Investigation of the processes of the near-cathode zone at the early stage of a small-scale air discharge by the method of laser interferometry

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The results of laser interferometry of small-scale plasma formations (200 m) arising in the near-cathode zone at an early stage (10 ns) of the development of a nanosecond air discharge at atmospheric pressure are analyzed. With the help of the developed InterfAn software, which takes into account diffraction effects on a small-scale inhomogeneous object and uses the 1st Rhytov approximation to recover information about the phase structure of the object, interference images are sequentially cleaned from parasitic noise and artifacts using Fourier filtering (checking the criterion for storing information on the structure of the object with an error of 1%). An adaptive nonlinear Volkov filter is implemented to reconstruct the phase shift map of the probing radiation when passing through the object with the establishment of the local error limit for each point of the frame. As a result, the distribution of the refractive index in the object is restored under the assumption of axial symmetry in the considered cut. The results indicate the formation of an ionization wave front in the near-cathode zone at an early stage of the discharge, which is close to spherical shape. The obtained two-dimensional maps of the discharge density show that several multidirectional microchannels develop around the sphere, which indicates the instability of the wavefront. This work was supported by the Russian Science Foundation (grant 22-29-00799).