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Lithium conditioning leads to a low collisionality edge and reduced recycling in LTX-beta

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We report the first observation of access to global recycling (R_W) near 0.5 from the plasma-facing components in the Lithium Tokamak eXperiment Beta (LTX-β), significantly below the minimum $R_W \sim 0.85$ reported in other devices using Li conditioning. We also observe that with increasing Li coating thickness, the effective particle confinement time τ_p^* is reduced while energy confinement τE (at fixed density) increases, with $\tau_E \sim \tau_p^*$ at the lowest recycling coefficients. Flat Te profiles with a hot edge, first reported in LTX, have been sustained for multiple τ_E – another clear signature of access to the low recycling regime. LTX-β operates with near complete coverage of lithium on its all-metal PFCs. In a series of experiments with varied Li wall conditioning, estimates of the recycling coefficient have been made using a Lyman-α array and DEGAS2 modeling. We observe a progressive reduction in Lyman-α emission with increased lithiumization and an increase in edge T_e. The particle flux to the limiting surfaces appears to be significantly reduced in comparison to fluid SOL models, indicating that a large fraction of the SOL ions are mirror trapped. Collisionality drops more than an order of magnitude below the banana regime boundary, indicating the importance of kinetic effects. Full-f 1x2v gyrokinetic simulations of SOL field lines with the GKEYLL code indicate that the fraction of ions trapped along field lines increases as collisionality drops, as a result of increased lithium evaporation. Predictions of the impact of high trapped ion fraction from GKEYLL are being evaluated with available experimental data.

Note: Abstract should be in (full) double-columned one page.