

PWIE SP-B.1 Kickoff Meeting

Proposed Plans for tasks in 2021

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and

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Kickoff Meeting, June 9th, 2021

Eurofusion PWIE SP-B.1 (Physics of erosion and deposition)

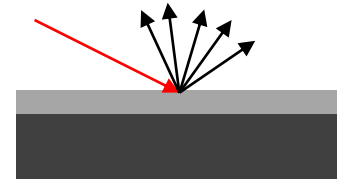
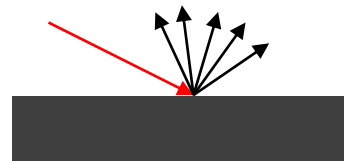
2021/01/01 – 2022/12/31

Our tasks to be performed:

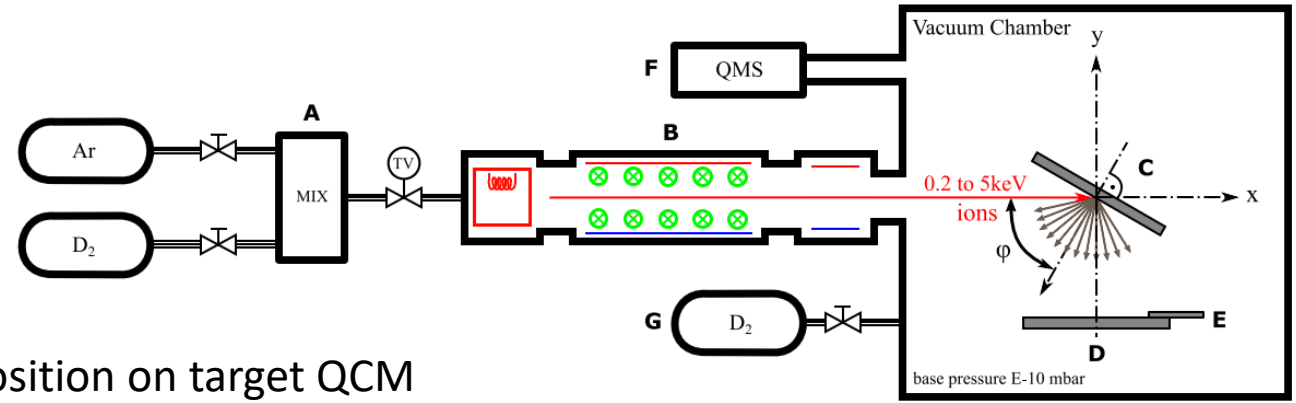
- Determine the sputtering properties, including angular distributions of sputtered particles, of W model systems with varying morphologies and re-deposited W layers
- laboratory experiments and analyses (ÖAW)

Our deliverables (D4):

Effective sputtering yields of W model systems (including angular distributions of sputtered particles) and re-deposited W layers, following exposure to controlled D and impurity ion beams (ÖAW)

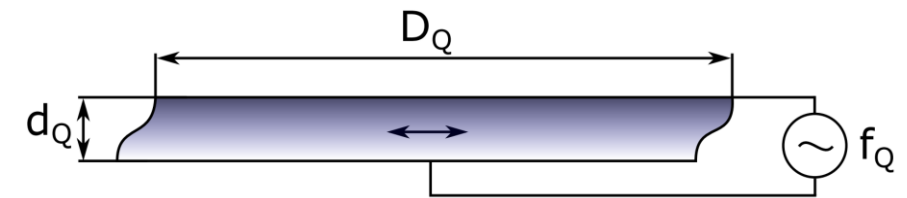


- A: Volume to create gas mix (i.e. Ar + D₂)
- B: Ion source + WF (0.2 to 5keV ions)
- C: QCM (target) -> sputter yields
- D: QCM (catcher) -> angular distribution
- E: W-platelet (Mateck) -> enables in-situ W sputter deposition on target QCM
- G: D₂ bottle for residual gas pressure tuning (10⁻⁸ up to 10⁻⁴ mbar)
- F: QMS for residual gas analysis



QCM (Quartz Crystal Microbalance)

- Utilisable for both erosion or deposition
- Resonance frequency changes with mass loss/gain [1]
- Determines mass changes down to 10⁻⁴ W monolayers/s [2]
- Temperature compensated (3rd mode) [2]



$$\frac{\Delta m}{m_Q} = \frac{\Delta d}{d_Q} = - \frac{\Delta f}{f_Q} \quad [6]$$

[1] Sauerbrey G., 1959 (<https://doi.org/10.1007/BF01337937>)

[2] Stadlmayr R., 2020 (<https://doi.org/10.1063/5.0012028>)

1) Create & characterise re-deposited W layers

- On flat W QCM crystal and/or Si Wafer platelet
- Deposition of 1-10 nm W in setup, D_2 residual gas pressure of 10^{-6} mbar to create W layer with lower density to introduce significant difference between classic and redeposited W layer
- IBA (Uppsala University, VR) to characterise thin layer (parallel to step 2 below)

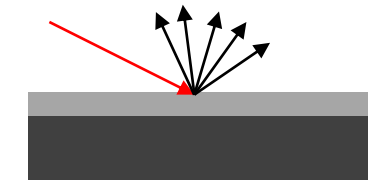
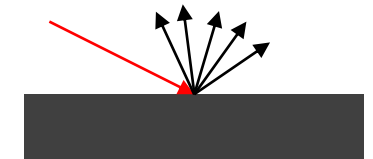
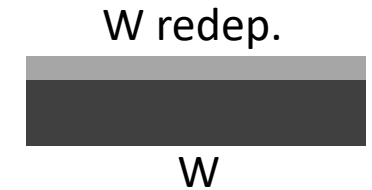
2) Reference experiments on twin QCM sample (flat W, no redeposited layer)

- Sputter yields $D_2^{1+} \rightarrow W$, $Ar^{1+} \rightarrow W$; 2keV; under various inc. angle
- Angular distribution of sputtered W atoms ($60^\circ Ar^{1+} \rightarrow W$ case)

3) Experiments with re-deposited layer on QCM sample

- Deposition of 1-10nm W in setup, D_2 residual gas pressure of 10^{-6} mbar to create W layer with less density
- Sputter yields $D_2^{1+} \rightarrow W$, $Ar^{1+} \rightarrow W$; 2keV; under various inc. angle
- Angular distribution of sputtered W atoms ($60^\circ Ar^{1+} \rightarrow W$ case)

For all : AFM investigation priori/posteriori irradiation



Time plan:

Project milestone	Estimated time	Status
Setup calibrations and upgrades	3 weeks	Almost done
1) Layer characterisation (ÖAW + VR)	3-4 weeks	Open
2) Reference experiments (ÖAW)	2 weeks	Open
3) Experiments on re-dep. layers (ÖAW)	2 weeks	Open
Data analysis & evaluation (ÖAW + VR)	3 weeks	Open

Planned start of experiments: Calendar week 26-30 (depends on current exp. campaign progress)

Project on track, no delays expected so far

Our **SP-D task** will further **support this work** with focus on **numerical simulations (SDTrimSP-3D, SPRAY)**