Improved H-mode Performance by Injection of Lithium Aerosol into the NSTX Scrape-Off Layer in Real Time*

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Lithium wall conditioning by injecting an evaporating aerosol of elemental lithium droplets into the plasma scrape-off layer (SOL) in real-time has been accomplished on the National Spherical Torus Experiment (NSTX). The method of injection involved the controlled dropping of a fine powder of spherical (44 micron diameter) lithium particles. This method of conditioning has allowed for greater flexibility as compared to lithium conditioning by evaporation. For example by simply controlling the timing of lithium injection, this technique has allowed for predetermined amounts of lithium to be (a) pre-positioned on the NSTX lower divertor before plasma breakdown (b) present at the midplane of the center stack during breakdown, (c) injected continuously at the plasma edge or (d) injected "surgically" into the outer strike point of an upper single null discharge. The injected mass flux (droplets/s) can also be modulated in time using the dropper/injector.

The injection of lithium droplets into the plasma edge has led to improvements in plasma H-mode performance approaching those that have been associated with lithium wall conditioning accomplished by evaporation before plasma initiation [1, 2]. As compared to discharges without lithium conditioning, these effects include: increases of electron and ion temperatures as well as stored energies, the elimination of ELM activity and a modest decrease in plasma density. These observations as well as the reduction of accumulated of impurities associated with ELM-free operation will be discussed.

In addition, it appears that NSTX H-mode discharges can tolerate a remarkably large influx ($> 5 \times 10^6$ droplets/s = 120 mg/s of Li = 160 TL/s of D_2) of lithium aerosol particles in the SOL without deleterious effects.

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[1] H.W. Kugel, *et al.,* Physics of Plasmas 15 (2008) 056118.
[2] M. G. Bell, *et al*., Plasma Phys. Control. Fusion 51 (2009) 124054.