WP PWIE SP-B Monitoring meeting

IBA analysis of boronization samples from WEST
Production and characterization of boron layers

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Overview of SP-B deliverables (VR)

Deliverable ID: PWIE-SP B.3.T-T005-D010

Title: Erosion and deposition patterns on selected WEST samples as well composition of plasma-exposed B and W layers (VR).

What was done: Characterization of samples via IBA (EBS, NRA, PIXE, ToF-ERDA) of boronized layers from WEST.

Deliverable ID: PWIE-SP B.4.T-T005-D012

Title: Ion-beam analyses of selected B reference samples (VR).

What was done: Preparation, characterization and distribution of boron layers for different research groups (round robin exercise).

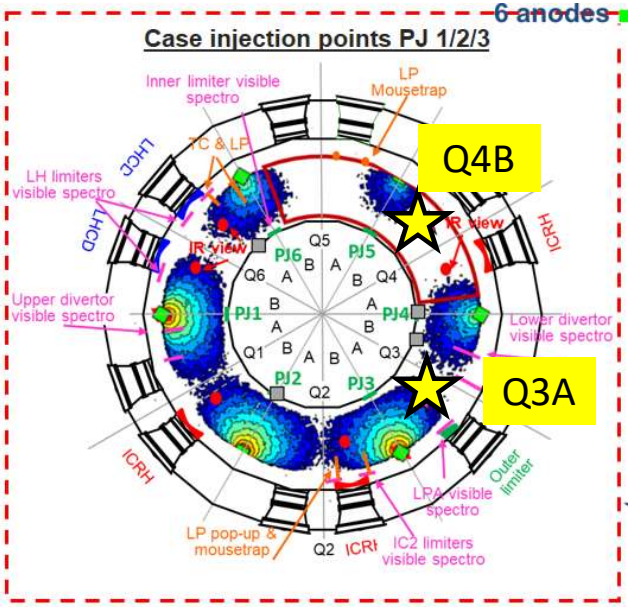
Deliverable ID: PWIE-SP B.5.T-T003-D007

Title: Ion-beam analyses of B. dust originating from AUG, WEST, and W7-X (VR).

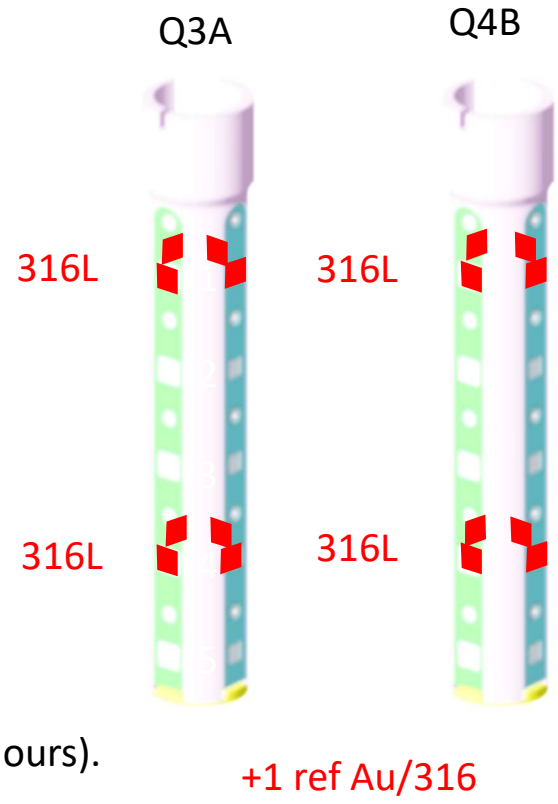
In progress: Dust samples collected from W7-X to be received soon.

Ion Beam Analysis of boronization samples from WEST

Boronization in WEST: **Samples received:** Au/boron layer/316L



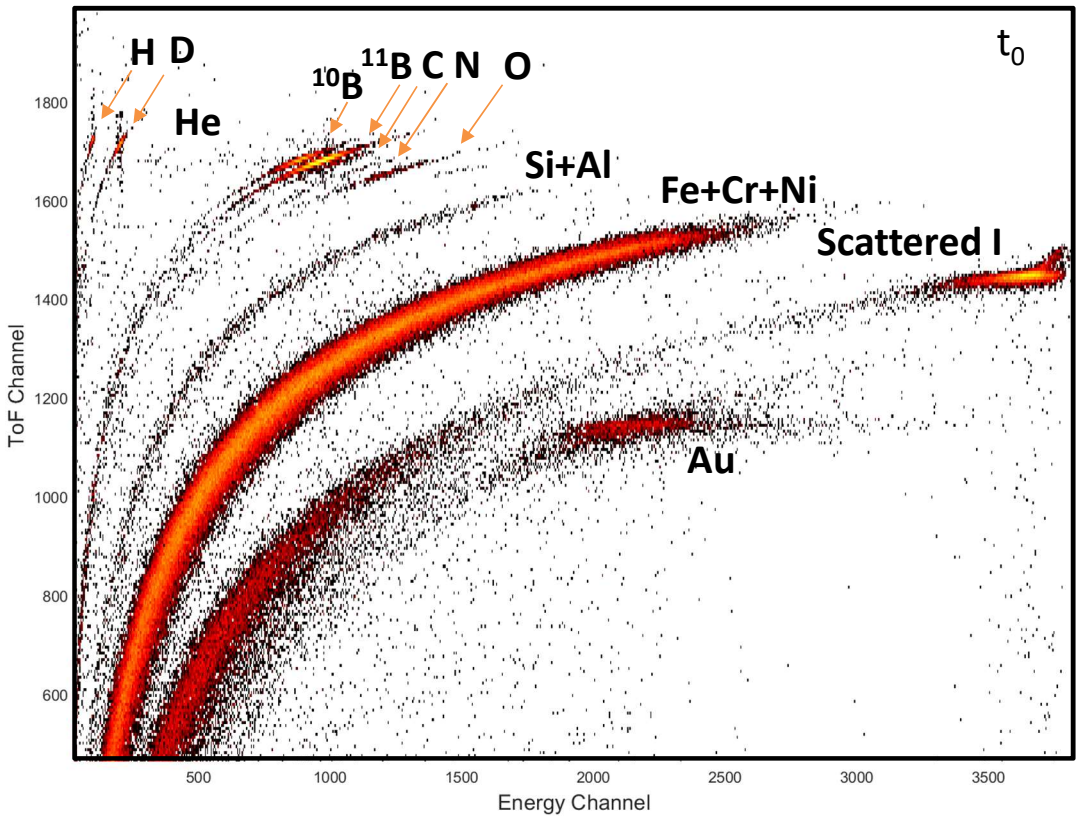
- Non-uniform boronization (PJ 1/2/3).
- 85% He – 15% B_2D_6 diluted in He (5 hours).
- Capping of samples with gold layer.



- Evaluate the uniformity of B layers in WEST:
  - Homogeneity in toroidal position (Q3A and Q4B).
  - Homogeneity along Z direction (vertical direction).
  - Homogeneity in 4 toroidal directions.
- Determine the amount of oxygen trapped in the boron layers and study how to desorb it.
- Presence of He in layers?
- Stability of layers in air?

Ion Beam Analysis of boronization samples from WEST

ToF-ERDA for sample B4:



IBA measurements at Tandemlab-UU (VR):

2025-04-28 (t_0):

- 1st measurement: EBS+NRA+PIXE using H^+ 2.6 MeV (higher sensitivity to B).
- 2nd measurement: ToF-ERDA I 36 MeV (identification and depth profile of all isotopes).

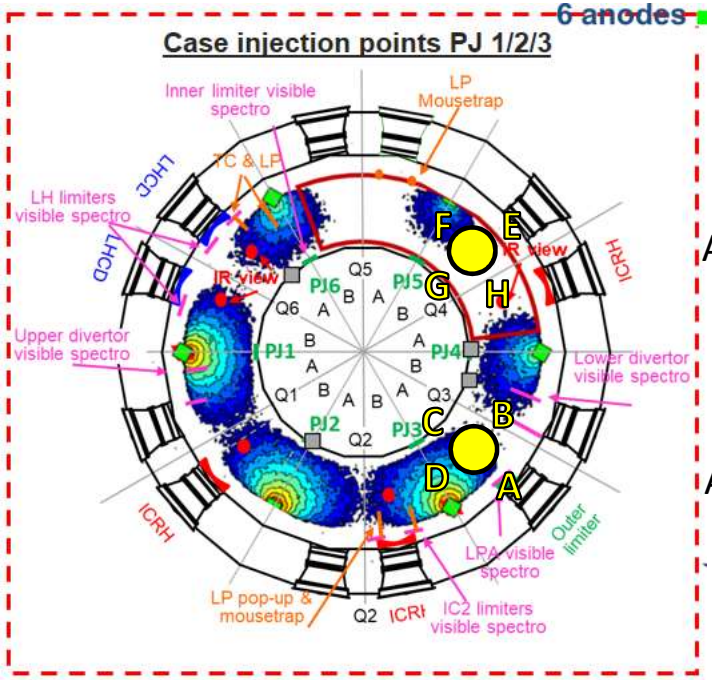
2025-05-07 (t_0 + 9 days in vacuum):

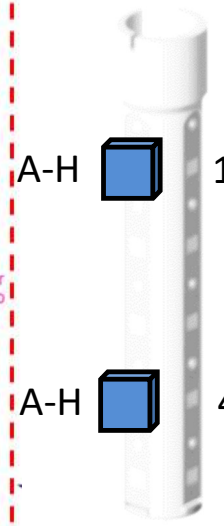
- 1st measurement: EBS+NRA+PIXE ^{3}He 2.5 MeV (higher sensitivity to D).
- 2nd measurement: ToF-ERDA I 36 MeV (identification and depth profile of all isotopes).

2025-06-26 (t_0 + 9 days in vacuum + 51 days in air):

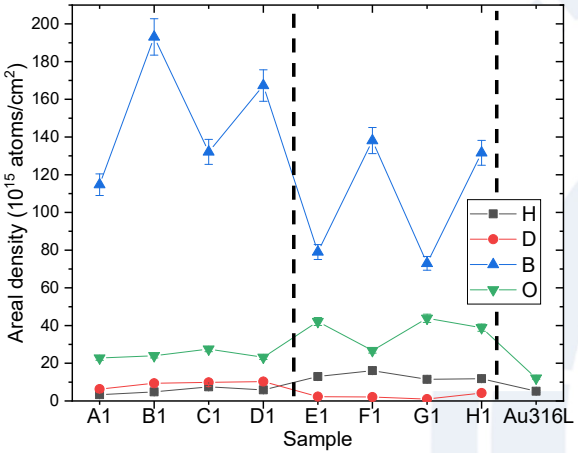
- 1st measurement: ToF-ERDA $^{79}Br^{9+}$ 28 MeV (identification and depth profile of all isotopes).

Ion Beam Analysis of boronization samples from WEST

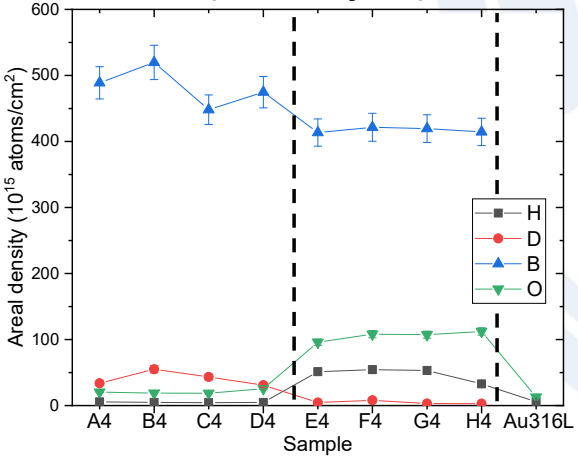




Row 1 (thin layers):



Row 4 (thick layers):



Main observations:

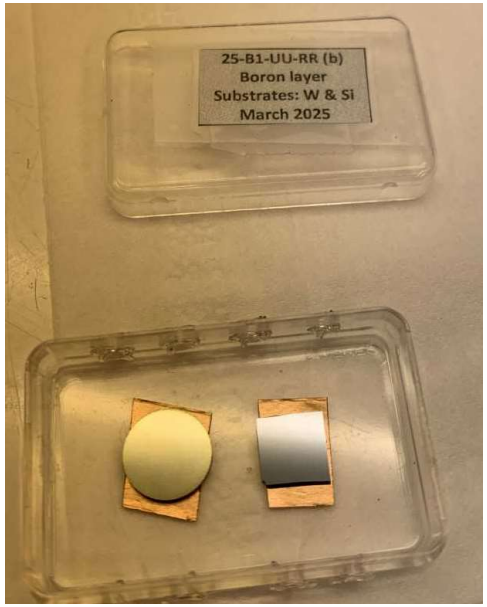
- Boron layer in row 4 (A4-H4) significantly thicker than row 1 (A1-H1).
- Higher oxygen + hydrogen and lower deuterium in E-H samples.
- Inverse correlation between boron and oxygen.
- Study of stability in air did not indicate any consistent effect in deuterium/boron loss, or oxygen in air.

Preparation, characterization and distribution of boron layers

Samples prepared at Tandemlab-UU:

- *Around 100 nm of boron on W (polished disks) and Si(100) substrates*.
- 1000°C annealing before deposition.
- Sputter deposition in Ar of boron layers for 4 hours (around 100 nm according to internal QCM).

As-grown



Vacuum sealed and distributed

Color change due to air exposure

Picture from Pavlos Tsavalas

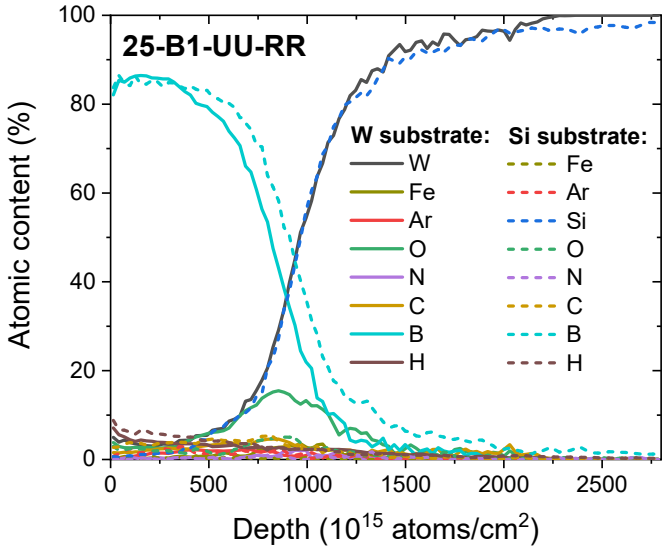
Also received samples from IAP-Romenia and POLIMI.

IBA measurements of samples as received.

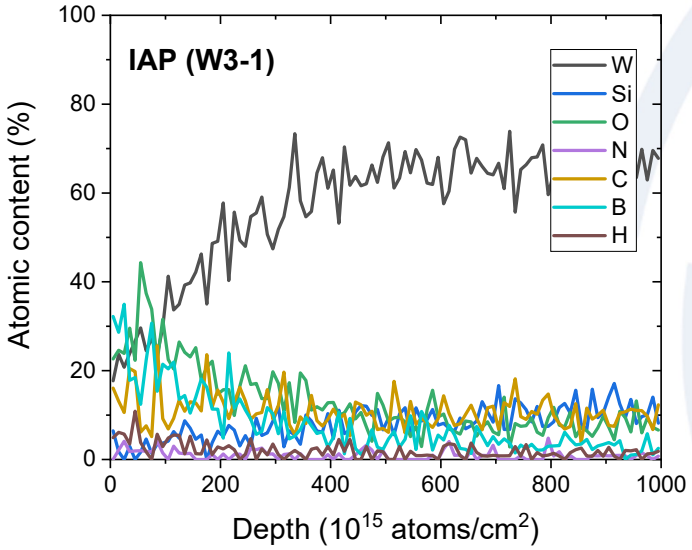
New measurements will be conducted following extended air exposure.

Preparation, characterization and distribution of boron layers

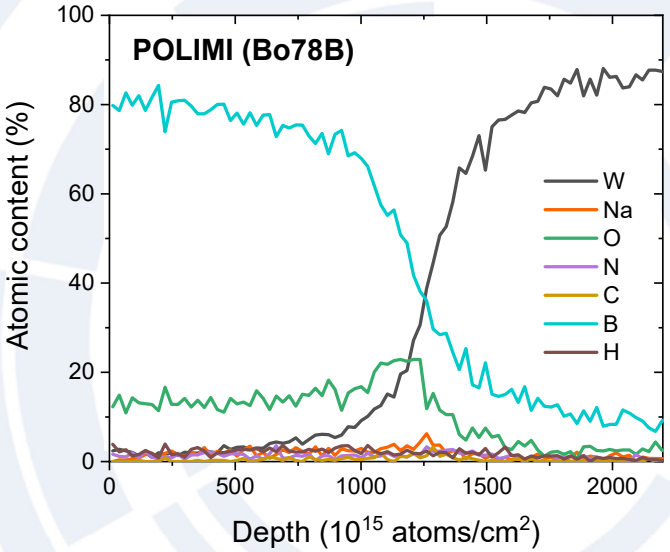
Ion beam analysis of boron layers:
ToF-ERDA I^{8+} 36 MeV



UU sample: higher presence of oxygen at the B/W interface.
Presence of metallic contamination.



IAP sample: Boron only present in the surface of layer. Slicing of data indicates the boron layer was not stable during the ToF-ERDA measurement.



POLIMI sample: higher presence of oxygen in the B/W interface.