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Latest results from a new TZM substrate flowing liquid Li limiter during high confinement plasmas in EAST device

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Significant engineering and scientific progress has been achieved using flowing liquid lithium (FLiLi) midplane limiters in the EAST facility, based on the concept of a thin (<0.1 mm), slowly flowing (cm/sec) Li film on a number of substrates [1-4]. Three generations of limiters have been deployed, with different substrate materials, surface conditioning techniques, and design characteristics. This talk will emphasize results from the third generation limiter in Aug. 2018, which used a Mo alloy (TZM) substrate instead of stainless steel-coated copper that was used in 2014 and 2016. FLiLi used as a divertor plasma-facing component (PFC) has the potential to improve plasma performance of a future DEMO device, building on the success of lithium conditioning in present day devices. Due to the progressive successes of the FLiLi limiter program, a 3rd generation limiter constructed entirely of TZM, an alloy with >99% Mo, was fabricated by conventional manufacturing techniques. Mo was chosen due to its high corrosion resistance, high sputtering threshold, and a good wettability to Li, as compared to stainless steel-coated copper. The third generation FLiLi was inserted at the outer midplane in EAST H-mode plasmas in an upper single-null configuration with auxiliary power and stored energy ˜8.3 MW and 280 kJ respectively. It was found that continuous, closed-loop Li flow with ˜80% surface wetting fraction was achieved, similar to the second generation FLiLi. The fuel retention rate was ˜200% higher than that with a Li coated wall. Furthermore, edge localized modes (ELMs) were strongly mitigated in H-mode plasmas with RF heating, possibly due to reduced recycling and anticipated changes in the edge density and pressure profiles. Details of the FLiLi design and performance, and concepts to extend the technology for divertor PFCs will be presented. [1] J. S. Hu, et al., Nucl. Fusion 56, 046011 (2016). [2] G. Z. Zuo, et al., Nucl. Fusion 57, 046017 (2017). [3] G. Z. Zuo, et al., Nucl. Fusion 59, 016009 (2019). [4] R. Maingi, et al., in IAEA FEC 2018, Gandhinagar, Gujarat, India, 22-27 Oct. 2018, paper FIP/3-5Ra.