Boronisation studies at TOMAS

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TOMAS

An image of TOMAS[1] is shown on the right, relevant to the boronisation research we have:

Wall conditioning systems:
- Glow Discharge
- ICRH[2]
- ECRH

Diagnostics
- Retarding Field Energy Analyzer (not shown on figure but can be swapped with the sample load system)
- Laser-Induced Desorption Quadrupole Mass Spectrometer (will be tested in 2024 by Sebastijan Brezinsek)
- Time of Flight Neutral Particle Analyser
- Langmuir probes, various pressure gauges and in the near future a reflectometer

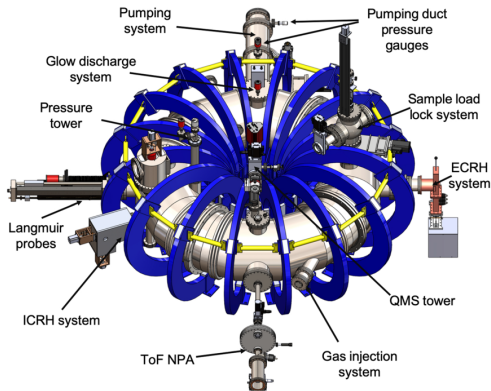FIG. 4. The 3D model of the upgraded TOMAS device.

Sample load system

A possible sample geometry is shown on figure a , in this geometry, the top 10x10 layer will be coated with boron and put in a sample mask (note that both others sample geometries and masks are available from PSI-2). This sample mask will be attached to a moveable arm which makes it possible to expose the samples in the TOMAS machine on various depths (from the top of the vessel all the way to near the middle) and angles (the arm can be rotated with the polar angle going from 0 to 90° and the azimuthal angle all 360°)
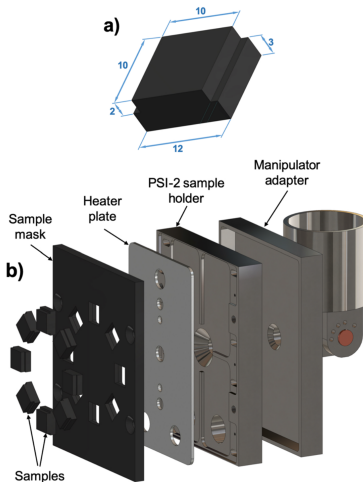
Pre- and Post-characterisation

In Forschungszentrum jülich (FZJ) there are various machines which we may use to manufacture the sample and characterize e.g the roughness, the layer thickness, the composition,...

Both the FZJ and the university of Uppsala have ion beams we may use, these have the possibility to do:

- ERDA
- RBS
- PIXE
- ...

Which may be used for further characterization

Aim of the research

- Studies of boron layer erosion by wall conditioning plasmas (e.g GD and ICWC)
- Fuel retention and removal from boron coating by GD, ECWC and ICWC

Research Plan

To accomplish the aim, we'd like to coat various materials used as PFC with boron, more specifically we'd like to coat fine structure graphite, CFC and stainless steel. For the erosion by wall conditioning we'll be exposing them to:

- H: GD,ICWC and ECWC
- He: GD,ICWC and ECWC
- H+He: GD,ICWC and ECWC
- possibly mixed ICWC+ECWC if time permits

For fuel retention and removal we'll first measure the retention efficiency by exposing samples to relevant conditions and then, using those characterized samples, use the same wall conditioning techniques, thus being able to measure the outgas efficiency. To simulate more realistic conditions, with the new upgrade of the sample holder, it will also be possible to heat the samples.

appendix

Even though it was not mentioned in the previous slide, we're also interested in investigating boronisation of tungsten but we're waiting for a clear research plan from the ITER side. We have been informed however that ITER-relevant tungsten is already available from our colleagues in Jülich.

As our plan is to focus on W7-X relevant studies for now, our experimental parameters will depend on the wall conditioning plasma characterization results and how they may be relevant to W7-X. Any ideas you may have, Chandra Prakash, are more than welcome!

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