Lithium deposition in NSTX as measured by quartz microbalances.

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Dynamic retention, lithium deposition, and the stability of deposited layers were measured by three quartz crystal microbalances (QMB) deployed in plasma shadowed areas at the upper and lower divertor and outboard midplane in the National Spherical Torus Experiment (NSTX). Dynamic retention of deuterium, was observed to be particularly conspicuous on the first discharge of a day[1]. In 2007, lithium was evaporated onto plasma facing components to control recycling[2]. Deposition of 200 μg/cm^2 over 3 months was measured by the QMB at the lower divertor that was in line of sight to the evaporator at the top of the vessel, while the QMB on the upper divertor, that was shadowed from the evaporator, received an order of magnitude less deposition. Intershot helium glow discharges (HeGDC) are used to control deuterium recycling from the walls on NSTX and lithium evaporation continued during GDC due to thermal inertia. During GDC both neutral gas collisions and the ionization and subsequent drift of Li^+ interupted the lithium deposition on the lower divertor. Some lithium was redirected by the electric field of the GDC to the tiles in the vicinity of the evaporator. After the GDC current was terminated, the lithium deposition rate on the lower divertor recovered as the 2 mtorr of helium was pumped out and mean free path for lithium increased to the dimension of the vessel. Neutral gas collisions at intermediate pressures during this pump out phase also enabled some deposition on the upper QMB out of the direct line of sight of the evaporator.

Occasionally strong variations in the QMB frequency were observed after lithium deposition. Fig. 1 shows a particularly dramatic case. There is no obvious source or sink of mass to account for these variations. We interpret the changes as being due to relaxation of mechanical stress and possibly flaking or peeling of the deposited layers. For the upward facing crystal in the lower QMB deposits are unlikely to fall off, however the material needs to be firmly acoustically coupled to the quartz to influence its oscillation frequency. Thick surface coatings are expected on in-vessel components in next step long pulse devices and thick codeposited layers on TFTR were observed to blister and flake off after exposure to air[4]. Quartz microbalances offer information on the mechanical stability of deposits that is otherwise difficult to diagnose *in-situ*.

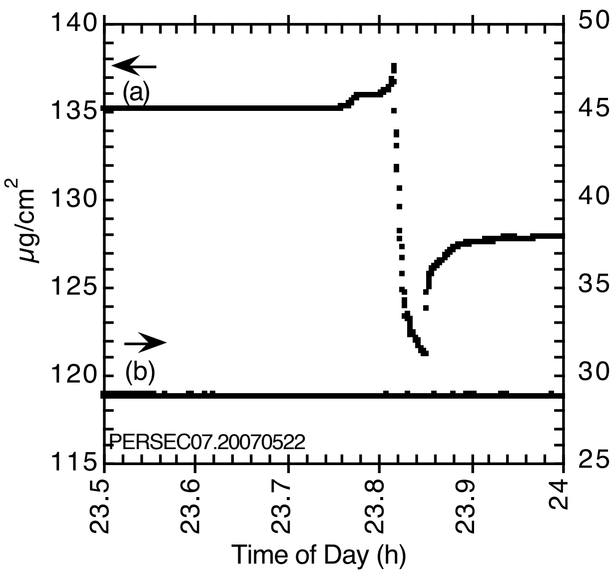

Fig. 1 Changes on (a) the upper and (b) the lower QMB. The excursion in (a) appears to be due to mechanical relaxation.

[1] C. H. Skinner et al., J. Nucl. Mater., 363-365 (2007) 247.

[2] H. W. Kugel et al., submitted to Phys. Plasmas (2007).

[3] C. H. Skinner et al., Nucl. Fus. 39 (1999) 1081.