IFERC Newsletter

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International Fusion Energy Research Centre, Rokkasho, Aomori 039-3212, Japan

Status of DEMO R&D Activity

Highlights in development of materials corrosion database

Task 4 is composed of two sub-tasks; sub-task 4-1: Material corrosion/erosion handbook development, and sub-task 4-2: Activated Corrosion Product (ACP) evaluation model development for fusion in-vessel components.

Regarding sub-task 4-1, static corrosion tests of F82H under simulated DEMO cooling water with H_2O_2 started in JA. The magnetic field corrosion test apparatus is under preparation for the operation in 2022. JA is exploring parameters (e.g., Reynolds number) that should be standardized among different testing methods to predict the detailed corrosion behaviour as shown in Fig-1. The susceptibility about the stress corrosion of CuCrZr was evaluated by the creviced bent beam (CBB) test. In EU, preliminary calculations of the radiolysis process on some divertor channels have been performed using a Python routine developed for homogeneous aqueous chemical reaction analysis. As for the evaluation of the interactions between the main water radiolytic species and possible corrosion products, the code modified by the addition of reactions involving iron ions has been successfully validated. The literature review on EUROFER corrosion in PbLi, effects of irradiation, magnetic field, and chemistry on corrosion has been completed.

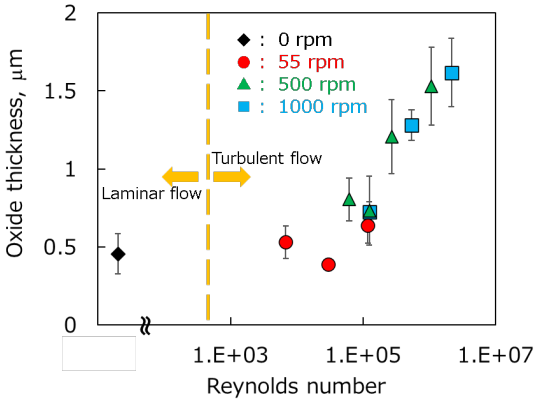

Fig-1: Relationship between Reynolds number and oxide thickness.

As for sub-task 4-2, concerning the ACP evaluation model for reduced activation steel, basic equations and parameters related to dissolution and precipitation of oxides have been organized, and an evaluation flow for dissolution and precipitation based on oxide solubility, etc. has been prepared by JA (see Fig-2). In EU, the ACP evaluation toolkit OSCAR-Fusion v1.3 has been coupled to RAVEN, i.e., a sensitivity /uncertainty quantification framework which allows parametric studies if coupled to an arbitrary code via Python API. The new version of OSCAR-Fusion, V1.4, has now been released. The differences between the two versions are under assessment.

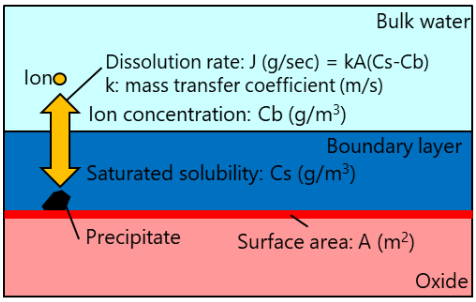

Fig-2: Schematic illustration of concept for ACP evaluation

Corrosion loop improvements are ongoing to insert an oxygen analyzer to perform oxygen contamination tests in EU. The testing activities carried out until 2021 had been conducted in ultrapure water with 10 ppb oxygen. Further work to improve the corrosion loop was aimed at tests simulating the action of Chemical and Volume Control System (CVCS). After several trials to test the corrosion loop modifications, a 1000-hours test is currently underway with water chemistry doped with 500 ppm KOH.

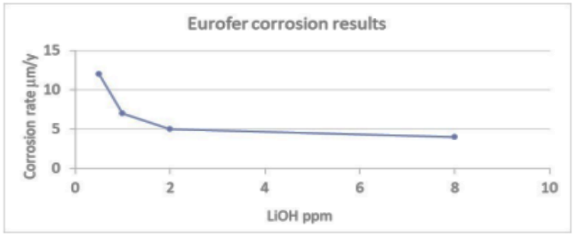

Fig-3: EUROFER corrosion results performed in autoclave and corrosion loop (HTHP: High Temperature, High Pressure) facilities

(DEMO R&D Task-4 TROs)