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FAST SWITCHING OF MEGAAMPERE CURRENT TO THE LOAD*

S.A. SOROKIN

Institute of High Current Electronics SB RAS, 2/3 Akademichesky Ave., Tomsk 634055, Russia, s.sorokin@rambler.ru, +7(3822)491617

In experiments [1, 2, 3] on fast switching of the megaampere current to a foil liner or a solid metal rod 1–2 mm in diameter, the formation of a thin layer of hot (>100 eV) dense plasma was observed on the surface of the liner (rod). The process of switching the current to the load is accompanied by a powerful pulse of soft X-rays emitted from the surface of the load. The current switches to the load in 1-3 ns in the process of sweeping (pushing away from the load) by the magnetic field of the plasma, previously injected in the area of the load and the conical load holder. (Fig.1a). In the course of these experiments, the question arose of whether the formation of a surface plasma is the result of implosion onto the load surface of a part of the injected plasma swept by the current. To clarify this issue, test shots were made in this work with different configurations of the load area and the composition of the injected plasma.

In the first test, instead of a conical holder (Fig. 1a), a cylindrical holder (Fig. 1b) was used, i.e., a cathode configuration was used close to that used in the plasma focus [4]. In this configuration, after the swept plasma reaches the end of the cathode, it is possible (this occurs in the plasma focus) to implode the plasma onto the load surface. Upon transition to a cylindrical holder, the X-ray power from the surface of the aluminum liner decreased by several times. This result can be explained by the implosion of a portion of the injected plasma onto the liner surface. This plasma transfers the current even after its stagnation on the surface of the liner.

In the second test, a screen was used to eliminate the possibility of radial implosion of the injected plasma on the load (Fig. 1c). The presence of the screen eliminates the possibility of sweeping the injected plasma from the periphery to the load. The power and duration of the X-ray pulse, as well as the X-ray image of the load with and without a screen, practically coincided. This test confirms that the anode configuration (presence or absence of a shield) does not affect the result and the formation of a short X-ray pulse is due to the plasma pushing away from the load surface and the subsequent explosion of this surface.

A change in the elemental composition of the injected plasma also does not affect the radiative characteristics of the load.

Thus, the performed studies confirm that when plasma is injected into the load region with a conical holder, the plasma is pushed away from the load and the current is switched over to the surface of the load (liner or rod) in a few nanoseconds.

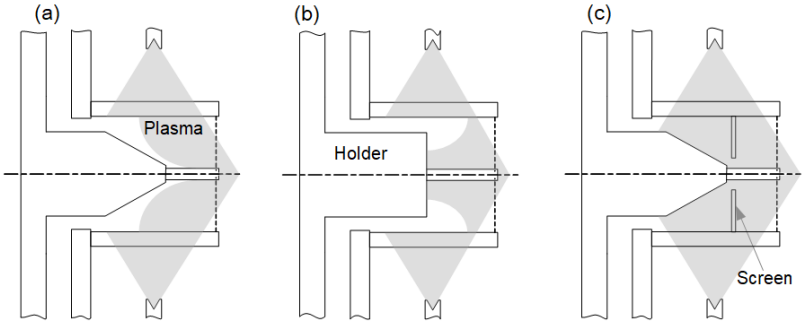

Fig. 1. Schematics of the load area with cone holder a), cylindrical holder b), cone holder and screen c).

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