Plasma acceleration in electromagnetic accelerator of rail type

S.A. Poniaev[1], B.I. Reznikov[1], R.O. Kurakin[1]

[1] *Ioffe Institute, St.Petersburg, Russia*

Nowadays due to increasing interest to the space exploration there is an interest to the new types of satellites engines. The chemical engines are only suitable for near-Earth operations and there is a strong shift to the electrical engines. Now there are many types of electrical thrusters, such as Hall and electrospray thrusters, ion engines, pulsed plasma and vacuum arc thrusters.

The promising way to create thrust is to use plasma engine with the configuration close to the electromagnetic rail accelerator (railgun). In this type of plasma accelerators depending on the ampere force, which is determined by the discharge current, external magnetic field, and the initial gas pressure in the channel, the velocity of the plasma outflow from the channel can exceed that of chemical thrusters by an order of magnitude or more. The drawback of such thrusters is pulsed type of working regimes.

In the report an analytical model that describes the gas and plasma flow in the railgun channel will be shown. Also the results of experimental investigations of the plasma acceleration in the electromagnetic railgun with an external magnetic field will be presented. The results will be shown for different gases including heavy one (Xenon). During investigations it has been found that there are operating regimes of the electromagnetic railgun with high specific impulse ($\sim 1000\ s$) and a high thrust ($5000 - 6000\ N$).

The additional optimization of electromagnetic railgun can be made from the point of view of construction, i.e. the ratio between channel cross-section and channel length significantly change the parameters of railgun as a plasma accelerator.

The work was partly supported by Russian Foundation for Basic Research (grant RFBR 18-08-01503).