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FTP/P7-15: Development of Small Specimen Test Techniques for the IFMIF Test Cell

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Recent progress of small specimen test technique (SSTT) for the IFMIF (International Fusion Materials Irradiation Facility) test cell is mainly evaluated in this paper. The engineering designs and validations of high flux test module (HFTM) are performed by JAEA, Japanese Universities, and Karlsruhe Institute of Technology (KIT) in the IFMIF/EVEDA (Engineering validation and engineering design activities) projects under Broader Approach (BA) Agreement between EURATOM and Japan. The optimization of shape and size of specimen and the arrangement are under evaluating and present plan is summarized. Effects of specimen size on mechanical properties such as impact properties and ductile-to-brittle transition temperature (DBTT) are known to occur in ferritic/martensitic steels, and some parts of them have been prepared in the guideline and standard of mechanical tests by ASTM-international and ISO. However, our research of ferritic/martensitic steel F82H shows that it does not match with our data, i.e., master curve method for fracture transition behaviors of F82H steel. Accordingly, we have to modify and develop these standards for the tests including small size specimens in IFMIF. Test methodologies are evaluated for the tests of fracture toughness, fatigue, crack growth rate, tensile, and creep for IFMIF, and the irradiation conditions are analyzed in HFTM of IFMIF.
In the design of HFTM, two types are proposed for RAF/M steels by EU KIT team and for the advanced materials by JA team, respectively. The former type has 12 or 24 rigs instrumented inside HFTM, and liquid NaK is used as a heat medium for small size specimens, and the upper limitation temperature would be up to 823 K. If it needs to test at higher temperatures than 823 K, we would have to use helium gas as a heat medium. The latter type of HFTM has been developed by JA team for use at temperatures up to 1,273 K, and the module design with 9 set-capsules (3 sets x 3 layers) is set in horizontal direction. The size of one capsule is 15 mm in height and 200 mm in width, and the regime of the capsules in HFTM just corresponds to the foot print size of neutron beam. For validation tests and engineering design, W-3%Re alloy and SiCf/SiC composites were selected as heater materials and the type R (Pt-Rh alloy and Pt) was chosen as thermocouples because of their phase stability during irradiation.

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