The Studies of Diffusion Mechanism and Simulation Model for Hypersonic Plasma with Heterogeneous and Un-magnetized Characteristics

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The plasma diffusion mechanism and simulation model are studied for the plasma generator which the diffusion velocity is hypersonic, and the electron density and collision frequency are heterogeneous, the maximum electron density can be controlled near the nozzle and the plasma dimension could attain 100 meters or even several kilometers.

The mathematical and simulation diffusion model of the ejected plasma is given in the paper, it is assumed that the supersonic plasma diffusion could be considered as the tiny jet flow expanded on the basis of the free molecular flow theory and supersonic engine theory in thin gas space. The calculation results are compared with the numerical and experimental results, the simulation model and the results are validated respectively. All results are demonstrated that:

1) The ionization degree and mass flux are the two important parameters that can decide to the results of electron density, collision frequency, whereas the shape of the transonic effuse is the essential factor that effects the diffusion angle.

2) The simulation model of the paper is compared with the numerical algorithm and experimentation, and the results are twice as great as the experimental results, but twice less than the numerical results. The errors among these results are acceptable in the study, so it is indicated that the model of this paper is the feasible way to compute the plasma diffusion, and the model has two features: its calculation is simple, and it is computationally efficient.

3) In order to accommodate more applications, the necessary plasma would be acquired by controlling the parameters of the hypersonic nozzle composition, ionization degree and mass flux.

In conclusion, the authors of the paper could offer the plasma diffusion model for correlative researchers, and it is valuable for analyzing microwave propagating in the man-made plasma.