IFERC Newsletter

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Status of DEMO R&D Activity

Highlights on Tritium Technology

Task 1 of DEMO R&D consists of three sub-tasks: (i) sub-task 1-1 on plasma wall interactions by analyses of samples from JET with the ITER-Like Wall (JET-ILW) for evaluation of tritium inventory and tritium recovery; (ii) sub-task 1-2 on development of conceptual design of Tokamak Exhaust Processing (TEP) systems for DEMO; (iii) sub-task 1-3 on development of tritium inventory evaluation tool for DEMO fuel cycle design.

In Task 1-1, both at IFERC and at the Beryllium Handling Facility at JET, work was limited in the Covid-19 time because of the regulations and restrictions in the access to laboratories. Despite these limitations, samples from Be limiters (ILW1-3 campaigns) and W lamellae (ILW-3 campaign) were shipped in 2021 from JET to IFERC, and a significant progress in research has been made, particularly in the field of the global tritium (T) determination and characterization of surface composition. The analysis of experimental data were very efficient, and all scientific and technical objectives planned for the first half of 2022 have been achieved.

The work concentrated on samples from the third ILW campaign (ILW-3) and a comparison to the situation after ILW-1. The main research topics included:

1. *global tritium analysis in limiter tiles (see Fig-1) and dust collected after ILW-3 and comparison to the data after ILW-1 and to dust samples from JET-C;*
2. *evaluation and discussion of results obtained for the limiter and divertor samples,*
3. *planning of future activities and material selection for analyses in 2022.*

Materials studies have been performed using tritium imaging plate techniques (TIPT), beta-induced X-ray spectroscopy (BIXS), thermal desorption spectroscopy (TDS), scanning electron microscopy (SEM), electron probe micro-analysis (EPMA), focused ion beam (FIB) and transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS) and X-ray diffraction (XRD). There are three very important outcomes: (i) determination of T activity desorbed from W lamellae samples: around 800 Bq in the form of HTO and HT; (ii) detailed comparison of T in W lamellae from ILW-1, ILW-3 and a sample exposed during all three campaigns ILW1-3; (iii) sputter-assisted XPS from the Be limiters: depth profiling of Be, C, O, W, and evolution of the Be and BeO features under Ar sputtering.

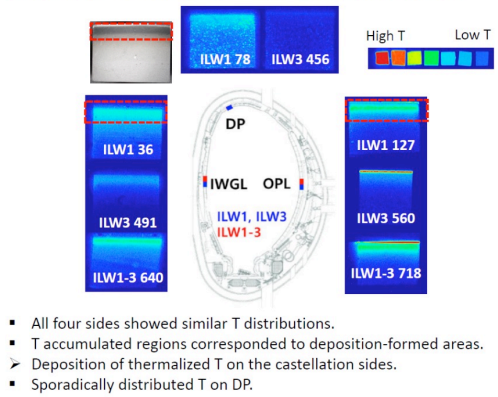

Fig-1: Global tritium distribution in the castellation

In task 1-2, a common architecture was agreed upon, and functional system blocks to be investigated were selected. In addition, direct recycling was evaluated and a conceptual design for a TEP (i.e. Refinement concept of gas analysis system with Laser Raman Spectroscopy for direct recycle loop and the application) was developed. A first assessment of the operational tritium inventory was performed in EU as shown Fig-2.

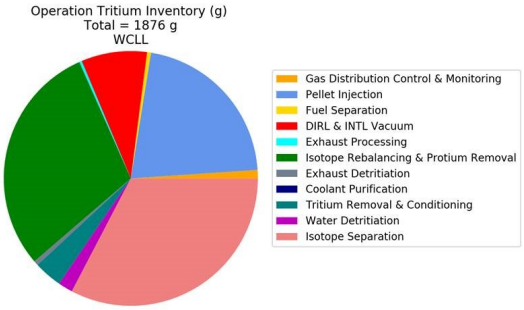

Fig-2: First inventory assessment by simulator in EU

In task 1-3, it was agreed to compare the EU Fuel Cycle Simulator with Japanese stand-alone models. The TEP (the feasibility of D-T mixed pellet production) and the ISS/WDS (refined numerical design code) systems have been identified as systems for the development of the physics models.

(DEMO R&D Task-1 TROs)