Effect of Lithium on the Edge Plasma in NSTX and NSTX-U

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Strategic planning studies have identified control of the plasma-material interface as a critical area for realization of power production. Solid plasma-facing components (PFCs) are the leading candidates for future devices, predominantly serving as PFCs for present devices. While ITER has been designed to work with W and Be, there is little safety margin on heat flux removal capability[1]. The power exhaust challenge for reactors the size of ITER is even harder, requiring higher amounts of core and divertor radiation[2]. Liquid metal PFCs have some attractive features that could remove some of the restrictions of solid PFCs. The typical erosion and PFC performance degradation of solid PFCs can be obviated with self-healing surfaces; the challenge shifts to controlling core impurity content, and managing tritium retention. Finally lithium PFCs, both solid and liquid, can provide access to low recycling, high confinement regimes, e.g. at $\geq$2x H-mode scalings[3], enabling attractive core and edge plasma scenarios.

Lithium coatings were used to reduce recycling, improve edge plasma performance and eliminate ELMs in NSTX[4-6], owing to the inward shift of the density and pressure profiles. Recent analysis confirmed that these profile and stability effects were also present in highly-shaped, high-performance NSTX discharges[7]. A liquid lithium divertor demonstrated control of lithium inventory, and prevented droplet injection via droplet size control[8]. Lithium coatings are the first stage of the liquid metal PFC program in NSTX-U[9], and results of a controlled lithium dose scan will be reported, if available, for comparison with previously published NSTX results.

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