Experience in the development of liquid metal plasma facing elements based on capillary pore structure for steady state operating tokamak

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Realization of steady-state operation of fusion reactor leads to the necessity of development of essentially new design and material for plasma facing elements (PFE). In this sense the most perspective decision is the concept of use of capillary-porous system (CPS) with liquid metal that provide PFE surface self-renewal and simultaneously the closed circulation of their corrosion products. Lithium and probably its alloy with tin are considered as the most promising liquids. It has been shown that the introduction of lithium in plasma SOL provides strong screening effect for plasma pollution. At the same time, lithium is not penetrating to plasma core. It results in substantial improvement of plasma confinement and promote achievement of practically stationary modes of plasma burning. Furthermore, the problem of power exhaust with high specific density (20-30 MW/m²) and upkeep of a comprehensible level of temperature on PFE surface can be overcame by the introduction of heat removal system into PFE design.

Experience in development, creation and experimental study of CPS based models of steady-state operating lithium PFE with systems of thermal stabilization for T-11M, T-10, FTU and KTM is considered. The possible scheme of liquid metal PFE concept realization in DEMO type and tokamak based neutron source reactors is presented.