IFERC Newsletter

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Status of DEMO R&D Activity

Highlights on Neutron irradiation experiments of BFMs

The objective of Task 3 (T3) of DEMO R&D, neutron irradiation experiments of Breeding Functional Materials (BFMs), is to characterize the BFMs under neutron irradiation. In the BA Phase I, R&D on advanced tritium breeders and advanced neutron multipliers as BFMs with high stability at high temperatures has been performed.

Due to the situation between the Russian Federation and Ukraine, the project plan involving irradiation campaigns at INM in Russia was cancelled and the Implementing Agencies agreed to perform neutron irradiations in two separate facilities, the BR-2 reactor of SCK-CEN in Belgium for neutron irradiation experiments for PIEs (Post Irradiation Experiments) and the WWR-K reactor of INP in Kazakhstan for in-situ tritium release experiments. The re-organization of the test programmes and preparation of equipment have been completed with the amendment of the corresponding procurement arrangement.

The main objective of the tritium in-situ experiments in the WWR-K reactor on the European Ceramic Breeder (EUCB) and Japan Ceramic Breeder (JACB) materials is to collect data on the behaviour of the material in terms of neutron interaction, tritium production, tritium retention and release. To reach this objective, several conditions in terms of temperature, the composition of the Purge Gas (PG) (i.e. He + x vol% H2), etc. have to be taken into account. The aim is to reach 0.5-1 dpa per reactor cycle in the ceramics and to lower the dpa/Li-burnup ratio as far as possible to obtain “ITER-like” conditions by tailoring the neutron spectrum accordingly. The activities are split into 4 subordinate tasks.

Concerning the neutron irradiation of PIEs in the BR-2 reactor, the main scope is the material qualification for their use in the ITER-TBM. The activity will be implemented via a sequence of phases, where each phase completion should be approved by EU and JA before proceeding to the next phases: Development of design documentation & safety case study (Phase 1), Final design, irradiation cost & time plan (Phase 2), Irradiation (Phase 3), and Preparation for Transportation (Phase 4).

In 2023, the following activities were performed based on the feasibility studies for irradiation in BR-2 and WWR-K reactors, respectively, using samples transported from JA and EU and so on finalization of the rigs/ampoules design (see Fig.-1 and Fig.-2), preparation of the irradiation rigs/ampoules and samples, transportation of JA/EU samples to each facility (SCK-CEN and INP), assembly of the irradiation rigs/ampoules with samples, mockup test for in-situ T release experiment at the WWR-K reactor, and the start of neutron irradiation for PIEs at the BR-2 reactor.

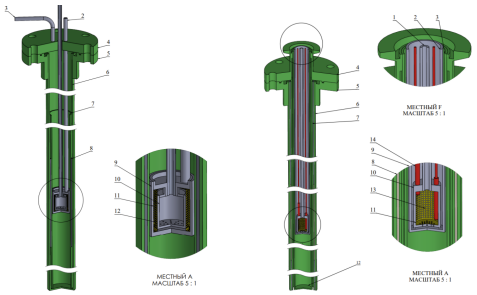

Fig.-1: examples of the design of rig and capsule for in-situ T release measurement in WWR-K; (left) option 1 and (right) option 2 (various options have been investigated by considering effectiveness and precision for measurement).

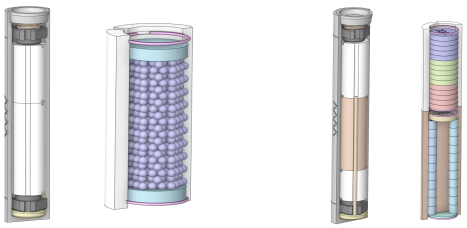

Fig.-2: (left) capsule & holder for pebbles and (right) capsule & holder for blocks used neutron irradiation for PIEs in BR-2

Work plans in 2024 are to finalize the design of the in-situ T release experiment, start the neutron irradiation for the in-situ T release experiment for JA and EU samples, and continue the neutron irradiation for PIEs for JA and EU samples.

(DEMO R&D Task-3 TROs)