system of LITHIUM AND TUNGSTEN LIMITERS OF T-10 TOKAMAK FOR ECR PLASMA HEATING POWER UP TO 3 MW

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The use of powerful (up to 3 MW) ECR heating of plasma in tokamak T-10 is faced with the problem of severe contamination of plasma with the introduction of more than 2 MW. The reason for this is the existing complex of graphite diaphragms, which includes an annular and rail diaphragms. Since they are located in the same branch pipe, they have a relatively small effective contact area with the plasma and a strong local overheating and erosion. Additionally, the use of graphite limiters leads to the formation films on the surface of the chamber’s walls, significantly increasing the flow of impurities and the recycling of the working gas.

To solve these problems a new complex tungsten and lithium limiters are developed and preparing to implement. As expected, the use of tungsten as the turned to plasma material would eliminate the supply of graphite, and cooling the periphery of the plasma due to the reirradiation at lithium will reduce the energy flux to the tungsten diaphragm. Auxiliary lithium diaphragm located in the shadow of tungsten diaphragms will be used as a source of lithium.

Settings and design of limiters are presented in the report. Lithium diaphragm is placed in the upper vertical port of the chamber of tokamak T-10 and can move relative to LCMS. The movement of the limiter in the SOL area allows adjusting the incoming flow of energy and, as a result, adjusting the flow of lithium to plasma. The plasma-facing surface of the limiter are made of capillary-porous system (CPS) with lithium. CPS material (tungsten felt with pore radius of 30 microns) ensures the stability of the limiter’s lithium surface under the MHD forces and the possibility of its constant renewal due to capillary forces.

The report presents evaluation of necessary flow of lithium from the surface of the lithium limiter to the plasma to ensure normal operation tungsten limiters with the ECR heating power of 3 MW for 400 MS. It is shown that the Zeff of the plasma should not exceed the value of Zeff = 2 in this case. In addition, it was estimated flux of lithium on the wall of the tokamak based on the results of a study of lithium behavior in tokamak T-11M. It is shown that ~13.5 g of lithium comes on the wall for a company of 1000 pulses. This value is comparable to the lithium arrives with using the evaporator-lithiator for conditioning the walls of the T-10 in the previous experiments.

Thus, the report shows that the modernization of the limiters on tokamak T-10 will provide regimes of ECR heating up to 3 MW with a reasonable flow of lithium.