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| **WPPWIE Deliverables Status Report** | | | | | **Date:** | | | 01-Sep-2022 | | |
| **Subproject:** | SP C / Retention and Release | | | | **Deliverable ID** | | | PWIE-SP C.1.T-T002-D005 | | |
| **Deliverable owner:** | S. Markelj (JSI) | | | | **Deliverable due date** | | | 31-12-2022 | | |
| **WP Leader:**  **SP Coordinator:** | S. Brezinsek (FZJ)  K. Schmid (MPG) | | | |  | | |  | | |
| **Task title:** | SP C.1 Transport of Hydrogen through the first wall of fusion devices | | | | | | | | | |
| **Deliverable title:** | JSI: Permeated amount of D for atom and ion beam loading as function of temperature | | | | | | | | | |
| **Status:** |  | **Completed** |  | **Partially completed** | |  | **Delayed** | |  | **Cancelled** |
| Please write a short status report (max. ½ pages) here.  Please check the status of the deliverable(s) with a “x” in the row above.  If the deliverable(s) are delayed, please also indicate an estimated completion date in the report text.  If the deliverable(s) include machine time, please indicate the number of days that have been used for the deliverable(s) in the report text.  For reference, the specification of this task from the PMP is given below. | | | | | | | | | | |
| **Reference from PMP:** | | | | | | | | | | |
| The transport of hydrogen isotopes HIs through the first wall of fusion devices is the driving process for HIs retention but also for permeation to the coolant. Both of these processes have fundamental implications for the safety and the tritium self-sufficiency of a fusion reactor. The first wall of a future fusion reactor will be comprised of the top armor material W and structural materials below like steel or Cu alloys that connect the top plasma-facing surface to the coolant. Therefore, the transport through the whole component from the W armor layer to the coolant needs to be understood. This firstly requires experiments on HIs retention in the different materials (W, steels and Cu-alloys) by trapping at intrinsic defects and at defects generated due to exposure to the fusion environment: bombardment by plasma species and/or MeV neutrons, formation of transmutation and decay products like e.g.: Re and He. Secondly experiments on permeation across the interface in between the materials are required that determine the barrier properties of the different interfaces and the influence of typical impurities like O on these properties. Finally, the transition from the metal coolant pipe into the coolant water needs to be understood to provide the dependence of the dissolution of HIs from the metal into the water as function of temperature, pH-value and pressure.  The experiments on HIs retention in the materials will allow making predictions about the loss of Tritium fuel species in the wall and the experiments on HIs transport will allow making predictions about the amount of Tritium recoverable through the coolant water. | | | | | | | | | | |
| **Inputs required:**  Facilities: MAGNUM, PSI-2, Accelerators | | | | | | | | | | |
| **Tasks to be performed:**   * Permeation (D,T) through Liquid/Solid interfaces with interface characterization (CEA) * Dynamic measurements of deuterium retention and isotope exchange in W (DIFFER) * Influence of ELMs on deuterium retention and outgassing in W (DIFFER) * Gas driven permeation through and retention in W, Steel, W on Steel and W on Cu (FZJ) * Measurement and modelling of Ion Driven Permeation in W, Cu and Fe-Ni alloys "heavy alloys" (MPG) * Compare D permeation through W with D atoms and 300 eV/D ions (JSI, MPG) * FIB/SEM/EDX analysis of material interfaces in multi material permeation samples (IPPLM)   Studying the influence of (re-deposited) W on EUROFER on D retention (OEAW, VR) | | | | | | | | | | |
| **Deliverables:**   |  |  | | --- | --- | | **Deliverable ID:** | **Deliverable Title:** | | D001 | CEA: Compare T permeation from gas to gas with gas to water | | D002 | DIFFER: Investigate dynamic inventory during exposure and influence of ELM like transients on post exposure retention. | | D003 | FZJ: Comparison of permeability W/CuCrZ vs pure substratesDIFFER: Evaluation of influence of plasma parameters and surface temperature on trapping and de-trapping post-exposure | | D004 | MPG: Measure ion and atom driven permeation through W and W-heavy alloys and provide self-damaged W samples | | D005 | JSI: Permeated amount of D for atom and ion beam loading as function of temperature | | D006 | IPPLM: TEM analysis of void formation in self-damaged W | | D007 | OEAW: Quantification of retained D in W "re-deposited" on EUROFER | | D008 | VR: Quantification of retained D in W "re-deposited" on EUROFER | | D009 | DIFFER: D concentration in the surface as function of temperature and plasma flux, Compare hydrogen loading efficiency of plasma vs laser-based ELM simulation (Transfer 2021) | | D010 | IPPLM: FIB/SEM/EDX analysis of multi material permeation samples (Samples from MPG, JSI) (Transfer 2021) | | | | | | | | | | | |
| **Management Information**  **Human Resources (2022)**:   |  |  |  |  | | --- | --- | --- | --- | | **Deliverable Owner** | **Beneficiary** | **PM** | **Deliverable (Team)** | | E. Bernard | CEA | 12 | D001 | | T. Morgan | DIFFER | 4+4 | D002, D009 | | A. Houben | FZJ | 11 | D003 | | A. Manhard | MPG | 2 | D004 | | S. Markelj | JSI | 3 | D005 | | L. Ciupinski | IPPLM | 4+4 | D006, D010 | | F. Aumayer | OEAW | 3 | D007 | | D. Primetzhofer | VR | 3 | D008 | | **Total** |  | 52 |  |   **Machine Resources (2022):**   |  |  |  |  | | --- | --- | --- | --- | | **Device** | **Beneficiary** | **Days** | **Related Deliverable** | | MAGNUM | DIFFER | 4+4 | D002, D009 | | Accelerator | DIFFER | 8+8 | D002, D009 | | UPP | DIFFER | 8+8 | D002, D009 | | Accelerator | JSI | 7 | D005 | | Accelerator | MPG | 2 | D004 | |  |  |  |  |   **Other resources:**  **Collaborations:**  WPBB, WPSAI  **Other information:**  Connected to TSVVs associated with WPPWIE | | | | | | | | | | |