DOI: 10.34854/ICPAF.51.2024.1.1.162

OPIMIZATION OF ANTENNA SYSTEM GEOMETRY FOR ICR-HEATING IN THE ELECTRODLESS PLASMA ROCKET ENGINE *)

[1,2]Abramov I.A., [3]Gospodchikov E.D.

[1]*National Research Centre Kurchatov Institute, Moscow, Russia, abramov_ia@nrcki.ru*
[2]*Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia*
[3]*Institute of Applied Physics, Russian Academy of Sciences, Nizhni Novgorod, Russia, egos@ipfran.ru*

In the electrodeless plasma rocket engine (EPRE) currently being designed at the National Research Center Kurchatov Institute, it is proposed to use ICR using the “magnetic beach” method. This heating method involves the use the Alfven eigenmodes of an inhomogeneous plasma cord excited in the region of a strong magnetic field exceeding the resonant value. The wavelength of the oscillations decreases as it approaches the ICR region, the phase and group velocities tend to zero – the oscillations "stop". Therefore, whatever the intensity of the dissipative processes operating in the resonant zone, the oscillations are almost completely absorbed. However, in an inhomogeneous plasma cord, along with a discrete spectrum of Alfven eigenmodes, there is a continuous spectrum – the Alfven continuum. The oscillations that make up the continuum experience the Alfven resonance, transforming into the lower hybrid ones. The latter have a significant longitudinal electric field, which leads to their effective absorption by plasma electrons [1, 2]. The efficient excitation of a discrete set of Alfven eigenmodes requires precise optimization of the antenna system used. In this paper, based on full-wave simulation of excitation of waves of the IC frequency range in plasma, taking into account the spatial dispersion of the dielectric response of both electrons and ions, several main types of antennas were compared in terms of the efficiency of energy input into plasma ions and optimal sizes were found for each of the considered types of antennas, in relation to laboratory models of EPRE, installations E-1 and PS-1.

References

[1]. A.V. Timofeev // Plasma Phys. Rep., 2014, V. 40. No. 1.
[2]. E.D. Gospodchikov, A.V. Timofeev // Plasma Phys. Rep., 2019, V. 45, No. 8.

*) abstracts of this report in Russian