Investigation of dependence of lithium and hydrogen collection by collector target from temperature of target surface in emitter-collector system on T-11M tokamak

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One of the key elements of the closed lithium loop concept near the first wall of the steady-state fusion neutron source (FNS) is a lithium collector for the collection of lithium “waste” and unused “fuel” (isotopes of hydrogen) for subsequent return to the plasma column. An important feature of the lithium collector efficiency is the degree of trapping of the falling lithium ions flow on collector. For example, for a smooth metal collector of stainless steel in the case of cooling it with liquid nitrogen, this coefficient could be considered close to 1, at least during the duration of exposure of 600 operating pulses of T-11M (it is equivalent to about 150 s of continuous operation of the collector). Under steady-state operating conditions, the collector target cooling with liquid nitrogen becomes unprofitable, and it should be ready for the transition to other ways of cooling and, respectively, to other working temperatures of lithium collectors surfaces. Therefore, the question of the tolerance limit of surface temperature deviations from the cryogenic level is important in real conditions, when the collector surface is already covered with the active layer of the absorbed lithium. Thus, the goal of this work was to study the efficiency of a smooth metal coating as a collector with respect to the incident lithium and hydrogen ions, namely, the determining of the acceptable temperature range for lithium and hydrogen collection by the lithium target.

Experiments were carried out on T-11M tokamak in typical discharges: \(I_p = 70\) kA, \(B_T = 1.4\) T, \(t = 200\) ms, \(n_e = 3\cdot10^{19}\) m\(^{-3}\). A vertical lithium limiter of T-11M was used as a Li emitter and a longitudinal lithium limiter was used as a Li collector. A movable collector target of stainless steel placed in the “shadow” of the vertical lithium limiter in the SOL zone was introduced in the tokamak chamber to a distance of about 10 cm. In addition, in the “shadow” of the main emitter a graphite limiter was located, which serves as an indicator of the lithium flow at the periphery of the plasma column.