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ELM pacing with lithium granules injection in W divertor on EAST

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Pellet ELM pacing is a baseline ELM control strategy for ITER. While reliable and effective ELM pacing has been achieved by injection of deuterium pellets into carbon-walled tokamaks, the reduction of peak heat flux with high frequency ELM pacing in metal-walled tokamaks has been marginal. In comparison, the use of non-fuel pellets such as lithium (Li) is desirable for ITER due to its decoupling ELM pacing from fueling. For ELM control, Lithium Granule Injection (LGI) experiments have been carried out on EAST [1] and DIII-D[2]. The injection of sub-millimeter Li granules to trigger and pace ELMs has demonstrated heat flux mitigation on EAST and DIII-D, each with a carbon wall. In 2016, the LGI experiment was performed in tungsten (W) divertor on EAST, and some exciting results of LGI applications were obtained. ELM pacing efficiency was studied by injecting Li granules of nominal diameter 0.3–0.9 mm, with injected speed of 50–120 m s−1. Robust ELM pacing with 100% efficiency of ELM triggering by Li granules injection was demonstrated in ITER-like wall plasmas during Li granule injection. ELM frequency was paced to ~130Hz from 300Hz, and high Z impurity accumulation was not observed. The experimental observations indicate that ELM triggering efficiency depends on many interwoven parameters, such as granule size, penetration depth, and heating scheme. Higher power discharges require larger granules for efficient triggering. A wide range of granule penetration depths was observed by two fast cameras. It was also observed Li granules injection shifted the density profile outward, which changed the characteristics of the edge fluctuations, i.e. more easily destabilizing the edge coherent mode. This work strengthens the basis for ELM pacing in future reactors.

[1]. D.K. Mansfield et al., Nucl. Fusion 53 (2013) 113023
[2]. A. Bortolon et al., Nucl. Fusion(2016) 56 056008

Eligible for student paper award?

No

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