Results from LTX with solid and liquid lithium walls

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The Lithium Tokamak Experiment (LTX) is an ohmically heated moderate-sized low aspect ratio tokamak with a heated liner or shell, which covers 80 % of the plasma surface area (4 m^2). In 2014, a new approach to lithium wall coatings was developed. Two 1.5 – 2 kW electron beam systems are used to evaporate lithium from a pool of liquid at the bottom of the lower shell. The e-beam system produces a 50 – 100 nm coating of liquefied lithium on the heated shells in < 5 minutes. Discharges using the new evaporative coating system have strongly reduced impurities, especially oxygen. Confinement in LTX ohmic discharges is now improved by up to 10×, compared to previous results with helium-dispersed coatings. Confinement times now exceed ITER ELMy H-mode scaling by 2-4× [J. C. Schmitt et al., Phys. Plasmas **22**, 056112 (2015)], with liquid or solidified lithium coatings. Core impurity concentrations of lithium have been measured to be <0.5%, with full liquid lithium walls at 240 C. This is the first experimental evidence that high performance tokamak discharges are compatible with large-area liquid lithium walls. Surface analysis of the e-beam evaporated films has been performed, which shows that the surface is primarily clean metallic lithium. Recent experiments in which the discharge density is fueled by high field side gas puffing to ~3×10^{19} m^{-3}, and then allowed to decay with no further fueling, show the development of broad, flat electron temperature profiles to the last closed flux surface, after gas puffing is terminated. Broad, flat electron temperature profiles have long been predicted as a consequence of very low recycling walls [S.I. Krasheninnikov, L. E. Zakharov, and G. V. Pereverzev, Phys. Plasmas **10**, 1678 (2003)], but this is the first observation of such profiles. Preliminary results for lithium concentrations in the core plasma with this very hot (>200 eV) edge are in the 5-10% range. Results and near term plans for an upgrade of LTX (LTX-U) will be summarized.