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Compatibility of lithium plasma-facing surfaces with high edge temperatures in the Lithium Tokamak Experiment (LTX)[1]

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High edge electron temperatures (200 eV or greater) have been measured at the wall-limited plasma boundary in the Lithium Tokamak eXperiment (LTX). High edge temperatures, with flat electron temperature profiles, are a long-predicted consequence of low recycling boundary conditions. The temperature profile in LTX, measured by Thomson scattering, varies by as little as 10% from the plasma axis to the boundary, determined by the lithium-coated high field-side wall. The hydrogen plasma density in the outer scrape-off layer is very low, 2-3 x 10^{17} m^{-3}, consistent with a low recycling metallic lithium boundary. The plasma surface interaction in LTX is characterized by a low flux of high energy protons to the lithium PFC, with an estimated Debye sheath potential approaching 1 kV. Plasma-material interactions in LTX are consequently in a novel regime, where the impacting proton energy exceeds the peak in the sputtering yield for the lithium wall. In this regime, further increases in the edge temperature will decrease, rather than increase, the sputtering yield. Despite the high edge temperature, the core impurity content is low. Z_{eff} is 1.2 – 1.5, with a very modest contribution (<0.1) from lithium. So far experiments are transient. Gas puffing is used to increase the plasma density. After gas injection stops, the discharge density is allowed to drop, and the edge is pumped by the low recycling lithium wall. An upgrade to LTX which includes a 35A, 20 kV neutral beam injector to provide core fueling to maintain constant density, as well as auxiliary heating, is underway. Two beam systems have been loaned to LTX by Tri Alpha Energy. Additional results from LTX, as well as progress on the upgrade – LTX-β – will be discussed.

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