Contribution ID: **744** Type: **not specified**

P2.173 Fuel Retention Diagnostic Setup (FREDIS) for desorption of beryllium and tritium containing samples

Tuesday, 18 September 2018 11:00 (2 hours)

In fusion devices, the retention of the fusion fuel deuterium (D) and tritium (T) in plasma-facing components (PFCs) is a major concern. Measurement of the hydrogen isotope content in PFCs and test samples gives insight into the retention physics.
In FREDIS, Thermal Desorption Spectrometry (TDS) is performed in an evacuated (p < 1E-8 hPa) quartz tube (Ø52 mm), where samples are heated by 6 infrared lamps up to 1433 K with linear temperature ramps of up to 1.67 K/s. The desorbed gases are detected up to 100 amu with a double-QMS (Quadrupole Mass Spectrometer) that can distinguish between helium and D2 and uses an innovative differential pumping system.
In a connected vacuum chamber (Ø250 mm), a Ø3 mm spot can be heated on the sample surface by a high energy Nd:YAG laser pulse (E < 100 J) within milliseconds (t < 20 ms) to several thousand degrees, ensuring complete fuel desorption within the heated volume [1]. This method of Laser-Induced Desorption (LID) can also be applied inside the fusion chamber and is planned as in situ retention diagnostic for ITER [2]. In FREDIS, LID is used as ex situ analysis method using the same double-QMS for absolute quantification. In this contribution we present the specifications of FREDIS and compare TDS and LID.
Moreover, FREDIS is designed to handle beryllium by means of glove boxes and in the future also tritium using a tritium trap. Therefore, FREDIS is located in a radiation controlled area – the High temperature Materials Laboratory (HML) – in the Forschungszentrum Jülich. FREDIS is capable of analysing beryllium- and T-containing samples from JET and potentially ITER.

This work is supported by: EUROfusion EEG-2017/05 (AWP17-EEG-FZJ/Zlobinski)

[1] M. Zlobinski, Jülich: Forschungszentrum, Zentralbibliothek (2016), Juel-4396, hdl.handle.net/2128/12453
[2] G. De Temmerman, et al., Nuclear Materials and Energy 12 (2017) 267-272, doi:10.1016/j.nme.2016.10.016

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Session Classification: P2