**Study of the operating regimes of a lithium divertor for the DEMO-FNS**

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It has long been recognized that volumetric dissipation of the plasma heat flux within the tokamak SOL is preferred to its localized contact with the divertor target. Volumetric dissipation mitigates both the anticipated very high heat flux and intense particle-induced damage due to sputtering [1]. Tungsten and beryllium as the plasma facing materials of ITER divertor could be damaged even during steady state plasma operation. Nowadays, a lithium vapor box [2][3] is being considered as an alternative divertor concept, which can reduce the parallel heat fluxes by 4 orders of magnitude for the DEMO conditions, namely from 20 GW/m$^2$ down to about 2 MW/m$^2$, with moderate lithium efflux from the box to the plasma core.

Preliminary estimations to choose an appropriate DEMO-FNS lithium divertor design were made. It was shown that the system with the incoming energy dissipation by means of Li evaporation in boxes with cold walls [2] for the double null magnetic configuration looks more suitable: heat loads onto walls – ≈ 0.5 MW/m$^2$ – don't exceed the 10 MW/m$^2$ engineering limitation and the lithium efflux into the core plasma reaches the value about 1 mg/s which should not lead to the degradation of thermonuclear reaction parameters. Analysis of the divertor in approach of dense Li vapor in boxes with hot walls [3] was conducted with amount of boxes from 2 to 4. The design with 3 boxes is preferable: Li efflux through separatrix and average wall heat flux are 1.4 mg/s, 1.66 MW/m$^2$ and 0.5 mg/s, 0.91 MW/m$^2$ for outer and inner divertor legs accordingly.

Several mechanisms of suppression of lithium flow from divertor have been taken into account: ionization, geometrical and ablation shielding. It was demonstrated that lithium efflux into the main plasma is suppressed mainly due to the ionization process within SOL which exponentially depends on its width. Plasma parameters within divertor and SOL for DEMO-FNS were roughly estimated. To obtain more accurate values it is necessary to conduct 2D modeling of SOL and divertor with lithium. Engineering and technological study of such design is also required.

This work was supported by the Ministry of science and higher education of Russian Federation in the framework of the state contract in the field of science under project No. 0784-2020-0020 using the Federal Joint Research Center "Material science and characterization in advanced technology" (project RFMEFI62119X0021), including the unique scientific facility "Spherical tokamak Globus-M".

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