MEASURING THE EXPANSION VELOCITY OF PLASMA FORMED DURING ELECTRICAL BREAKDOWN ALONG AN EXPLODING AL FOIL IN A MEDIUM OF DISORBATED GASES*

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This paper presents experimental results on measuring the plasma expansion velocity formed during electrical breakdown along an exploding Al foil. Electrical breakdown occurs in the environment of a mixture of gases desorbed from the surface of the foil when it is heated by the flowing current. Aluminum foil had the dimensions: length 20 mm, thickness 6 microns, width varying from 0.93 to 1.05 mm. Foil explosion was carried out by a sinusoidal current with a period of oscillation of 1780 ns. The current amplitude varied depending on the charging voltage (U_c = 10, 20, and 30 kV) of a 0.25 μF capacitor and was about 6.5, 14, and 22 kA, respectively.

The plasma expansion velocity was measured using three electric probes under the earth potential and located at the edges and in the middle of an exploding foil. The distance from the foil to the probes varied from 2 to 16 mm. In the experiments, the time of appearance of the signal on the probes was measured relative to the moment of breakdown along the foil. Measuring the time of flight of the plasma from the foil to the probes, and knowing the distance to the probes, the plasma expansion velocity was calculated.

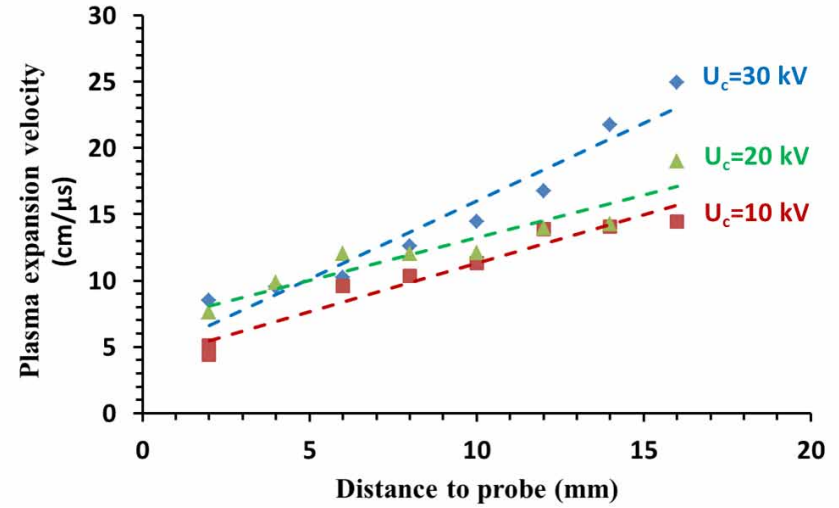

Fig. 1. The expansion velocity of plasma formed during the breakdown along the exploding aluminum foil at different capacitor charging voltages.

In addition to probe measurements, in this work, we recorded the optical images of an exploding foil and the glow of expanding plasma with four frame camera HFSC-Pro with an exposure time of 3 ns. These studies allowed us to get an idea of the shape of the forming plasma envelope and measure the rate of expansion of the bulk of the desorbed gases and metal vapors as a function of time. In addition, ideas were obtained about the processes occurring in the near-electrode regions at the moment of the occurrence of a breakdown.

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