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APPLICATION OF GRID ELECTRODE IN PLASMA ACCELERATOR, PRODUCTION OF HIGH-SPEED BORON JET *)

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In this paper, it is proposed to use a central electrode of coaxial plasma accelerator (directed jet velocity is about 100 km/s, density is ~ 10^{16} cm^{-3}, the pressure is up to 2 bar [1]) with ribbing, which allows to reduce the yield of metal impurities in the resulting jet. Central electrode ribbing is created by applying a stainless steel mesh to the surface of the electrode rod.

One of the existing problems of using a plasma accelerator in a tokamak as an injector is the noticeable release of metal impurities from electrode erosion. In coaxial geometry, the area of outer electrode (with an internal diameter of 46 mm) is 4.6 times larger than area of central electrode (with diameter of 10 mm). Therefore, due to the higher current density on central electrode surface compared to the outer one, metal evaporation occurs more intensively. This is confirmed by numerous tests, after which damage to central electrode is regularly observed. The decision to use a grid on the central electrode (a rods diameter of 0.1 mm, a cell size of 0.1 mm) allows increasing its surface area while reducing surface current density.

All experiments were conducted on experimental test bench. The plasma accelerator was powered by capacity of 200 μF. Pulse current was ~ 100 kA, time duration was ~ 12 μs. The voltage applied to electrodes was 4-5 kV. Gas: hydrogen, helium. A survey spectrometer was used to determine the composition of the jet.

The problem of feeding boron into the tokamak reactor for possible formation of p-^{11}B fusion in the reactor was considered separately. p-^{11}B fusion is a promising direction in the field of controlled fusion, which has a number of advantages over the DT reaction, primarily in the absence of neutron emission [2]. However, the issue of efficient boron supply to the reactor center has not been resolved. The plasma accelerator is capable of forming a jet with a high directed velocity and high density. Initially, it was planned to form a discharge by feeding boron in the form of powder into the interelectrode region, but this method did not allow ionizing boron and developing a discharge. As a result, jet with boron was obtained using a double-layer grid, rods diameter of 0.1 mm, a cell size of 0.1 mm, applied to the central electrode. Boron powder with a granule size of 50 μm was introduced between electrode and grid. Discharge was formed by injecting helium into interelectrode gap and its breakdown. Boron granules are carried away by discharge and exit as part of the jet. At exit from the accelerator, jet spectra with characteristic lines of helium and boron are obtained.

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*) abstracts of this report in Russian