Cs-Ba Switching Devices for Efficient Current Management Using Plasma Instabilities

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At present, the problems of current control in the electrical circuits of space nuclear power plants are topical. Effective radiation-resistant electronic switching devices, thermionic converters, current and voltage stabilizers, transformers, generators are needed. To solve this problem it is possible to use radiation-resistant electronics based on a strongly nonequilibrium anisotropic plasma. Thus in this work, we have investigated electrokinetic parameters of diode and triode switching devices with cesium-barium filling, the following results were obtained:

Diode device:

- the possibility of controlling the current modulation by means of an auxiliary discharge, as well as external electric and magnetic fields has been founded;
- it has been established, that full current modulation at an ignition voltage of 5…6 V and a discharge current density of ~10 A/cm^2 can be implemented due to the development of Bursian-Pierce plasma instability [1] and the formation of nonlinear structures in the plasma.

Triode device:

- it has been established, that mechanism of discharge extinction using fine-mesh grid, as well as the mechanism of spontaneous breakage, is associated with nonlinear oscillations in the Knudsen plasma;
- stable modulation at frequencies of 1-10 kHz of specific electric power of 5 kW/cm^2 and an efficiency of more than 95% was obtained at the anode voltage 50 V;
- the use of fine-mesh grid as a control electrode provides high power in the range of cesium vapor pressures of 10^{-4}-10^{-2} Torr and low voltage losses in the open state of 0.8-2.5 V.

References

[1] Ender A.Ya., Kuznetsov V.I., Schamel H., Akimov P.V. Switching of nonlinear plasma diodes. 1. Analytic theory. Phys. Plasmas, 2004, vol. 11, no. 10, pp. 3212–3223.