Measurements of Tungsten Migration in the DIII-D Divertor

P2-27

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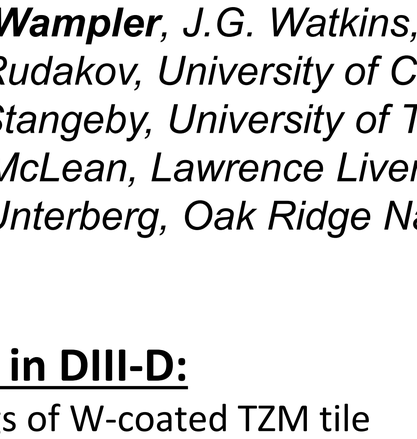
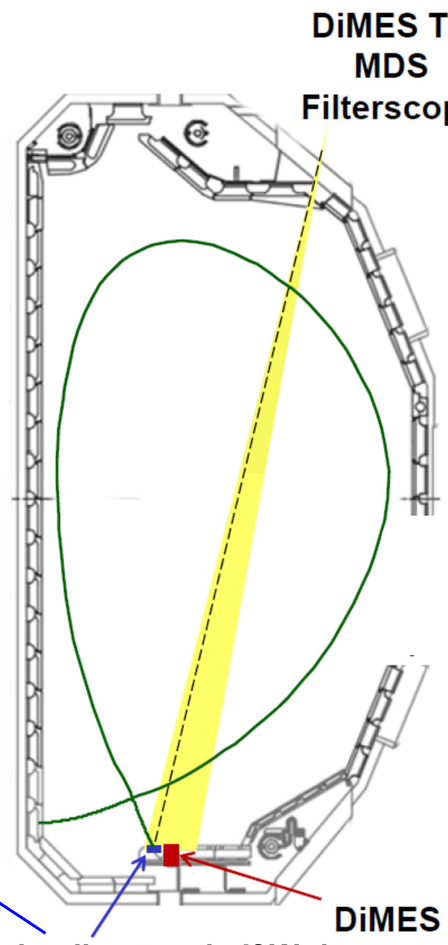
Tungsten-Ring experiments in DIII-D:

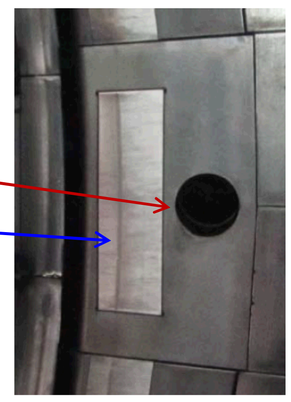
Two almost complete toroidal rings of W-coated TZM tile inserts installed in the lower divertor of DIII-D

Main goals:

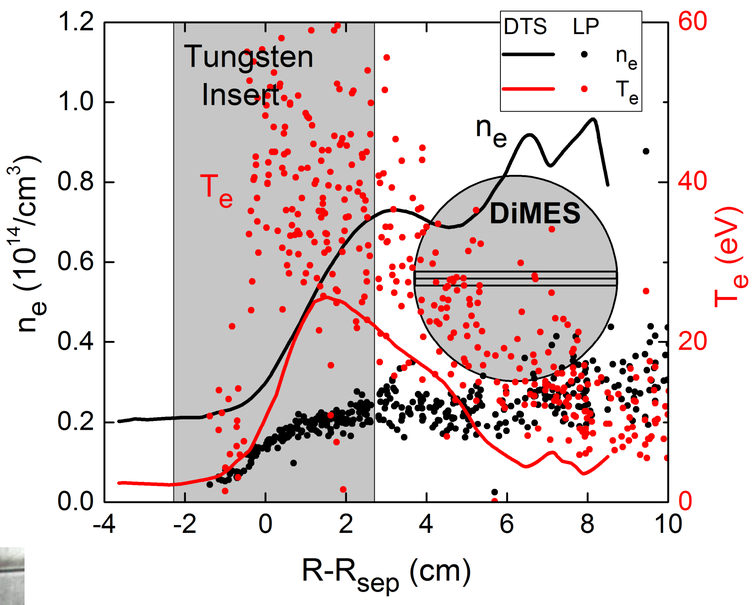
- Quantify W source in a variety of operational conditions
- Study W migration and core contamination
- Demonstrate compatibility with high-performance plasma operations





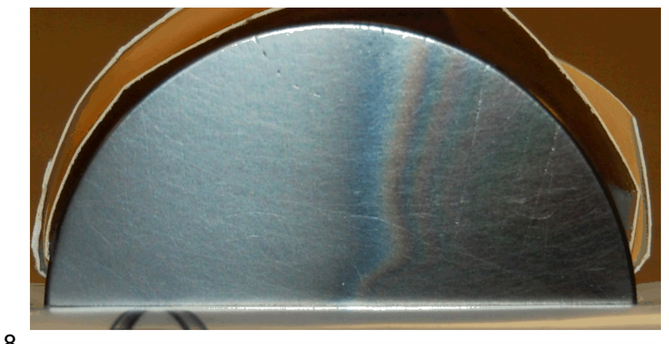


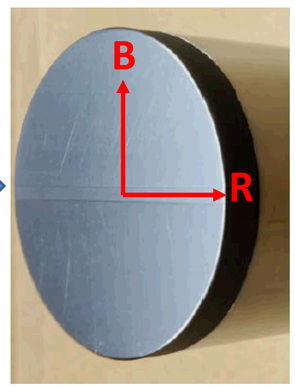
DTS and Langmuir probe show that the outer part of DiMES was exposed to cool dense plasma favoring net deposition.

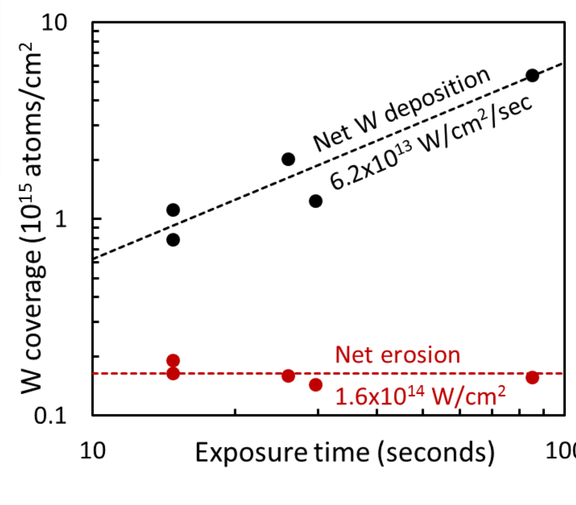


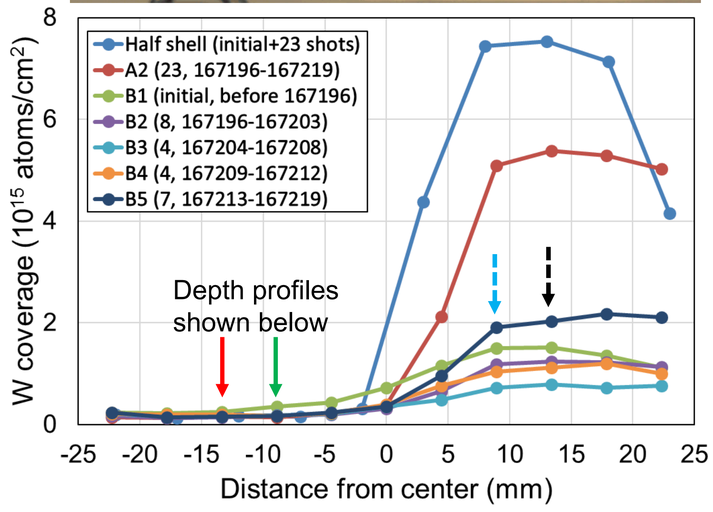
DiMES Experiment:

- Provides data for comparison to simulations (ERO, WallDYN) of material erosion & deposition.
- DiMES probe with two removable inserts (A,B) 1 x 50 mm along the radial direction to examine time and spatial-dependence of W deposition.
- Probe exposed to ~ 67 shots prior to test with strike point remote from W ring (initial condition).
- Probe then exposed to 23 similar L-mode plasmas (3.7 sec/shot) with replacement of inserts with strike point on W ring:









B2 B3 B4 B5

Shot # 1 8 12 16 23

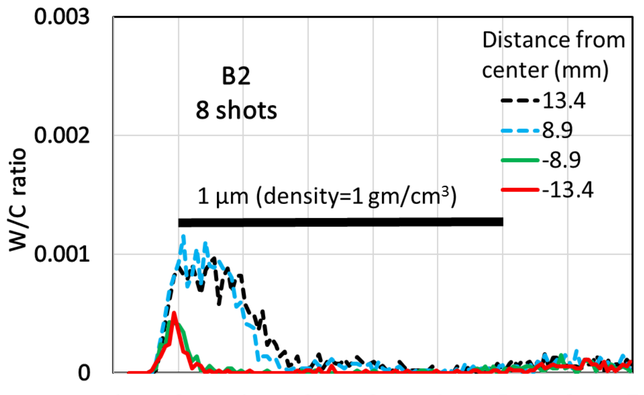
A2

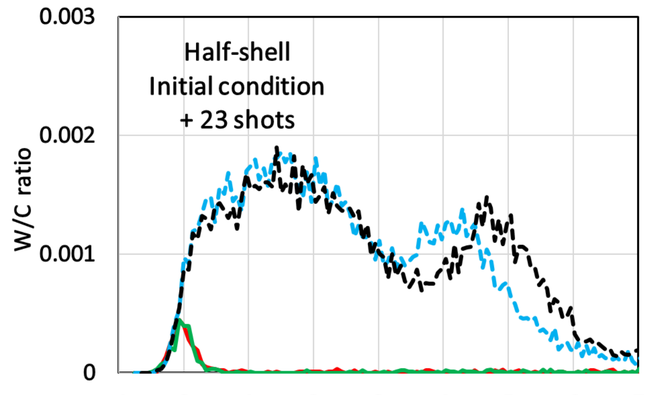
Remove A1, B1 initial condition

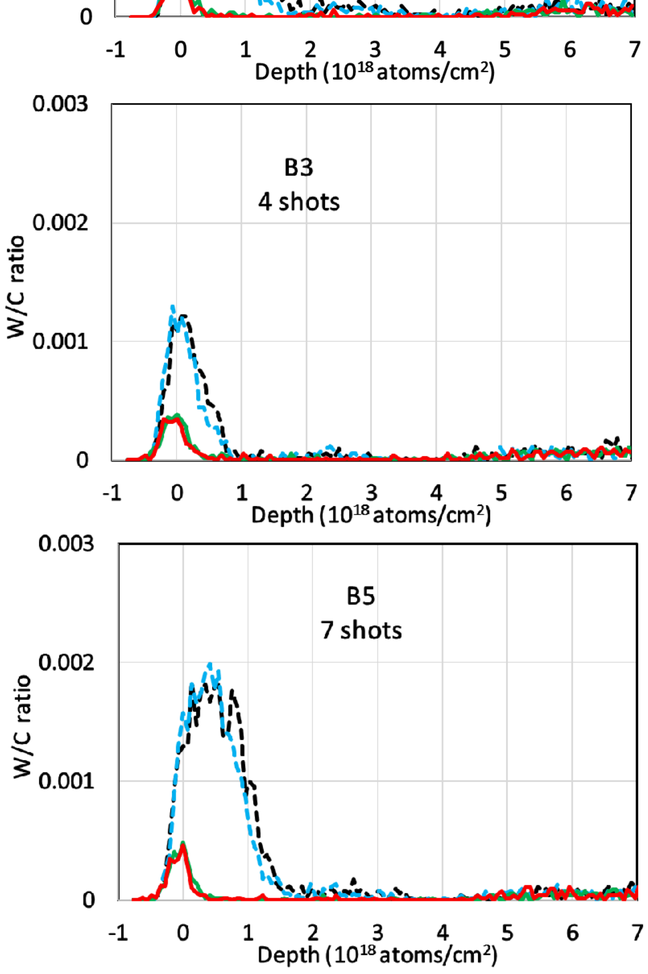
DIII-D shots 167196-167219

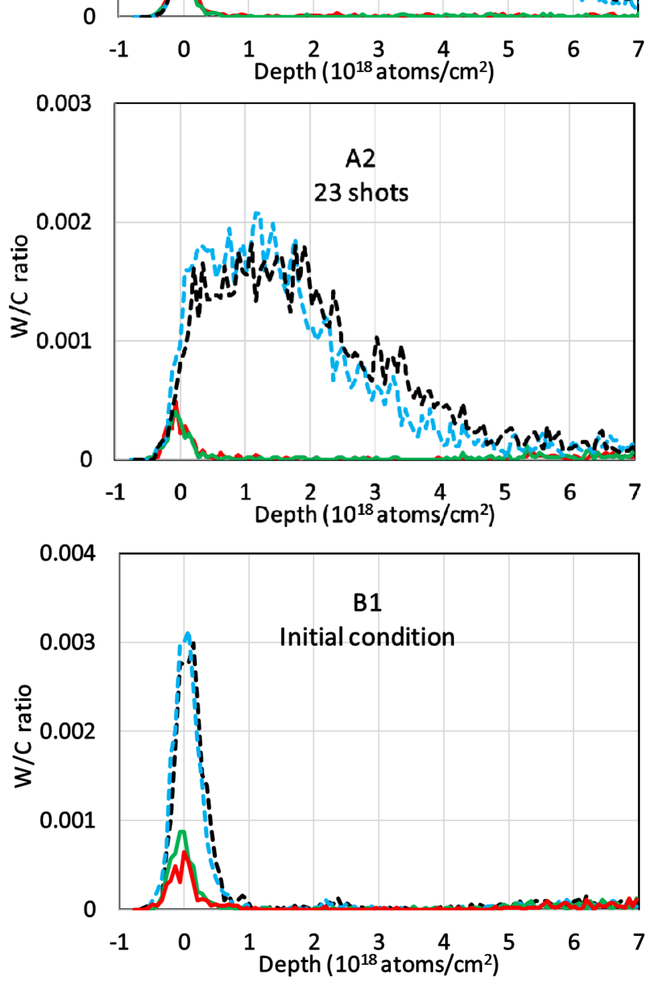
Remove:
- B5 (7 shots)
- A2 (23 shots)
- Half-shell (initial condition + 23 shots)

W depth profiles & areal density measured by









Conclusions

- W coverage on DiMES depends on the ratio of incident fluxes of W and C from the plasma, and the balance between C deposition and erosion.
- Nearer the strike point there is net erosion, W coverage quickly reaches a steady-state value ~1.6x10^{14} at/cm^2 insensitive to exposure time. W moves along the surface by successive erosion & redeposition.
- Farther from the strike point there is net C deposition, the deposit thickness and W coverage increase with exposure time at a rate ~4x10^{16} C atoms/cm^2/sec, with W/C atom ratio ~1.5x10^{-3}.
- This suggests W moves across the surface by successive erosion/redeposition.

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