Startup modes of bi-directional wave plasma source operating in Argon

Shumeiko A I[1,2,@], Pashaev A D[2] and Telekh V D[1]

[1] Bauman Moscow State Technical University, 2nd Baumanskaya Street 5, Moscow 105005, Russia

[2] Advanced Propulsion Systems LLC, Nobel street 7, 2/35/5, Moscow 121205, Russia

[@] shumeikoandrei1995@gmail.com

Sources of wave discharges are proposed to be used in propulsion systems with multiple thrust vectoring capability [1, 2]. Despite the fact that radiofrequency breakdown in low-pressure gases is a well-studied phenomenon [3, 4], there are still poorly studied configurations of radiofrequency and external constant magnetic fields. In particular, the configuration consisting of half-turn antenna and an external axial constant magnetic field is of interest. This configuration is proposed for use in a bi-directional wave plasma source capable of creating plasma flows in at least two directions.

In the investigated source, it is possible to change the magnitude of the induction of external constant magnetic field, flow rate of propellant, radiofrequency current applied to antenna, and diameter of outlet openings of the gas discharge chamber. The dynamic pressure in the vacuum chamber, in which the bi-directional wave plasma source is placed, is 1 mtor at an Ar flow rate of 200 sccm.

The minimum value of the electric field strength required for the radiofrequency breakdown of Ar in the bi-directional wave plasma source is 30 V/m. The decrease of the breakdown threshold is found to be within the increase of the magnetic field induction magnitude at a given diaphragm. It is determined that the magnetic field affects the breakdown threshold, provided that the ratio of the Larmor frequency to the frequency of electron-neutral collisions is greater than one.

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