IAF SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (1) (5)

Author: Mr. Andrei Shumeiko
Bauman Moscow State Technical University, Russian Federation

Dr. Victor Telekh
Bauman Moscow State Technical University, Russian Federation

# STARTING MODES OF MULTIDIRECTIONAL PLASMA THRUSTER OPERATED IN NOBLE GASES

**Abstract**

Wave plasma sources are proposed for use in propulsion systems with multiple thrust vectoring capability. Although radiofrequency breakdown in low-pressure gases is a well-studied phenomenon, there are still poorly studied configurations of radiofrequency and external constant magnetic fields. In particular, the configuration consisting of a 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 external constant magnetic field determined by the current applied to the electromagnets, propellant flow rate, radiofrequency current applied to the antenna, and diameter of orifices located at each end of the gas discharge chamber. The magnetic field magnitude is regulated in the range of 0.5...5 A. The propellant flow rate is regulated in the range of 35...400 G in peaks. The two different currents of 9 MHz and 13.56 MHz frequencies applied to the antenna are studied and regulated in the range of 0...25 A. The diameter of the orifices is altered in the range of 3...10 mm. Dynamic background pressure in the vacuum chamber is ranging from 20 mPa at 20 sccm to 190 mPa at 200 sccm. The experimental results of starting modes study of a multidirectional plasma source operated in Kr, Xe, and Ar are reported. The starting modes diagrams are built in dimensions of threshold electric field, dc current determining magnetic field magnitude, and propellant flow rate of 20. . . 200 sccm range. 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.