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Plasma-wall interactions and plasma behaviour in fusion devices with liquid lithium plasma facing components

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The main requirement to the first wall of the steady-state tokamak reactor is its ability to the long-time operations without significantly altering of its physical properties under heavy bombardment by the hot hydrogen plasma. As shown by laboratory experiments the surface of all known hard materials is destroyed during the steady-state hydrogen plasma operations and must be periodically replaced. The application of liquid lithium as a self-recovery and renewable material of plasma facing components (PFC) can solve the PFC problem of the steady-state fusion reactor. This paper is an overview of liquid Li application in the current tokamaks: T-11M (TRINITI, RF), T-10 (Kurchatov, RF) which used the plasma limiters based on the tungsten capillary-pore system (CPS) concept. Lithium coated CPS suppresses the splashing of molten metal during the development of plasma instabilities and can be used as lithium emitter – collector in the scrape-off layer (SOL) of the tokamak limiter or divertor. The crucial issue of the tokamak plasma is its impurity contamination. Lithium experiments in the current tokamaks discovered the poor lithium penetration into the hot plasma core from its periphery (lithium screening) and the appearance of the lithium non-coronal irradiative blanket in the plasma SOL. Lithium screening can be the physical basis of the closed lithium circuit concept with the irradiated blanket which can protect PFC from a high local heat load. The paper gives an overview of the recent experiments with removal of hydrogen isotopes from lithium CPS and SS collector. Finally, it will be discussed the possibility of the use of lithium-tungsten CPS for steady-state fusion neutrons sources (FNS) based on tokamak device.

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