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OPTIMIZATION OF THE PROTOTYPE OF AN ION GRIDDED THRUSTER WITH AN EXTERNAL MAGNETIC FIELD OPERATING ON AIR MIXTURE *)

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These days, the question of more effective human exploitation of near-Earth space is becoming increasingly pressing. In this connection, the still undeveloped ultra-low earth orbits (ULEO) (160–250 km) are of particular interest. Long-term flights of spacecraft (SC) on ULEO will make it possible to develop ultra-fast communication networks throughout the planet, reach a new level in the study of the Earth's surface and atmosphere [1] and reduce the cost of putting satellites into orbit by an order of magnitude. Spacecrafts used at such low altitudes would be smaller and cheaper, but the quality of the data received from them would be higher, and the requirements for the radiation resistance of the electronics used on board would be lower.

One of the most important aspects of the operation of a spacecraft in ULEO is the presence of a residual atmosphere, which creates significant aerodynamic braking, on the one hand, clearing these orbits from any space debris, on the other hand, forcing them to have a constantly running thruster on board, compensating for the braking force. Only an electric propulsion thruster (EPT) can effectively cope with such a task. One of the main candidates for the role of such a thruster is a radio-frequency gridded ion thruster (RF GIT) due to the high specific impulse values and the wide possibilities for separately regulating both the specific impulse value and the value of the extracted ion beam current.

But the main advantage of RF GIT in this context is the potential ability of the thruster to operate on any propellant, including residual atmospheric gases surrounding the spacecraft during flight in ULEO. If create an atmospheric gas intake device (AGID) associated with the engine, which provides a sufficient flow of the propellant into the thruster to create thrust compensating the air braking, RF GIT makes it possible to carry out a stable long-term flight of a spacecraft on ULEO without carrying huge amount of working fluid on board [2]. Work on the creation of AGID is also actively carried out in the global scientific community.

Since it is known that at an altitude of ~200 km the atmosphere predominantly consists of molecular nitrogen and atomic oxygen [3] this work set the task of studying the possibilities of optimizing the operation of RF GIT on nitrogen, oxygen and their mixture, simulating a gaseous environment in orbit. An inductive ion source with a diameter of 10 cm was used as a model of RF GIT. To improve the thruster efficiency, an external magnetic field was applied to the discharge and the operating frequency of the generator was varied. The experimental results are compared with calculations.

References

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