Deuterium Retention in NSTX with Lithium Conditioning*

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Fuel retention is an important constraint in the selection of plasma facing materials for next-step tokamaks and a key concern for ITER. Lithium coated plasma facing components in NSTX have reduced D recycling, suppressed ELMs and improved confinement[1,2].We report on gas balance measurements of retention in NSTX before- and with lithiumization of the vessel. The gas retained in ohmic discharges was measured with the pumping valves closed by comparing the vessel pressure rise to that of a gas-only pulse. For neutral beam (NB) heated H-mode discharges the gas input and gas pumped by the NB cryopanels was carefully tracked. Special attention was paid to a smooth ramp down of plasma stored energy, to minimize heating of the plasma facing components. High (≈ 90%) prompt retention of the D fuel was observed for ohmic and H-mode discharges both with- and without lithiumization. The edge neutral pressure was substantially reduced by lithium and the retention fraction was slightly higher, however the additional retained D was released after the discharge. The wall inventory was calculated by a particle balance model and increased continuously during the discharge. The D ion fluence on the outer divertor was estimated from Langmuir probe and D-alpha measurements and the retention compared to the D ion fluence was 6-8%. Following a day's plasma operations the pump valves were closed to track the D outgassing. After a rapid initial rise in D pressure, D pumping by the wall could be observed as the vessel cooled.

The results were modeled by a new wall gas balance (WGB) code that incorporates the vessel geometry and particle and power input. Initial results matched temporal evolution of the averaged plasma parameters in the core and edge and the neutral gas pressure. A new PMI probe was commissioned that exposed ATJ graphite and silicon/palladium samples to the plasma and retrieved them under argon for prompt thermal desorption spectroscopy and other surface analysis in collaboration with Purdue University[3]. Interesting correlations between the surface analysis results and the gas balance measurements will be described.

[1] H. W. Kugel, et al., Phys. Plasmas., 15, (2008) 056118.
[2] M. G. Bell et al., Plasma Phys. Control. Fusion, Dec. 2009.
[3] J. P. Allain, C. N. Taylor et al., this conference.

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