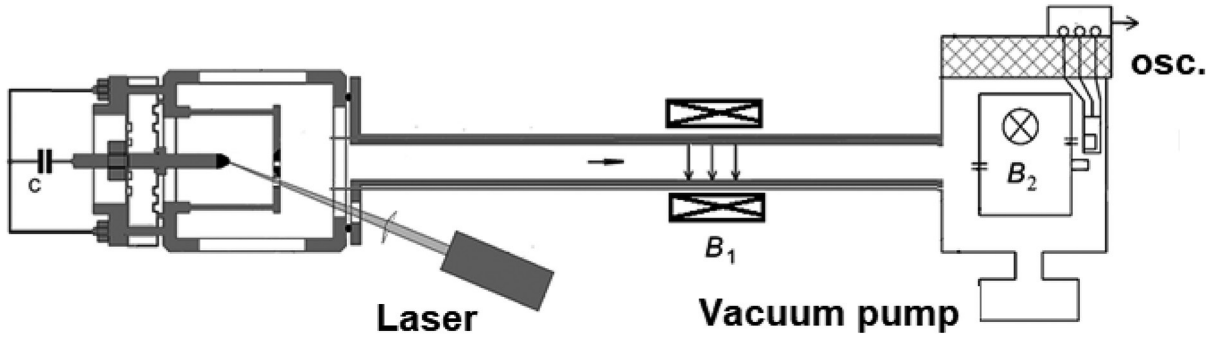

Fig. 1. Time-of-flight corpuscular ion diagnostics scheme

References

1. **Korobkin, Yu. V.** Vacuum discharge instability at laser initiation of a cathode spot [Text] / Yu. V. Korobkin, I. V. Romanov, A. A. Rupasov, A. S. Shikanov // Technical Physics. – 2005. –Vol. 50, No. 9. – C. 1139–1144.

2. **Korobkin, Yu. V.**, Paperny V. L., Romanov I. V., Rupasov A. A., Shikanov A. S. // Plasma Physics and Controlled Fusion. – 2008. – Vol. 50. – 065002 (14 p.)

3. **Alkhimova, M. A.** The source of X-rays and high-charged ions based on moderate power vacuum discharge with laser triggering [Text] / M. A. Alkhimova, E. D. Vovchenko, A. P. Melekhov et al. // Nukleonika, – 2015. Vol. 60(2) – P. 221–227.

4. **Kozlovskij, K. I.** Laser-Spark Source of Intense Ion Fluxes for Accelerators [Text] / K. I. Kozlovskij, E. D. Vovchenko, A. E. Shikanov et al. // Physics of Particles and Nuclei Letters. – 2024. – Vol. 21, No. 3. – P. 328–330.