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INSTABILITIES IN THE NEAR-CATHODE ZONE AND THE FORMATION OF THE MICROSTRUCTURE OF AN ELECTRIC SPARK *)

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By using picosecond laser probing simultaneously at two wavelengths of 532 nm and 1064 nm, the features of the generation of highly-ionized plasma from a pointed cathode after the onset of the electrical breakdown of a millimeter-sized air discharge gap at atmospheric pressure were investigated. It was found that the transition from a micron-sized cathode spot to a growing spark channel is accompanied by the formation of a spherical plasma region located at the base of the spark channel in the near-cathode region. The spherical plasma region has a diameter of about 100 μm and is characterized by a decrease in the electron density in its center, to 3×1019 cm−3, and an increase, to (5−6)×1019 cm−3, in the region of its shell with a width of about 20 μm. It is shown that the growth of the subsequent spark channel is provided by a powerful ionization front originating at the boundaries of the spherical plasma region during its expansion within the first 1 ns after the gap breakdown instant. It was found that, during the expansion of a spherical plasma region, plasma instabilities develop at the boundary of its shell leading to the appearance of the first microchannels with a diameter of about 20 μm. Subsequently, the number of microchannels increases giving rise to a complex microstructure in the resultant spark channel.

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References

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