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USE OF LITHIUM CAPILLARY STRUCTURES IN OHMIC DISCHARGES OF TOKAMAK T-10 *)

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This paper presents the results of experiments on the T-10 tokamak using lithium capillary-porous structures. At the first stage, lithium was sputtered onto the chamber at the location of the circular and rail graphite limiters before a series of experiments. It has been shown that spraying lithium with graphite diaphragms can significantly reduce deuterium recycling and the level of impurities in the plasma. In this case, recycling is significantly reduced by 5-10 discharges, but completely returns to its previous level after 20-50 discharges. After lithiation of the tokamak chamber, regimes with an effective plasma charge close to unity were obtained with a significant reduction in radiation losses and loop voltage. The effect of reduction of impurity levels lasted for 1-2 weeks.

The second stage used a lithium-filled capillary porous structure as a moving rail diaphragm in a T-10 configuration with tungsten main limiters. The introduction of a lithium diaphragm into the SOL region leads to an increase in lithium flows and its accumulation on the chamber. As a result, there is a significant decrease in the level of impurities and the effective charge approaches unity. Despite the strong influence on impurities, the lithium concentration in the central regions remains less than one percent.

Experiments with deep insertion into the region of closed magnetic surfaces showed reliable operation of the lithium capillary structure with longitudinal plasma heat fluxes up to 3.6 MW/m2. It is shown that the introduction of a diaphragm leads to purification of the plasma from impurities, similar to experiments with lithium spraying and the introduction of a diaphragm into the SOL of plasma. However, in a number of experiments, a strong increase in bolometric losses and loop voltage was observed with a decrease in the level of light impurities. In this case, the radiation losses characteristic of tungsten had maximum in the central regions of the plasma.

Under conditions of good impregnation of the capillary structure with lithium, when the diaphragm was introduced into the hot region of the plasma, in some experiments the discharges ended with disruptions due to massive injections of lithium droplets from the diaphragm. It is shown that the emission of droplets is associated with the squeezing out of lithium due to pondermotive forces of the current to the diaphragm from the plasma in a magnetic field.

Experiments have shown a strong dependence of lithium sputtering on the temperature of the plasma interacting with the diaphragm.

It was discovered that at high heat fluxes onto the lithium diaphragm, the effect of thermal stabilization by evaporating lithium occurs. Estimates showed that at T-10 it was observed when the lithium temperature reached about 500 0C. However, a more realistic estimate is 450 C0, made in experiments on the FTU tokamak.

The introduction of the diaphragm to the closed magnetic surfaces caused strong heating and evaporation of lithium. In this case, the maximum level of gas injection turned out to be insufficient to maintain the density in the discharge and cool the periphery due to a strong drop in recycling. As a result, increased lithium flows led to almost completely lithium plasma.

*) abstracts of this report in Russian