Topic: EX-C

Edge plasma transport and microstability analysis with lithium-coated plasma-facing components in NSTX

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The application of lithium coatings to the plasma-facing components (PFCs) of the National Spherical Torus Experiment (NSTX) has been shown to strongly impact plasma performance, improving energy confinement and eliminating ELMs. The pedestal structure is strongly affected by lithium: in discharges with lithium coatings, the density pedestal widens, and the electron temperature (T_e) gradient increases inside a radius of ψ_N~0.95, but is unchanged for ψ_N >0.95. Interpretive 2-D plasma/neutrals modeling has been performed for pre-lithium and with-lithium discharges. The modeling indicates that the application of lithium to the PFC surfaces reduces R from ~0.98 to 0.9. The inferred effective electron thermal (χ_e^{eff}) and particle (D_e^{eff}) profiles reflect the profile changes: χ_e^{eff} is similar in the near-separatrix region, and is reduced in the region ψ_N < 0.95 in the with-lithium case. The D_e^{eff} profile shows a broadening of the region with low diffusivity with lithium, while the minimum value within the steep gradient region is comparable in the two cases. The linear microstability properties in the near-separatrix and pedestal-top regions have been analyzed. At ψ_N=0.88, low-k ($k_\theta\rho_s$ < 1) microinstabilities are unstable, with the dominant modes being ITG-like in the pre-lithium case and TEM-like with lithium. The radial electric field shearing rate at this location increases with lithium, becoming significant compared to the maximum linear growth rate. In the region ψ_N>0.95, both the pre- and with-lithium cases are calculated to be strongly unstable to ETG modes, and are also both found to lie near the onset for kinetic ballooning modes.