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| **WPPWIE Deliverables Status Report** | | | | | **Date:** | | | 01-Sep-2022 | | |
| **Subproject:** | SP X / Plasma characterization, laser-  based diagnostic development, and wall conditioning | | | | **Deliverable ID** | | | PWIE-SP X.3.T-T002-D004 | | |
| **Deliverable owner:** | P. Petersson (VR) | | | | **Deliverable due date** | | | 31-12-2022 | | |
| **WP Leader:**  **SP Coordinator:** | S. Brezinsek (FZJ)  H. J. van der Meiden (DIFFER) | | | |  | | |  | | |
| **Task title:** | SP X.3 Characterisation and optimisation of TOMAS wall conditioning plasmas | | | | | | | | | |
| **Deliverable title:** | ECWC, ICWC, and GDC plasma characterization / Pre- and post-characterization of samples used for cleaning and isotope exchange (VR) | | | | | | | | | |
| **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:** | | | | | | | | | | |
| Ion Cyclotron Wall Conditioning (ICWC) is included in the ITER Research Plan as well as part of the wall conditioning of long-pulse facilities. A high and isotropic flux of neutral particles is generated in these low-density discharges through elementary collision processes. The effectiveness of ICWC for modifying the plasma facing surfaces, evidenced in numerous experiments on tokamak, results largely from these neutrals. This subproject proposes to study the further the production and role of energetic neutrals in ICWC and its impact on wall conditioning, thus, the impurity removal and the fuel content removalTomator1D predicts a neutral hydrogen particle flux on TOMAS that is sufficiently high to be detected by a time-of-flight neutral particle analyser provided in FP8. The energy distribution of neutrals can be resolved by the ToF NPA in the energy range of 10 to 1000 eV. Optimisation of the plasma in connection to modelling predictions shall enhance the efficiency of the neutrals for wall conditioning purpose.  The stainless-steel TOMAS device (120mT Continuous-wave operation) is equipped with a wide frequency band ICWC plasma source, an upgraded Electron Cyclotron Resonance Heating (ECRH) system and a W7-X prototype DC glow discharge anode. In the present framework a material sample system as well as multiple plasma and PWI diagnostic tools will be installed (LP, OES, RFA, LID-QMS etc.). They permit a better characterisation and optimisation (pressure, composition, pumping speed, cycling, heating power) which will feed into predictions for tokamaks and stellarators.  Moreover, dedicated cleaning attempts on reference samples with pre-characterised surface conditions and stellarator/tokamak samples will be applied. This work is accompanied with dedicated pre- and post-characterisation of material samples. | | | | | | | | | | |
| **Inputs required:**   * Characterizing the particle fluxes to PFCs in ICWC and ECWC conditioning discharges * TOMAS facility operational with upgraded diagnostics (flux, energy, temperature, plasma) * Reference samples and samples after plasma exposure in toroidally confined plasmas (WPTE or WPW7X)   Access to surface analysis stations in FZJ, VR, and ERM-KMS (together with SP B) | | | | | | | | | | |
| **Tasks to be performed:**   * Diagnostic upgrade and ECWC, ICWC, RF plasma characterisation in TOMAS * Modelling of TOMAS plasma to describe neutral particle conditions as well optimise efficiency and homogeneity of the plasma * Plasma-facing material cleaning in TOMAS with optimisation of experimental conditions * Pre- and post characterisation of reference samples applied to cleaning attempts   Coordination of TOMAS experiments and relation to ITER conditions as well as other toroidal facilities like W7-X, WEST, AUG | | | | | | | | | | |
| **Deliverables:**   |  |  | | --- | --- | | Deliverable ID: | Deliverable Title: | | D001 | ECWC, ICWC, and GDC plasma characterization + comparison with stellarator and tokamak experiments / fuel/impurity removal studies at reference samples / Modelling of wall conditioning RF-based plasmas (LPP-ERM-KMS) | | D003 | ECWC, ICWC, and GDC plasma characterization / fuel/impurity removal studies at reference samples / Pre- and post-characterization of samples used for cleaning and isotope exchange (FZJ) | | D004 | ECWC, ICWC, and GDC plasma characterization / Pre- and post-characterization of samples used for cleaning and isotope exchange (VR) | | D005 | ECWC, ICWC, and GDC plasma characterization / Modelling of wall conditioning RF-based plasmas (KIPT) | | | | | | | | | | | |
| **Management Information**  **Human Resources (2022)**:   |  |  |  |  | | --- | --- | --- | --- | | **Deliverable Owner** | **Beneficiary** | **PM** | **Deliverable (Team)** | | K. Crombe | LPP-ERM/KMS | 9 | D001 (K. Crombe, A. Goriaev\*, …) | | S. Möller | FZJ | 4 | D003 (S. Möller, M. Rasinski, D. Nikolai, ...) | | P. Petersson | VR | 3 | D004 (L. Dittrich, P. Petterson,…) | | V. Moiseenko | KIPT | 4 | D005 (V. Moiseenko, Y. Kovtun, ...) | | **Total** |  | 20 |  |   **Machine Resources (2022):**   |  |  |  |  | | --- | --- | --- | --- | | **Device** | **Beneficiary** | **Days** | **Related Deliverable** | | TOMAS | FZJ | 20 | D002 | | Accelerator | VR | 5 | D004 | | Accelerator | FZJ | 3 | D002 | |  |  |  |  |   **Other resources:**   * Travel for TOMAS campaigns   **Collaborations:**   * WPTE, WPW7X * ITER and ITPA DivSOL   **Other information:**  \* EEG to wall conditioning and TOMAS exploitation since mid-2021 | | | | | | | | | | |