IFERC Newsletter

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Meetings

2nd Joint Technical Coordination Meeting between DDA and R&D

The 2nd Joint Technical Coordination Meeting (JTCM-2) of DEMO Design Activity (DDA) and DEMO R&D activity was held at Katsura Campus of Kyoto University in Kyoto Japan on 6 February 2014 with 54 participants (including 25 remote participants); 4 from IFERC-PT, 26 from JA home team and 24 from EU home team. The objective of this meeting was to enhance mutual cooperation between DEMO R&D and DDA following the request by the peer review panel of DEMO R&D activity implemented in 2012.

In EU, the "roadmap to the realization of fusion energy" was completed at the end of 2012. In Japan a joint core team has been formed with participation from JAEA, universities and industry to investigate tactics and a roadmap for the establishment of a technological basis required for the development of DEMO. R&D issues regarding the establishment of a technological basis for DEMO have been analyzed based on hearings from experts.

In EU, a study, which was started in 2012, was continued to establish a Material Design Database for DEMO conceptual design activities. One of the priorities is the improvement of the material irradiation database for operating conditions that are critical for the DEMO design. The main objective of this work is to establish a link between R&D priorities and design needs, following the recommendations of the Material Assessment Group (MAG) report.

In Rokkasho, the license for handling tritium and other radio-active samples was obtained in July 2013. Test equipment for corrosion of SiC by Li-Pb has been made at ENEA, and will be shipped to Rokkasho in early May 2014. Four different heat treatments of RAFM were tested on F82H-BA12 heat, and tensile and Charpy impact tests were conducted. The tensile strengths were equivalent to those of IEA heats and BA07 heats, and Ductile-Brittle Transition Temperature (DBTT) was found to be better than the others. Preliminary fabrication of beryllide pebbles ø 1 mm for neutron multiplier was successful with the Rotating Electrode Method (REM) using the plasma-sintered beryllide rod. Advanced breeder pebbles (Li_2TiO_3 with excess Li ($Li_{2+x}TiO_{3+y}$)) have been produced and their physical, chemical, mechanical and other properties were characterized.

EU R&D activities are basically devoted to supporting the design of the two European Test Blanket Systems in ITER. The majority of them are relevant for the development and the conceptual design of the breeding blanket for DEMO.

Ca-Mordenite-type zeolite (MOR) may be a good candidate for the separation column material of the gas chromatograph for hydrogen isotope analysis. Tritium Imaging Plate (TIP) and Tritium Microautoradiography (TARG) enabled the measurement of hydrogen depth profile in the F82H-base materials exposed to hydrogen plasma with trace tritium. Tritium durability of Nafion membrane was demonstrated, suggesting that Nafion membrane is an adequate material for the electrolysis cell of the water detritiation system of ITER. Two types of erbium oxide coating; vacuum arc deposition and metal organic decomposition showed penetration reduction factors of 10^3-10^5.

With its unique capability of handling tritium, beryllium and irradiated tungsten simultaneously, investigation of plasma wall interactions including hydrogen isotope retention and dust of plasma facing materials from ITER-Like Wall Experiment on JET will be conducted in the DEMO R&D facility in Rokkasho site. The above R&D studies will be continued at the Rokkasho facility, at TPL (Tritium Process Laboratory of JAEA), and at Japanese Universities in 2014, as the last stage of the BA R&D study.

Two significant publications focusing on the irradiation effects on SiC and SiC/SiC composites are now available for the design. BA activities aim to further develop them to compile as the composite property handbook/database with special emphases on lifetime, prediction model, erosion/corrosion under Pb-Li, etc.

The status of the structural material database (e.g., RAFM) was reviewed, including n-irradiation data, in Europe and Japan to identify areas of possible collaboration, especially related to the establishment of a common materials engineering database for DEMO design activities.

Codes and standards play an important role by

providing a sound and consistent technical basis in ensuring the safety of nuclear power plants. The European focus has been to survey the current codes and standards landscape (Nuclear and non-Nuclear applications) and identify any in-vessel component gaps and populate simplified approaches in the conceptual design phase. The structural design criteria needs for a Japanese DEMO were discussed, with special emphasis on the design of a Water-Cooled Solid Breeder (WCSB) blanket.

The Progress in the development of structural materials of reduced activation ferritic/martensitic steel F82H in Japan was reviewed. The development of fabrication technologies was in progress, even though some challenges such as HIP joint non-destructive evaluation remain. There is a good database for F82H including irradiation data. The DBTT shift is an issue as for the low temperature irradiation effects, and the loss of uniform elongation and decrease of total elongation are the issue in terms of design technologies, as far as DBTT will not exceed operation temperature.

Initial database templates based on examples from the well-established CEA infrastructure – EUROFER inclusion in RCC-MRx code, were produced. Still substantial part of the work like populating the databases, and Validation of specimens / state of small specimen test technology has to be done in the forthcoming years.

Establishing a common materials engineering database for DEMO design activities, especially for structural materials, is recognised to be an area of priority for the near future. This would include the analysis of n-irradiation data available at relevant temperature and doses in Europe and Japan and the planning of new n-irradiation experiments in existing fission reactors. Additionally, dialogue should be improved between Europe and Japan on the definition of requirements and elaboration of Structural Design Criteria.

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