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Analysis of materials exposed to hydrogen isotopes (H,D,T) in permeation experiments: surface pre-characterization and post-exposure depth profiling of steel, tungsten, and Cu-Cr-Zr.

Wednesday, 25 November 2020 16:00 (20 minutes)

The aim of this contribution is to present a) the available instrumentation for characterization of plasma-facing components from fusion devices at Uppsala University and b) an overview of our intended contributions to the CRP.

At Uppsala University, a 5 MV pelletron with 6 beamlines, a 350 kV high-current implanter with 3 beamlines as well as a Low-energy ion scattering system have been used for research related to nuclear fusion. In the presentation the available instrumentation and complementary facilities as well as highlight basic capabilities for hydrogen depth profiling using Nuclear Resonance Analysis and different elastic recoil techniques will be introduced. Recent developments will also be discussed:

a) a new chamber for in-situ thin film growth and modification while performing ion beam analysis and a new low-energy ion beam analysis chamber for Rutherford Backscattering Spectrometry (RBS), low-energy particle induced X-ray emission (PIXE) as well as low-energy nuclear resonance analysis (NRA).

b) a new chamber for in-situ thin film growth and modification for the medium-energy ion scattering system

c) a new-low energy implantation facility

We will also introduce our intended contributions to the present CRP on hydrogen permeation of fusion relevant materials, which specifically are:

1. Surface pre-characterization of materials (reduced activation steels, W, Cu-Cr-Zr alloys) by ion beam methods: nuclear reaction analysis and heavy ion elastic recoil detection analysis, to determine H and low-Z impurities: oxygen, carbon, sulphur.
2. Preparation of samples loaded with H or D by implantation and ion beam pre-characterization of such samples.
3. Preparation of ion-implanted (H, He, high-Z ions) targets to simulate transmutation products in neutron-irradiated materials; for instance, steel implanted with H, He and Mn.
4. Determination of diffusivity and permeation rate by analysis (with high-resolution quantitative depth profiling) of H, D, T in materials used in permeation experiments. The laboratory has capabilities for handling T-containing samples.
5. Contribution to the selection and qualification of materials, and to the unification of experimental set-ups/conditions in order to enable comparison of results obtained in different laboratories.

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