Development of Particle Control Techniques for NSTX

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NSTX Results Review

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Particle Control in NSTX, Involves Primarily Controlling Recycling and Impurity Influxes

NSTX

- Improved particle control yields discharge density control.

- To reduce and control spontaneous density rises, due to recycling and impurity influxes we have compared

  I. Boronization on hot and cold surfaces,

  II. Varying HeGDC durations and Helium discharge cleaning,

  III. Brief daily boronization, between discharge boronization, and HeGDC.

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I. Summary and Conclusions for Comparison of Hot Boronization and Cold Boronization

• ***Following Hot Boronization, a significant improvement was observed in initial Ohmic and NBI performance.***

• **The elusive Ohmic, H-mode achieved after 2nd discharge and maintained in the discharges thereafter.**

• **Initially lower Ohmic Dα luminosity was observed; might have been due to**

- **Less retention of codeposited D_2 during Boronization on hot surfaces**
- **Reduced porosity/trapping sites in coatings deposited on hot surfaces**

• **Then, after the D_2 wall loading of the preceding 56 Ohmic Discharges, the first NBI fiducial discharges, transitioned easily to H-modes but exhibited D_a luminosity comparable to NBI discharges following Cold Boronization.**

• ***Duration of Hot and Cold Boronization comparable; as fluence to the wall increases, changes to the film microstructure between Boronizations appears to eventually dominate over initial film conditions.***

II. Summary and Conclusions for Comparison of HeGDC and He Discharge Conditioning

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- **For the present GDC geometry, a 15 minute HeGDC between discharges was needed for reproducible timing of the L-H transition. Shorter HeGDC applications were found to delay the L-H transition.**

- **Helium discharge conditioning provides better density control for the succeeding D discharge than standard 15 min HeGDC between discharges.**

  - ***This result is consistent with previous work on TFTR, although on other machines, HeGDC between discharges has been found to be sufficient. We intend to investigate if this is due to GDC geometry.***

III. Summary and Conclusions for Comparison of Morning and Between Shot Boronization & HeGDC

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• Short Boronization in the morning followed by comparable duration of HeGDC can restore and enhance good conditions.

• Additional short Boronization in the morning and Between-Shot-Boronization do not improve surface conditions, if enough Boron is on the wall - perhaps due to codeposited D_2 not completely removed.

• Between-Shot-Boronization tends to require an increase in duty cycle due to need to apply HeGDC to remove codeposited D_2.

Future Questions

- **Would more than ~1-2 g of Morning Boronization improve performance further?**

  - probably not, based on the short Between Discharge Boronization testing, and recent work at LHD which found the oxygen gettered on B to be mostly on the back and front sides of the B, *not in the middle*.

- **Which Fiducials are the most sensitive?**

  - the high performance DND and LSN exhibit about the same sensitivity.

- **What is the optimum figure of merit for characterizing state of wall conditions and the need to re-boronize?**

  - present indicators: Da/BII, OII/CIII, and OV/CIII

- **Can Dα/He, O/He ratios be measured during Between Discharge HeGDC to monitor the state of the conditioning?**