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# Improvement of plasma performance with flowing liquid lithium PFCs in EAST

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Flowing liquid lithium (FLiLi) used as a plasma-facing component (PFC) has been shown to improve plasma performance, due to reduced fuel recycling and impurity generation, in several devices. Liquid Li PFCs may provide a potential solution to the problem of power exhaust for the divertor design of future DEMO device, but many technical questions require answers. Good progress has been achieved using flowing liquid lithium (FLiLi) limiters in the EAST device, with a thin, slowly flowing free boundary Li film with a thickness of <0.1 mm and a flow rate ~2 $cm^3s^{-1}$. Three FLiLi designs have been deployed for particle and power exhaust in EAST.

First, it was confirmed that liquid Li could be driven by an innovative in-vessel DC electromagnetic (EM) jxB pump, using the steady state toroidal field, to form a recirculating loop in 2014[1]. Second, several technology improvements, e.g. an improved manufacturing method for uniform Li distribution, an additional EM pump for supplying liquid Li to the Li distributor, surface texturing to improve wetting [2], a thicker SS protective layer, and a new cooling system using high pressure He gas, were deployed in 2016[3]. These improvements effectively resulted in the improvement of liquid Li surface coverage, the elimination of surface erosion, and the increase of heat exhaust capability. Third, an upgraded 3rd generation FLiLi using Mo as the substrate material with a high corrosion resistance, high sputtering threshold, and a good wettability to Li was developed, targeting more uniform Li flow than previous limiters using stainless steel (SS) layer as substrate. Promising results were obtained during the FLiLi operation, including a reduction of impurities and recycling to improve plasma confinement [1], and an edge Li emission layer due to the strong plasma-material interaction between the liquid Li surface and plasma [4]. The FLiLi limiter program has shown basic compatibility with H-mode discharges with auxiliary heating power up to 8.3 MW. Moreover, a gradual mitigation of edge localized mode (ELM) activity in H-mode plasmas was observed with FLiLi operation [5]. Upcoming experiments target the use of thermoelectric MHD force to drive liquid Li flow along the surface channels. These efforts are aimed at generating designs and evaluating the feasibility of liquid Li PFCs for a DEMO divertor.

References

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