DOI: 10.34854/ICPAF.51.2024.1.1.174

HALF-WAVE ANTENNA-INITIATED MICROWAVE DISCHARGE IN HIGH-SPEED GAS FLOWS *)

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Various discharges in high-speed gas flows have been studied over the last decades within the framework of solving plasma aerodynamics problems [1]. The need to determine the mechanisms of the impact of discharge plasma on high-speed flows determines the relevance of the current research. In this work, a microwave discharge initiated at the tip of a half-wave antenna placed in high-speed air and propane-air flows has been studied experimentally. The aerodynamic channel was mounted into the waveguide perpendicular to the wide wall [2]. The discharge was generated using a 2.45 GHz magnetron source designed to operate at powers up to 5 kW in continuous mode. The structure of the microwave discharge was recorded using high-speed video recording with a Videosprint camera. The optical spectrum in the visible and near-UV region was recorded by OceanOptics spectrometer. By analyzing the spectra, the main parameters of the discharge plasma were determined: electron concentration and temperature, gas temperature.

It is experimentally shown that the structure (length of the luminous channel, its thickness, luminescence intensity) of the microwave discharge depends on the flow parameters: the pressure in the flow and its velocity. Figure 1 shows a composite image of four fragments of frames of high-speed imaging of the discharge at different pressures in the flow. The electron concentration n_e of the order of 10^{15} cm^{-3} was determined experimentally, and it was found that the plasma is in a state close to equilibrium with electron and gas temperatures of about 5500K, which agrees with the results of earlier studies [3].

Figure 1. A composition of video frames of microwave discharge at different pressures in the flow. Frame exposure is 2 μs. The air flow velocity is 200 m/s, directed from left to right. The field strength vector E is parallel to the flow.

K.N. Kornev is a grantee of the Theoretical Physics and Mathematics Advancement Foundation «BASIS» and thanks it for financial support. The research was carried out at the expense of the grant of the Russian Science Foundation № 23-22-00233.

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*) abstracts of this report in Russian