EUROfusion

PWIE

PWIE, SP B.3

Ion beam analysis of reference and tokamak samples

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DEMOKRITOS

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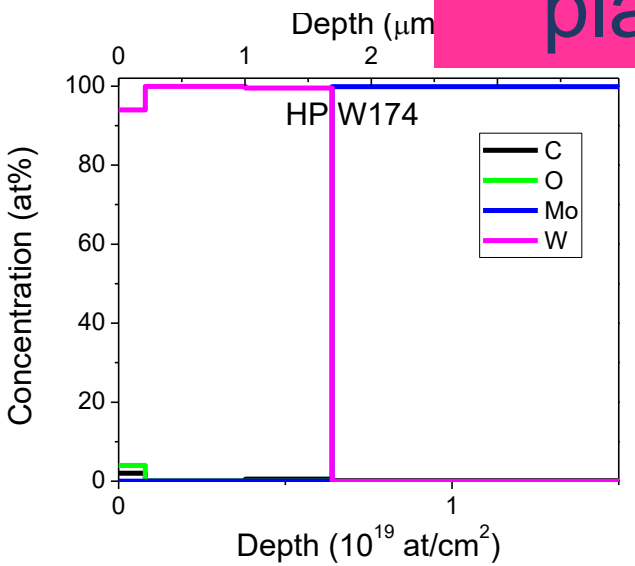
W Reference Samples from PoliMi: d-NRA analysis

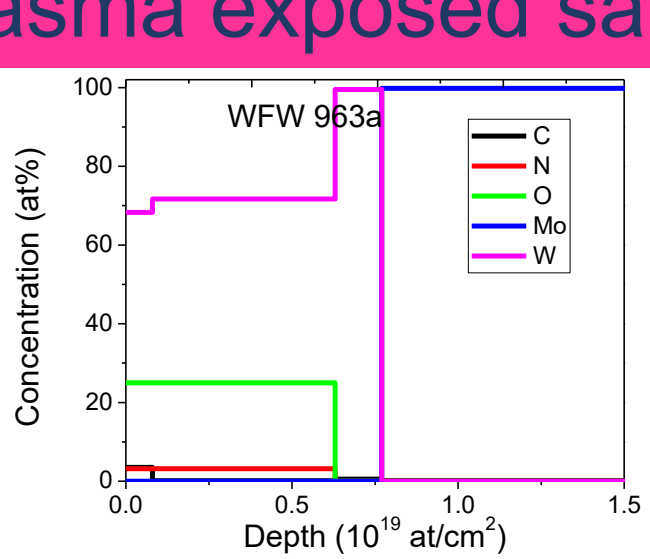
- The O concentration varies in the range 22 to 24 at%, 50% larger than the nominal one (15 at%)
- The N concentration in N and O containing sample is found 30 at%, 100% larger than the nominal one
- The O and N depth profiles are uniform
- O and N are found up to a depth of around 2 μm
- Small carbon amo

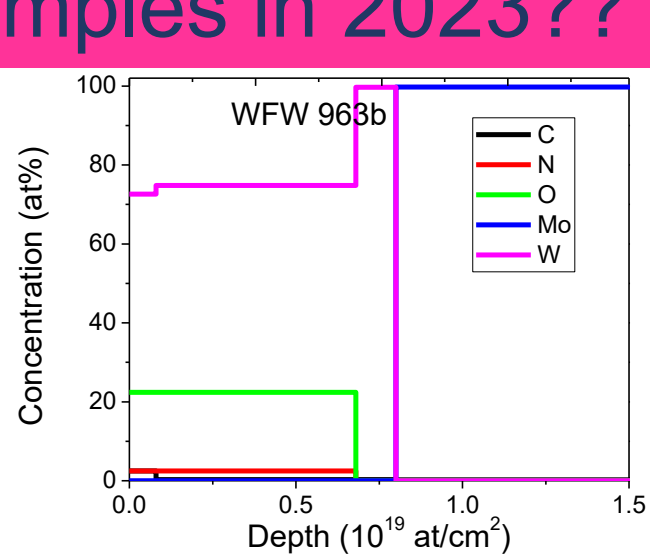
Samples

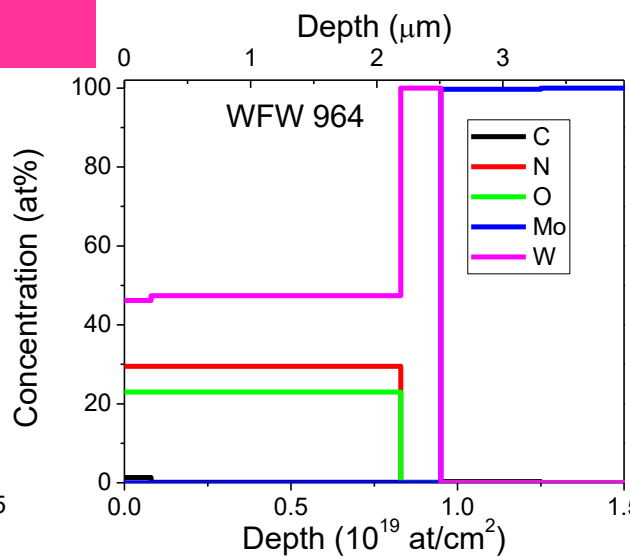
	HP W174	WFW 963a	WFW 963b	WFW 964
	Compact columnar W	Amorphous-W 15% O nominal content		Amorphous-W 15% O +15% N nominal content
Element	Amount (10^{16} at/cm^2)/**Atomic Concentration (at%)**			
C	4.6/**2**	6.1/**3.5**	6.7/**2.5**	2.8/**1.3**
			17/**3.0**	244.9/**30**
			2.3/**22.4**	190.9/**23.0**

We expect to receive the corresponding plasma exposed samples in 2023??



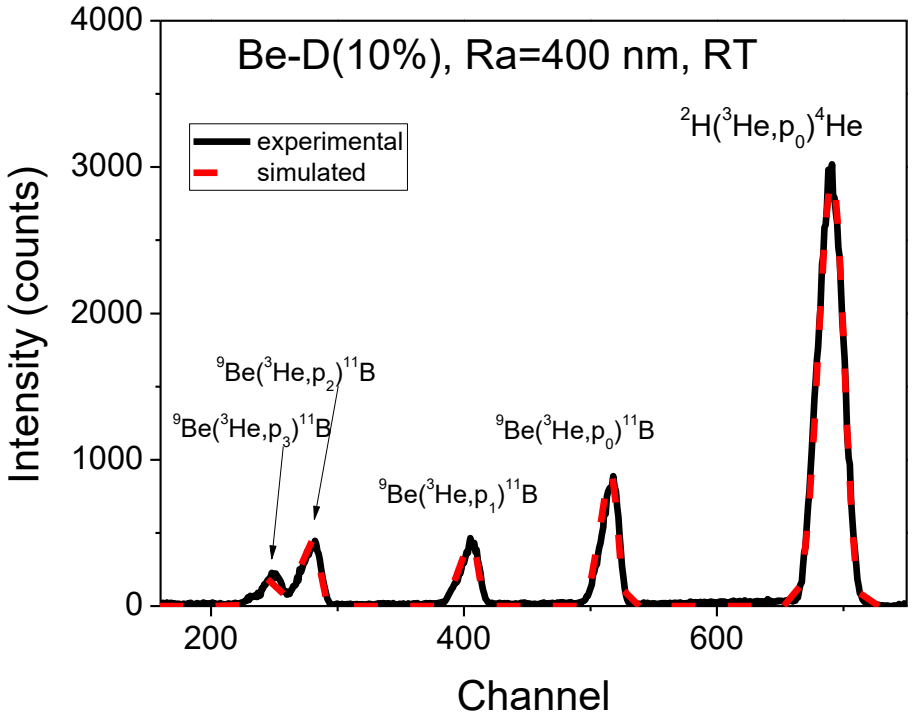






Investigation of Be-O-D films on W substrate using ^{3}He NRA

Beam: ^{3}He
Energy: 2 MeV
Detection Angle: 135°
120 μm Mylar between target and detector
^{9}Be(^{3}He,p$_{0,1,2,3}$)^{11}B: N. P. Barradas et al C. S. data &
^{2}H(^{3}He,p$_{0}$)^{4}He: V. Kh. Alimov et al C. S. data

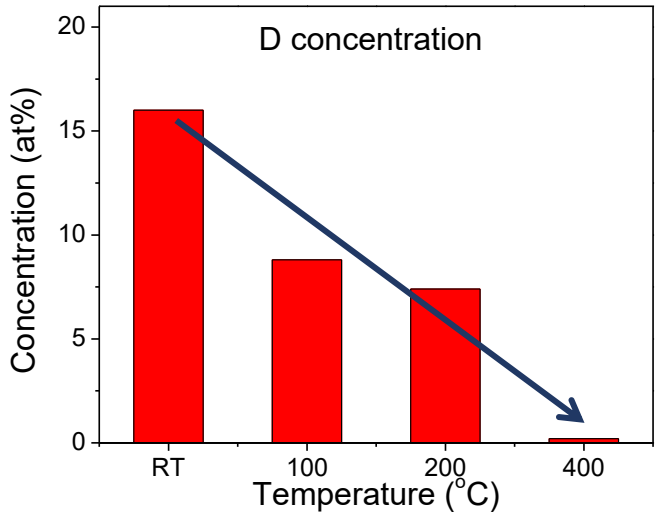


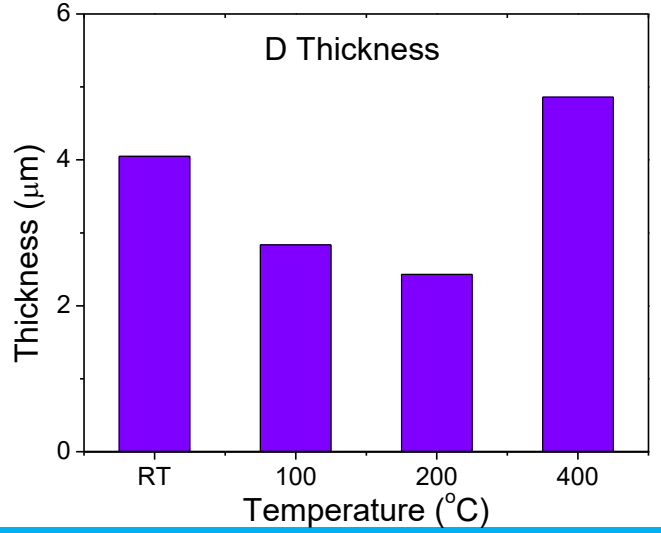
Samples

Description	Roughness	Deposition Temperature
W/Be-D(10%) 5μm	400 nm	RT
		100°C
		200°C
		400°C
W/Be-D(5%) 5μm	100 nm	RT
		100°C
		400°C
W/Be-O-D(5%) 5μm		RT
W/Be-O-D(20%) 5μm		RT

Characterization of Be-(O)-D films on W using ^{3}He NRA – the effect of deposition temperature & oxygen

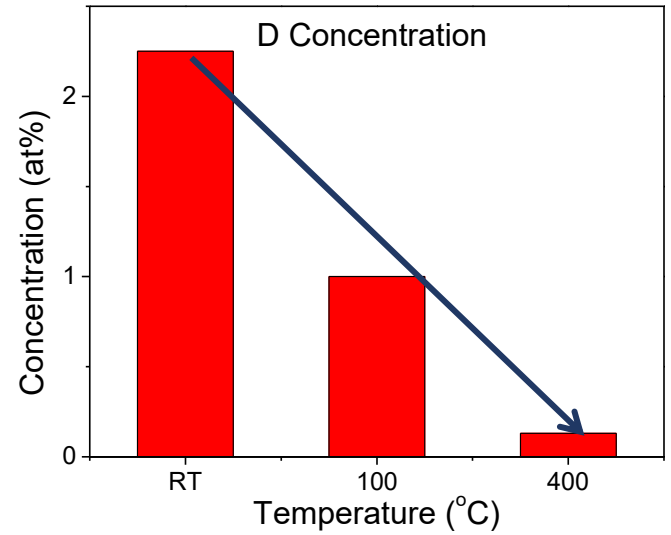
Be-D(10%), Roughness 400 nm

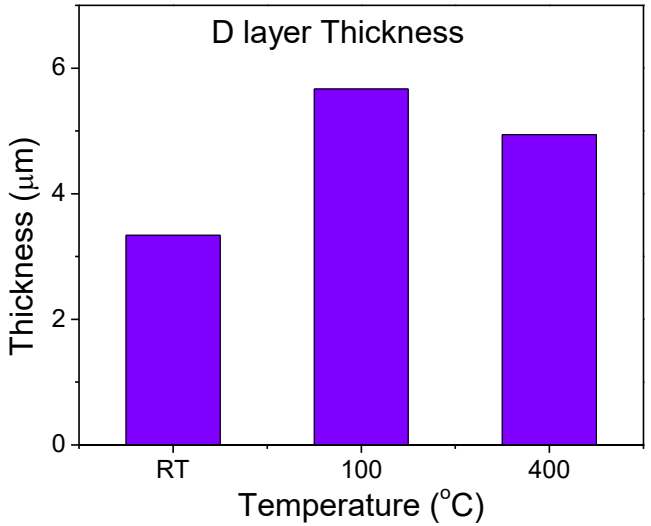




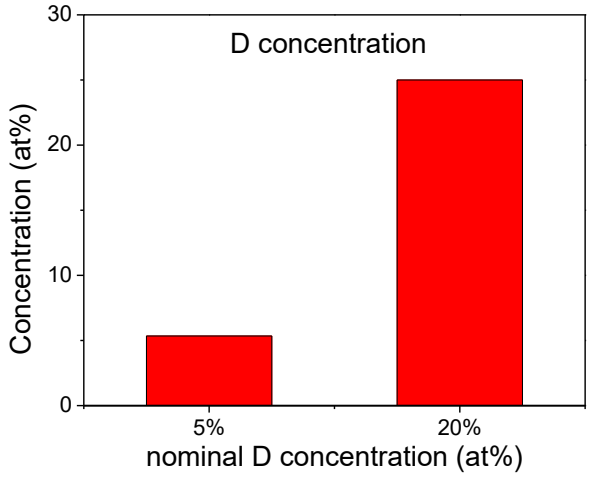
- Decrease of D content as the deposition temperature increases
- At 100 °C D concentration decreases by a factor of ~2 independently on roughness valu.
- At 400 °C D concentration decreases by a factor of ~10 independently on roughness value
- D is found at depths of about 3 to 6 μm; no clear dependence on deposition temperature
- In Be-O-D films D concentration is similar to the nominal values

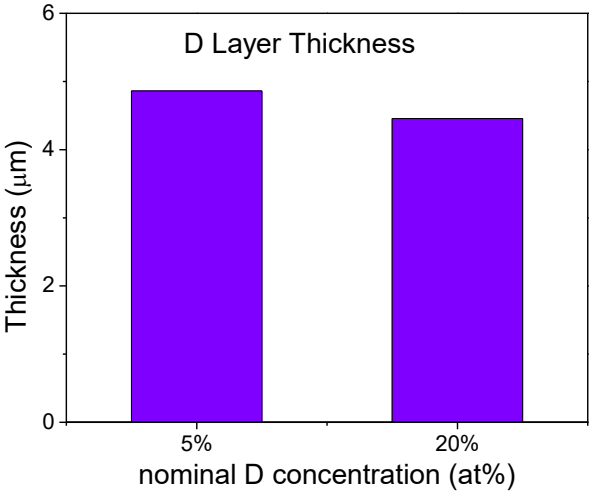
Be-D(5%), Roughness 100 nm





Be-O-D(5%, 20%)

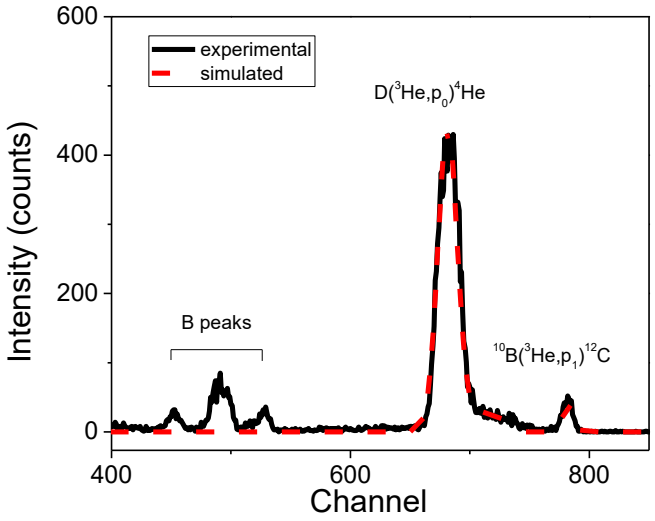




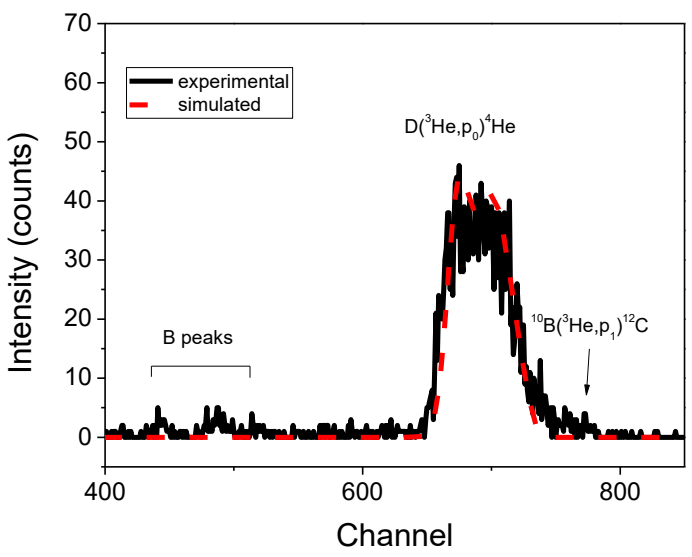
Investigation of WEST C4 tiles with ^{3}He beam

Beam: ^{3}He
Energy: 2 MeV
Detection Angle: 135°
120 μm Mylar between target and detector
^{2}H(^{3}He,p_0)^{4}He: V. Kh. Alimov et al C. S. data
^{10}B(^{3}He,p_1)^{12}C: J. R. Patterson et al C. S. data

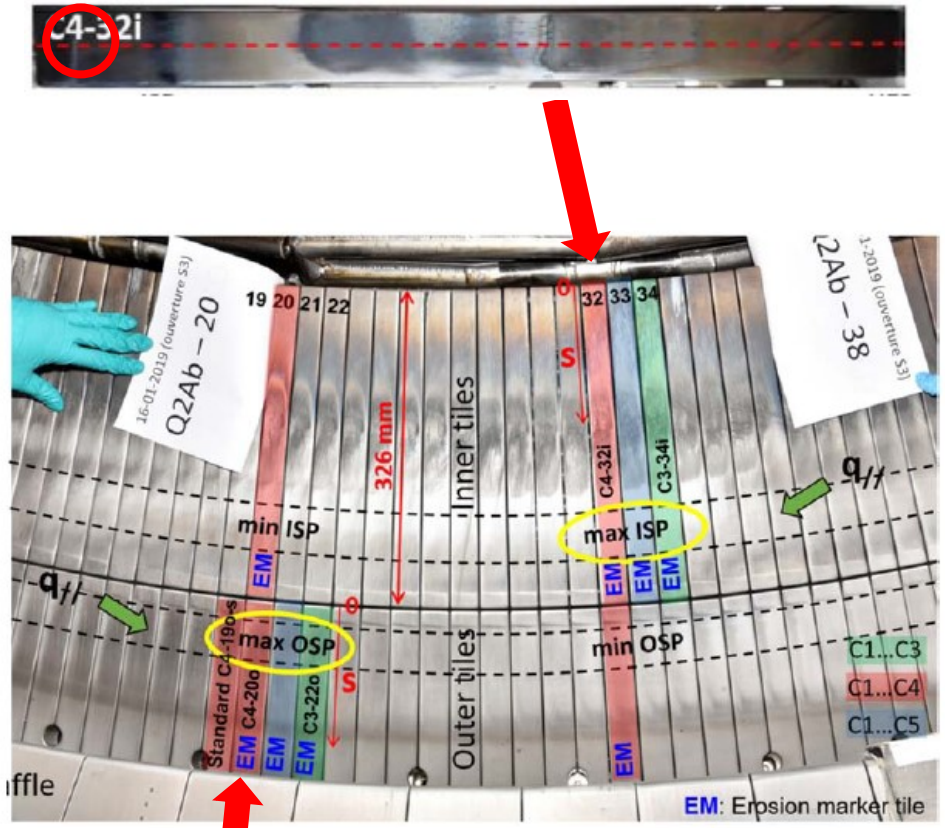
C4 20oG Pos 3



C4 32iQ Pos 2



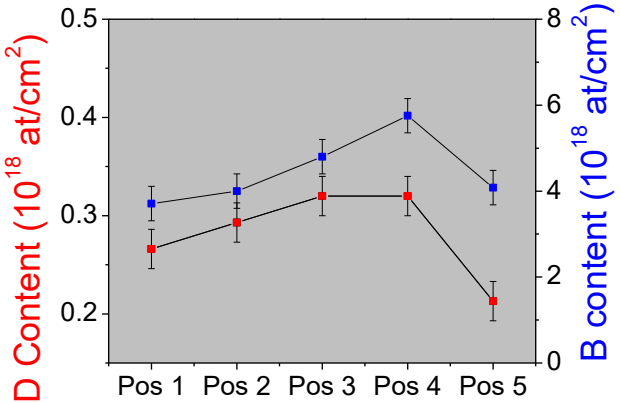
C4 32iQ



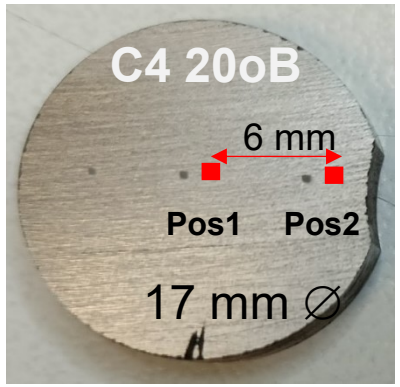
C4 20oG C4 20oB

Deuterium retention in C4 20o & 32iQ

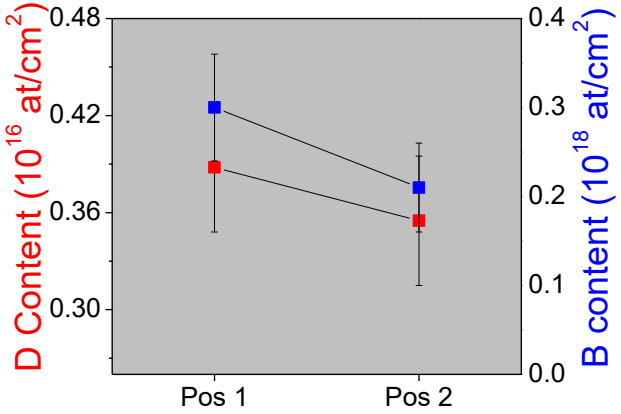
S=125 mm



- Almost uniform D content along poloidal direction
- Overestimation of B due to c.s. data at 2 MeV
- Similar pattern along the poloidal direction of B deposition and D retention

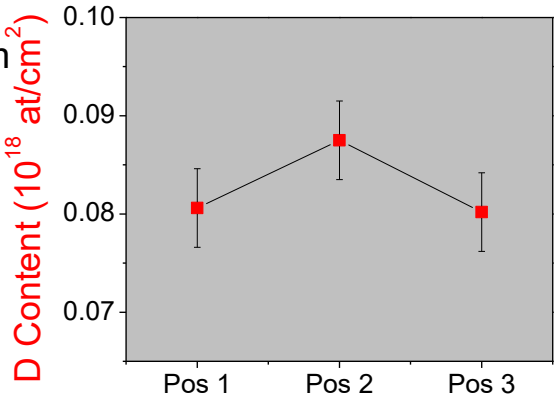


S=31 mm



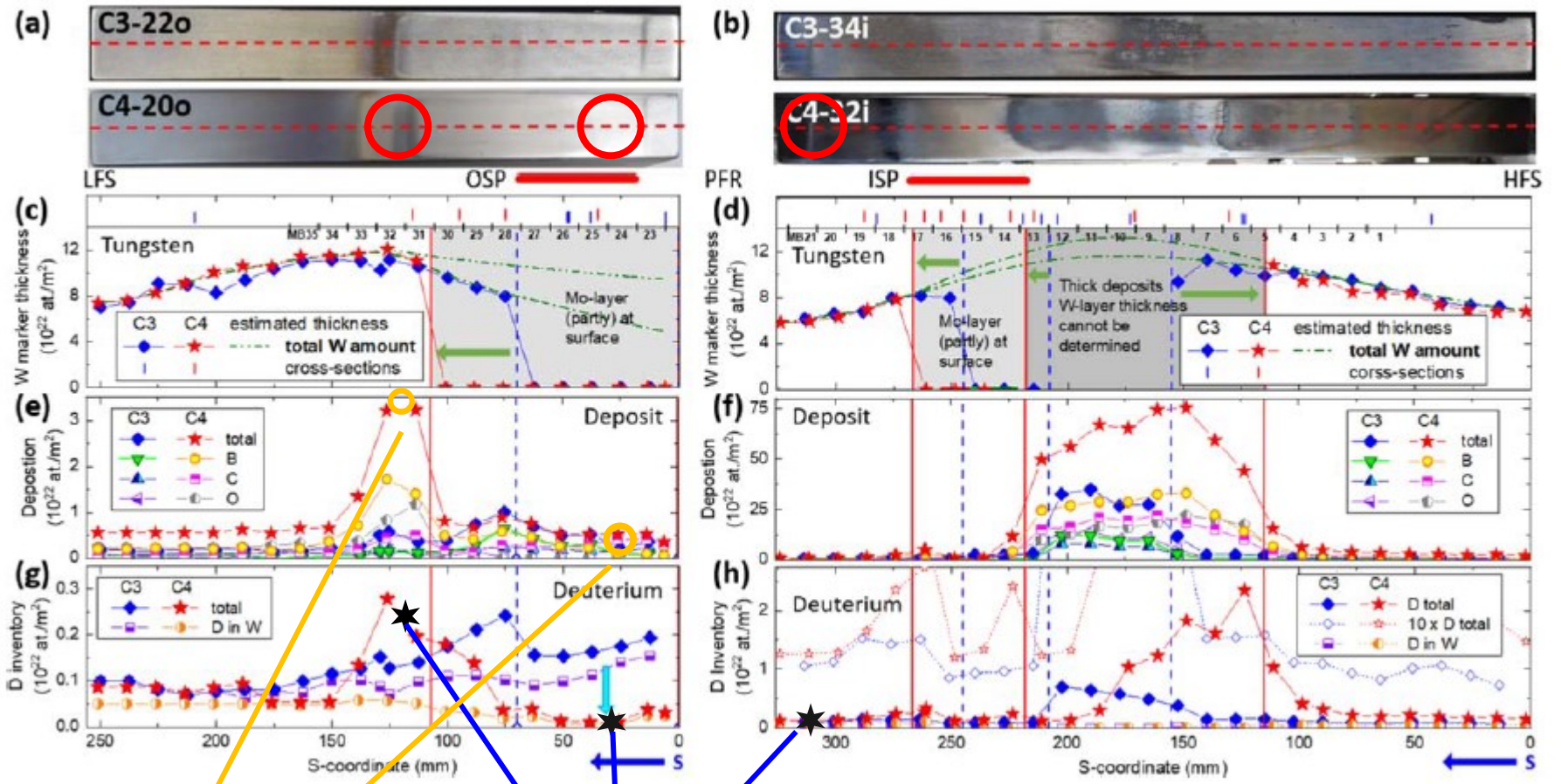
- No significant variation along poloidal direction
- 2 orders of magnitude decrease of D content compared to C4 20oG
- B content one order of magnitude lower than in C4 20oG

S=312.5 mm



- No significant variation along poloidal direction
- 2 to 3-fold decrease of D content compared to C4 20oG
- D(^{3}He,p_0)^{4}He peak overlaps with the ^{10}B(^{3}He,p_1)^{12}C one

Comparison with Previous Results



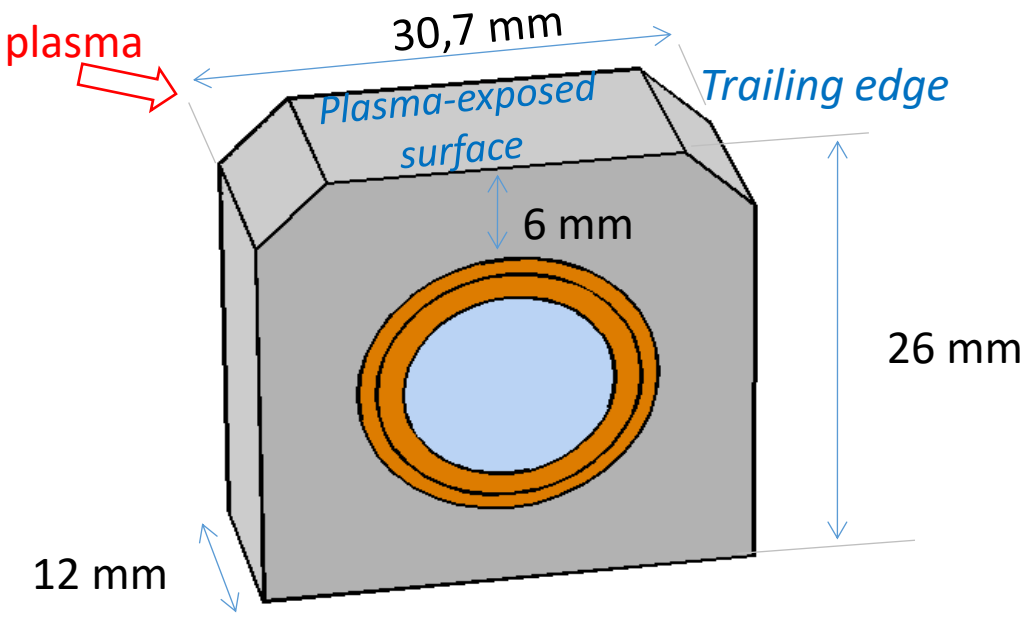
M Balden *et al* 2021

D content: Very good agreement with M. Balden et al 2021

B content: overestimation by a factor of ~3 compared to M. Balden et al 2021 due to incorrect cross section data at 2 MeV

Planning for 2023

- Analysis of 2 ITER-like samples PFU#WECN001 MB28 from WEST (received today)
  - IBA, SEM/EDS, XRD, profilometry measurements along toroidal profile



- Analysis of C5 samples from WEST (to be received mid-May)
- Analysis of Be-D & Be-H samples from C. Pardanaud (underway)
  - XRD to determine grain size as a function annealing temperature to calibrate Raman FWHM