Edge Transport and Turbulence Reduction, and the Formation of Wide Pedestals with Lithium Coatings in NSTX

R. Maingi and J.M. Canik, *Oak Ridge National Laboratory*

The coating of plasma facing components (PFCs) with lithium improves energy confinement [1] and eliminates ELMs in the National Spherical Torus Experiment (NSTX), the latter due to a relaxation of the density and pressure profiles that reduces the drive for peeling-ballooning modes [2]. Here we show that both a reduction in recycling (due to lithium pumping) *and* cross-field transport is needed to reproduce the measured profile changes [3]. Furthermore we document a concomitant density fluctuation reduction measured in the steep gradient region.

The experimental transport coefficients are obtained [4] via data-constrained modeling using the SOLPS code [5], which couples a 2D fluid treatment of the edge plasma transport to a Monte Carlo neutrals calculation. First, a reduction in the PFC recycling coefficient from R~0.98 to R~0.90 is required to match the drop in D_α emission with lithium coatings. Furthermore, a ~75% drop of the D_{eff} and χ_e from $0.8 < \psi_N < 0.93$ are needed to match the profile relaxation with lithium coatings; indeed, the region of low transport in the H-mode simply extends to the innermost domain of the simulation. Note that transport is similar with and without lithium coatings outside of ψ_N ~0.93, with D_{eff}/χ_e~0.2/1.0 m^2/s. Turbulence measurements using an edge reflectometry system [6] show a sharp decrease in broadband density fluctuation levels with lithium coatings, with$\delta n/n$ reduced by an order of magnitude.. Turbulence from high-k scattering is also reduced. These transport changes allow the realization of very wide pedestals, reflecting a ~100% width increase relative to the reference discharges. * Research sponsored in part by U.S. Dept. of Energy under contracts DE-AC05-00OR22725 and DE-AC02-09CH11466.

[1] H. W. Kugel *et al*, Phys. Plasma **15** (2008) 056118.

[2] R. Maingi *et a*l, Phys. Rev. Lett. **103** (2009) 075001.

[3] J.M. Canik, *et a*l, Phys. Plasmas (2011) submitted.

[4] J.M. Canik, *et a*l, J. Nucl. Mater. (2011) at press.

[5] R. Schneider *et al*, Contr. Plasma Phys. **46** (2006) 3.

[6] S Kubota *et al*, Bull. Am. Phys. Soc. **53** (2008) 188.