WP PWIE SP F kick-off meeting: VR (UU and KTH)

Tasks to be performed [2026]:
Production of B:W:N:O layers with co-deposited deuterium, followed by pre-characterisation and post-mortem analysis after exposure in TOMAS plasmas (VR).

Deliverables [2026]:
D007 - Assessment of deuterium removal from ion-implanted mixed tungsten–boron layers following exposure to TOMAS wall-conditioning plasmas (VR).

Samples

Layer description (100-150 nm):
W + B (high B content)
W + B (low B content)
W + B (high B content) with D
W + B (low B content) with D
W + N (low N content)
W + N (high N content)
W + O
Clean W sample (control)

Objectives:
To study tungsten mixed layers (including B, N, O, and D) under IC plasma exposure: Investigate contamination removal and the resulting surface modifications (formation of W-enriched layers after exposure) and impacts in cleaning rates.

For D containing samples: Evaluating the efficiency of D removal by comparing short and long exposure runs using H as the working gas.

Strategy:
Characterization before and after exposure by IBA, and control samples will be prepared to account for aging effects.

For boron-containing deposits with deuterium, the results will be directly compared with laboratory-scale investigations of D removal by in-situ annealing.

Samples

Samples to be produced by magnetron sputtering:

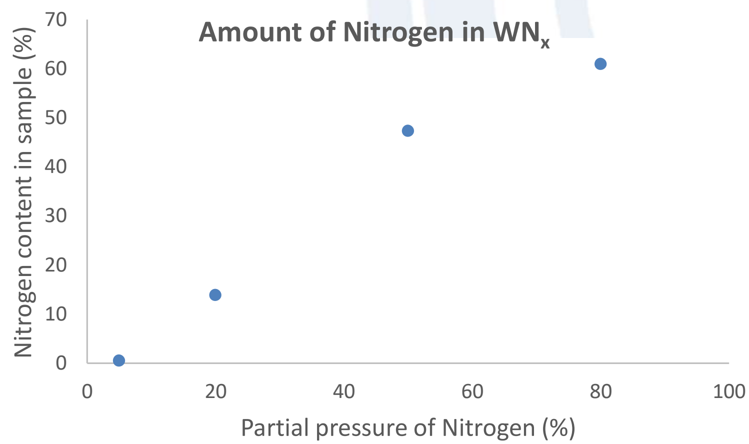
- Mixture of W and B Samples to be like samples used in previous study
- Mixture of W and N

Sample name	W	W:B (2:1)	W:B (1:1)	W:B_9 (1:9)	B
B concentration (at. %), ToF-ERDA	0	~37	~50	~90	96
Film thickness (nm), TEM	181	235	126	150*	149
Film density (g/cm^3)	18.7	17.0	16.2	–	2.47

(Deuterium retention in sputter-deposited W-B layers: in-situ implantation and ion beam analysis during annealing
D.N. Gautam et. al. Nuclear Materials and Energy 45, 2025, 102000)

Pre and Post exposure analysis methods:

- Time of Flight Elastic Recoil Detection Analysis
  Gives all elements present in the film
- Rutherford Back Scattering (RBS)
  Extra sensitive for W profile
- High Resolution RBS
  To see surface changes in W concentration
- Surface microscopy methods such as optical microscopy and Scanning Electron Microscopy



Study of Potential Impurities on Fusion ReactorWalls
S Zandren and N Rågåker Batcheler project 2026 KTH

Exposure conditions

Suggested plasma exposure conditions:

IC frequency, MHz	Magnetic field, A*	RF power, kW	Gas pressure, mbar	Gas	Duration, min*	Duty cycle, s	Sample position, mm	Comment
45	1600	~ 5	$\sim 7*10^{-4}$	H	10	4/10.9	0	Short hydrogen exposure
45	1600	~ 5	$\sim 7*10^{-4}$	H	30	4/10.9	0	Longer hydrogen exposure
		~ 5	$\sim 7*10^{-4}$	He	10	4/10.9	0	Matched to have similar power and duration as hydrogen exposure,
		~ 5	$\sim 7*10^{-4}$	He	30	4/10,9	0	Longer version of He exposure

Exact parameters not necessary if changes allows for combination with other exposures.
Priority should for the two long pulses with H and He if theree is limited time.

Suggested diagnostics:

- Monitoring of samples temperatures
- Comparison of particle fluxes by Retarding Field Analyzer or Neutral Particle Analyser (Possibly by selecting using old data and having the same discharge parameters)
- Monitoring of gas phase by Residual gas analyzer (Not priority)

Possible new mask for sample exposures

- Allows for more samples while using the same basic structure
- Possible for several samples close together or longer samples

  Makes it possible to study local homogeneity of cleaning
- Produced in Stainless steal

  Easy to manufacture and allows for thin lip to hold sample in place that makes it easier to use simple samples such as flat silicon samples
- Can be coated with W layer to act as W surface

  Other masks with similar coating are also possible
- Increased risk of samples falling out if they are several in a row

  By having small distance between samples, filling a row fully and perhaps some form of tape on the back side this risk is minimized.