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Comparison of Shock Wave Propagation in The Stationary and Decay Plasma of The Glow Discharge in The Different Gases

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Experiments were conducted on the electric discharge installation of Ioffe Institute of Russian Academy of Science in the trans-sonic regimes of shock wave propagation. Such regimes with difficulty yield to numerical simulation, those more in the plasma, and at the same time precisely these regimes are interesting for the practice. The experimental form of the distribution of pressure after shock wave in the plasma differs significantly from form in the gas without the plasma. “Two-wave” form in the plasma makes it possible to hope for reductions in the expenditures of energy of the gas motion for an increase in the entropy in the shock wave, as this occurs also in the case of the mechanical method of splitting wave, for example on the conical surfaces.

Experiments are carried out for the careful study of the distribution of pressure behind the shock wave and the velocity shock wave during its propagation across the positive column of the steady-state glowing discharge, and also in the decay plasma after the disconnection of discharge, in moistened and dried air, in the dust-laden air, in atmospheric air, and also in nitrogen and in argon. It was for the first time, in comparison with the experiments in air with the oversaturated vapors of water, that the study of the influence of moisture and dustiness of air was carried out separately, which gives the possibility of the analysis of the influence.

Experiments in different kinds of air and experiments in the decay plasma are important for the practical use of the effect. Experiments in nitrogen and in argon are necessary for the comparison and, as a result, for understanding of the mechanism of the effect, without which it is difficult to give reliable practical recommendations.

After the modernization of installation and realization on the basis of the contemporary electronic base of the original scheme of the schlieren method, and also after the application of contemporary procedures of processing results, the accuracy of experimental data was essential improved.

It was shown that distribution of the pressures behind the shock wave in moist and dried air, and also with the small artificial dustiness of air, differ little from each other.

The influence of humidity distinctly is manifested in a change in the positions of the maximums of the shock wave velocity in its distribution across the positive column of the steady-state glowing discharge. The influence of dustiness is noticeable with an increase of the concentration of dust in 10 times in comparison with the natural dustiness, the influence strongly depending on wave velocity. More thorough study is required for investigation of the influence of the high dust concentrations on the effect being investigated.

From the experiments in the decay plasma in dried and in moistened air, in nitrogen and in argon a conclusion was made that the form of pressure distribution behind the shock wave depends on the concentrations of the excited states of gases, including - singlet oxygen. The times of essential reconstruction of waveform after the disconnection of discharge are found.