Study of the response of an optical system when registering a small-scale structure of an electric spark when probing with coherent light

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The paper investigates the features of image transmission of a fine-structured electric spark in an optical lens system, recorded using a probe laser radiation. The structure of such a spark is fundamentally small-scale, and the resulting laser shadow images and interferograms are partially distorted due to the influence of the instrumental function of the optical registration system. Here, we consider in detail probing of the fine-structured spark by 532 nm laser radiation. By simulating the spark image transmission in an optical registration system, we evaluate the effect of the system response function on the quality of the registered spark patterns. We show that the spark microstructure is reliably resolved only by optics having a spatial resolution better than several micrometers. Also, it is found out that the defocusing effect, which naturally arises due to the finite depth of field of an optical registration system, is crucial for precise investigation of complex-structured sparks and should be accounted for in the image processing. Our findings reveal extreme difficulties in diagnosing of the fine-structured spark and, at the same time, provide reliable basis for its comprehensive investigation.
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