IFERC Newsletter

IFERC

IFERC-N-2023-26, 4 Dec. 2023
International Fusion Energy Research Centre, Rokkasho, Aomori 039-3212, Japan

Status of DEMO R&D Activity

Highlights on the development of materials corrosion database

Task 4 (T4) on R&D on development of material corrosion database, is composed of two main activities: 1) Material corrosion/erosion handbook development including the effect of fusion DEMO relevant environments (magnetic field and irradiation) on corrosion behavior, the effect of flow regime on corrosion behavior, the effect of chemistry on corrosion behavior, and the assessment of post corrosion property (subtask 4-1), and 2) Activated Corrosion Product (ACP) evaluation model development for fusion in-vessel components composed of corrosion product and T behavior and the ACP model development (subtask 4-2).

Regarding subtask 4-1, the main achievements are as follows; (1) Water corrosion behavior of F82H was evaluated under a fusion-specific environment (e.g., H_2O_2 effect shown in Fig.-1),

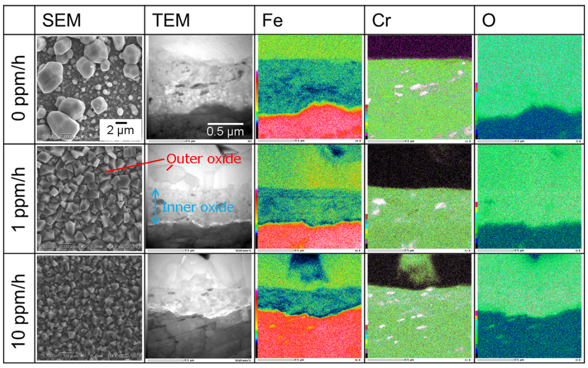

Fig.-1: Effect of H_2O_2 on corrosion property of F82H

(2) The effect of temperature and dissolved hydrogen on the environment assisted corrosion (EAC) of Cu alloy was preliminarily evaluated, (3) The effect of Zn addition on water corrosion of EUROFER97 was assessed, showing little impact on the morphology and composition of the corroded layer (Fig.-2), and (4) Cr_xC_y coated-CuCrZr segment was tested in reducing water chemistry, revealing degradation. A new coating composition (Cr_2O_3) will be studied in 2024.

As for subtask 4-2, the tritium permeability of F82H from high temperature and high-pressure tritiated water was preliminarily evaluated by JA using the equipment fabricated in 2022. A preliminary test at 270°C was completed to evaluate tritium permeability and confinement capacity. Based on the results, a higher tritium concentration in the primary tritiated water will be considered to modify the equipment to higher temperatures to more closely match DEMO conditions. In EU, the corrosion rate of EUROFER was determined in a range from 4-9 µm/y on base material and from 10-20 µm/y on welding. Increasing the LiOH concentration a significant reduction of corrosion rate was measured. A corrosion law for EUROFER97 was included in the OSCAR-Fusion code. The one order of magnitude difference between F82H and EUROFER97 must be investigated and explained (Fig.-3).

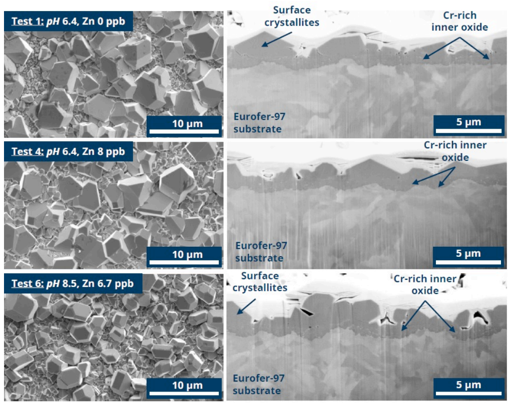

Fig.-2: Effect of Zn addition on water corrosion of EUROFER97

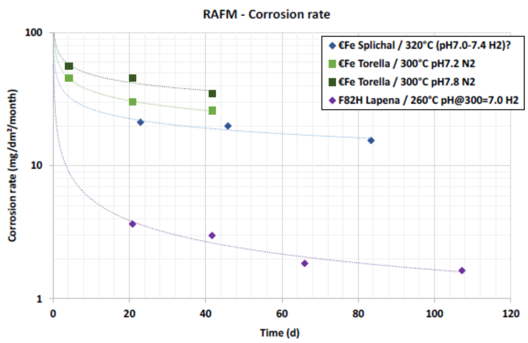

Fig.-3: Corrosion rate of EUROFER97

(DEMO R&D Task-4 TROs)