Periodic evaluation of PFC conditions during run campaign: lithium intercalation and survey of elemental composition

NSTX-U FY15 Research Forum - M&P - TSG

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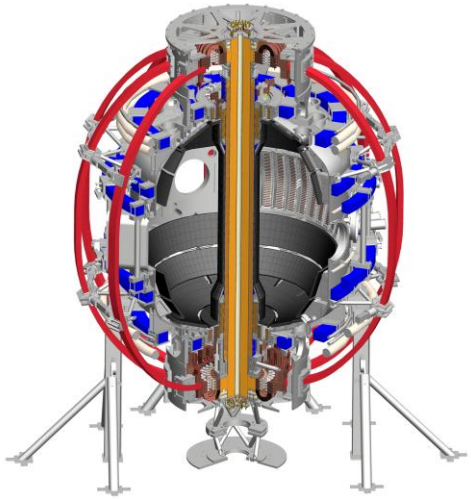
NSTX Upgrade



Fusion Energy Sciences

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PPPL

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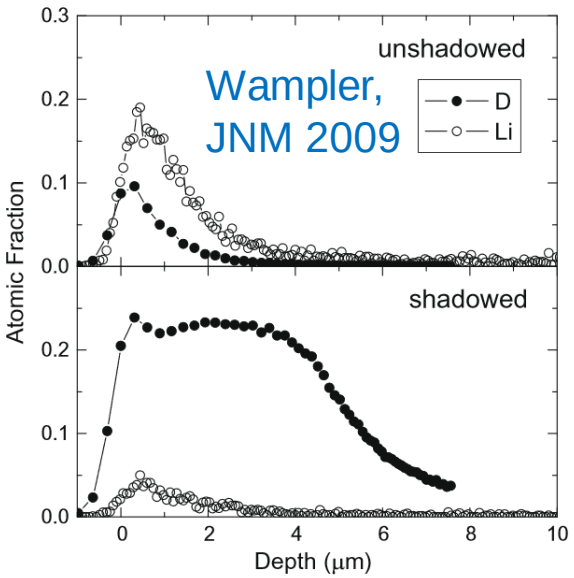
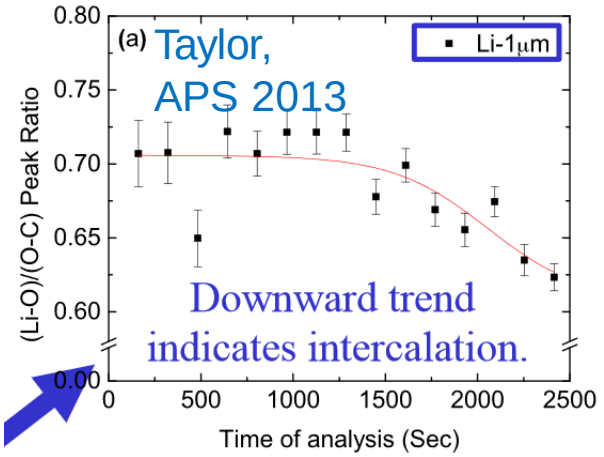
Goal: Periodic MAPP analysis to provide information on evolution of PFC conditions

- PFCs conditioning history (e.g., lithium inventory) likely to play a role on the effect of PFC on plasma performance
- Periodic *in-situ* surface analysis via MAPP can provide a 'real-time' estimate of the PFC surface conditions during experimental campaign
- Necessary conditions:
  - One ATJ sample not interchanged during the year
  - ATJ sample not undergoing TDS analysis
  - Sample exposed to same conditioning, plasma exposure as PFCs
- Key surface properties to test periodically (e.g., weekly):
  - Lithium intercalation lifetime in graphite
  - Surface elemental composition

Periodic evaluation of lithium intercalation to understand evolution during run campaign

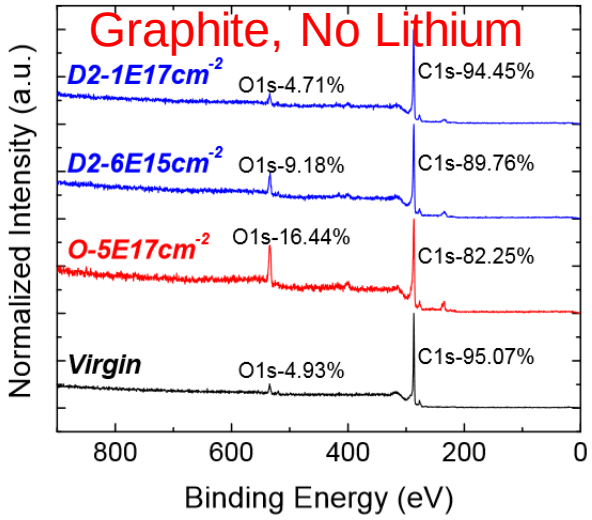
- Lithium known to intercalate in graphite but timescale and its evolution unknown in NSTX
- Nuclear reaction analysis on NSTX tiles showed:
  - "Lithium was within a few microns of the surface indicating little or no transport by diffusion through the carbon." [Wampler,JNM2009]
- This XP proposes to periodically test Li intercalation on lithiated ATJ (e.g., weekly) via XPS (5-10 nm):
  - MAPP exposed to the last evaporation of the day, retracted before plasma exposure
  - XPS at Li and C 1s energies at regular intervals until a characteristic intercalation time is observed
- Periodic tests will reveal whether intercalation varies with the PFC history, e.g., as a result of formation of different compounds on graphite, cumulated amount of lithium, etc.

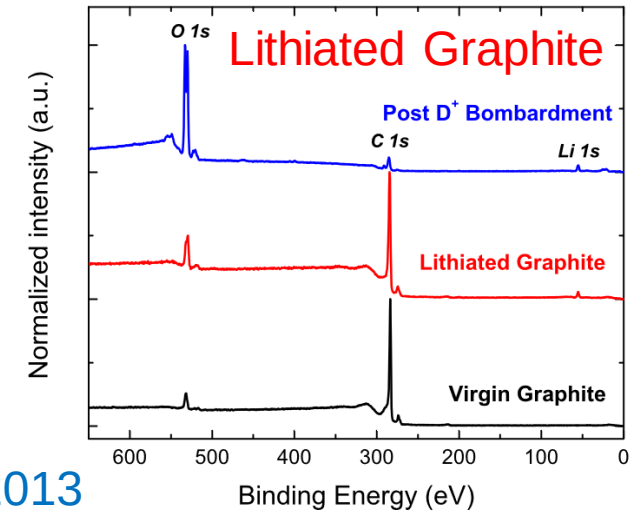




Periodic full XPS scan for elemental composition of PFC surface

- Periodic check of elemental composition to provide information on PFC surface composition evolution during the run campaign
  - Full XPS scan weekly on ATJ sample with same history as NSTX PFCs
- Useful for comparison of the surface evolution observed from spectroscopic monitoring of the lower divertor PFCs
- Can inform on additional impurities on PFCs
- Useful comparison with high-Z sample





Taylor, APS 2013