Modeling the effect of lithium on SOL dynamics and the SOL heat flux width observed in NSTX

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Abstract

The effect of lithium wall coatings on scrape-off-layer (SOL) turbulence is modeled with the Lodestar SOLT code to explore the implications for the SOL heat flux width on NSTX of experimentally observed, Li-induced changes in the pedestal profiles. The connection is important because pedestal profiles impact the overall fusion performance of ITER and future machines while the SOL heat flux width impacts the survivability of divertor target plates. The SOLT code used in the modeling has been expanded recently to include ion temperature evolution and ion diamagnetic drift effects. This work focuses on two NSTX shots: pre- and post-Li deposition. The simulation density and energy profiles are constrained, inside the last closed flux surface *only*, to match those measured in the two experiments, and the resulting drift-interchange-driven turbulence is explored. The effect of Li enters the simulation only through the profile constraint: Li modifies the experimental density and temperature profiles, and these profiles affect the simulation SOL turbulence. The power entering the SOL (P_{SOL}) measured in the experiments is matched in the simulations by adjusting "free" dissipation parameters (e.g., diffusion coefficients) that are not measured directly in the experiments. At power-matching, (a) the heat flux SOL width (λ_q) is smaller in the post-Li case, as observed experimentally, and (b) density fluctuation amplitudes are reduced, post-Li, also as observed. The instabilities and saturation mechanisms that underlie the SOLT model equilibria are discussed.

* Work supported by USDOE grants DE-FG02-97ER54392 and DE-FG02-02ER54678.