**Topic: EX-D**

# Characterization of lithium and carbon divertor sources in the mixed material NSTX divertor with lithium-coated plasma facing components*

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The evaporation of lithium on graphite and molybdenum plasma facing components (PFCs) in the NSTX divertor led to modifications in divertor impurity influxes and scrape-off layer (SOL) and core impurity particle transport. The total (physical + chemical) carbon sputtering yield on divertor graphite tiles was reduced with the application of lithium coatings in lower single null, NBI heated (4-6 MW), H-mode discharges in NSTX with divertor incident ion fluxes up to $\sim 10^{23}$ ions/m$^2$/s. Absolute values of the total carbon sputtering yield ($Y_C$) from lithiated graphite indicated $Y_C \leq 1\%$, which is up to 4x less than the combined yield for physical and chemical sputtering, leading to total divertor carbon influxes at the outer strike point on the order of several $10^{20}$ ions/s. Neutral lithium sputtering yields ($Y_{Li}$) from solid lithium coatings on graphite and porous molybdenum substrates [1], were found to be consistent with physical sputtering from deuterium-saturated lithium (with $Y_{Li}$~3-7%). The surface temperature dependence of $Y_{Li}$ was observed on both graphite and molybdenum substrates, consistently with the temperature-enhanced sputtering behavior found on test stands (IIAX [2] and PISCES [3]), with $Y_{Li}$ up to 10-20%. Gross divertor lithium influxes on the order of a few $10^{21}$ atoms/s were typically observed. In ELM-free discharges, a large difference (>100x) in the core penetration factors for divertor impurity influxes was found between carbon and lithium. This difference is only partially (~10x) explained by the different core particle transport between the two impurities [4]. The larger carbon penetration factors indicate the possible importance of main wall carbon sources and/or the weaker divertor retention for carbon impurities. The latter was confirmed by 2D multi-fluid edge transport simulations with the UEDGE code [5] which indicated better divertor retention for lithium as a result of the narrower source profile at the target and the weaker classical parallel forces.

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