

DOI: 10.34854/ICPAF.51.2024.1.1.071

EXPERIMENTAL STUDIES OF THE POSSIBILITY OF THE LITHIUM LEVEL CONTROL ON THE T-11M TOKAMAK BY APPLYING VOLTAGE TO THE EMITTER AND COLLECTOR ^{*)}

Shcherbak A.N., Mirnov S.V., Lazarev V.B., Vasina Ya.A., Leshov N.V., Antonov P.A., Zorin A.V., Ageev A.V., Dzhigailo N.T., Dzhurik A.S., Otroshchenko V.G., Petrova N.P., Prishvitsyn A.S., Petrov Yu.V., Morozov V.A.

JSC "SRC RF TRINITI", Troitsk, Moscow, RF, shcherbak@triniti.ru

It is well-known that the use of lithium as plasma facing material in tokamaks has a strong positive effect on the characteristics of the plasma discharge. Firstly, the introduction of lithium to the edge plasma leads to the decrease in the content of low Z impurities. In addition, it prevents the penetration of high Z impurities into the core plasma, which results in the decrease the effective charge of the plasma and the increase the electron temperature [1].

As was proposed earlier [2], it is used the creation of a closed lithium circulation loop in the SOL (scrape-off layer) region for the intrachamber elements protection. Lithium emitters are used for lithium injection into the SOL plasma, and lithium collectors are used for its collection from the SOL and return transportation to the emitter. In the situation of a quasi-stationary discharge it is proposed to use a simplified semi-closed lithium circulation loop. It is necessary to remove captured lithium from the collector with simultaneous refilling of the emitter to the initial level between discharges. The number of such cycles of the "lithium removal – lithium refilling" have to decrease due to the effect of the appearance of "secondary" collector-emitters [3] in the shadow of the main lithium emitter. Such "secondary" collectors are capable of gradually accumulating of the lithium incoming from the plasma with following increasing return flow to the plasma. Thus, the lithium injection from the main emitter is decreased. As a result, equilibrium occurs when the emission of lithium from the main emitter and the removal of "excess lithium" from the collector reach a minimum level. Consequently, it is need to control the level of lithium emitted to the plasma from both the emitter and the collector in order to reduce the total lithium content in the discharge chamber of a quasi-stationary tokamak and prevent its accumulation.

The possibility of the lithium level control in the chamber of the T-11M tokamak and the possibility of lithium flows control by applying potentials of different polarities to the intrachamber elements relative to the walls of the discharge chamber were investigated in the paper. The voltage applied to the emitter and the collector.

It has been shown that applying a negative potential to the collector relative to the walls leads to the increase in lithium collection by at least 1.5 times compared to the case when a positive voltage was applied to it or the collector was shorted to the chamber.

The positive voltage supply to the emitter increases the flow of lithium to the edge plasma.

References

- [1]. Lyublinski et al, Complex of lithium and tungsten limiters for 3 MW of ECR plasma heating in T-10 tokamak. Design, first results, Nucl. Fusion, 57 (2017) 066006.
- [2]. S. Mirnov et al, Experiments at the T-11M device in support of the tokamak concept with closed Li cycle, Fusion Engineering and Design, 2010, Vol. 85, I. 6, 919-923.
- [3]. Mirnov, S. et al, Experiments with lithium limiter on T-11M tokamak and applications of the lithium capillary-pore system in future fusion reactor devices, Plasma Phys. Control. Fusion, 48 (2006) 821-837.

^{*)} [abstracts of this report in Russian](#)