§70. Advanced Evaluation of Radiation Effects on Fusion Materials

Shikama, T., Kurishita, H., Yamazaki, M.,
Hatakeyama, M., Narui, M., Watanabe, M.,
Nagata, S., Chou, M., Hasegawa, A. (Tohoku Univ.),
Hatano, Y. (Univ. Toyama),
Atsumi, H. (Kinki Univ.),
Kimura, A., Takagi, I., Sato, K. (Kyoto Univ.),
Ohnuki, S. (Hokkaido Univ.),
Watanabe, H. (Kyushu Univ.),
Ueda, Y. (Osaka Univ.),
Terai, T., Oda, T. (Univ. Tokyo),
Oya, Y. (Shizuoka Univ.),
Tsuchiya, B. (Meijyou Univ.),
Nishitani, T. (JAEA),
Muroga, T.

Established in 1969, International Research Center for Nuclear Materials Science, IMR, Tohoku University, (the Center) has been playing a vital role as the joint-use research center in Japan where researchers and graduate students throughout Japan can visit to study the effects of neutron irradiation on the physical and mechanical properties of a variety of structural and functional materials. The accessible radiation reactors are JMTR, JOYO, JRR3 in Japan, FFTF (Fast Flux Test Facility), HFIR (High Flux Isotope Reactor), etc. in USA and BR2 in Belgium. The Center has developed and provided hardware and software as research tools by joint-user's requests. Through its activities the Center has been widely recognized as the core institution for nuclear materials research in Japan. In 2010, the Center reached an agreement of the bidirectional collaborative research program with NIFS to promote comprehensive studies on fusion reactor engineering and technologies (key persons: T. Shikam and T. Muroga).

Nine research proposals have been submitted to NIFS and all accepted after reviews at NIFS and the Center. The titles and principal investigators (caretakers at the Center) for each proposal are:

(89) Advanced evaluation of radiation effects on fusion materials: T. Shikama, Tohoku Univ. (M. Hatakeyama)
(90) Evaluation of neutron irradiation effects on fusion blanket materials joints and coating: A. Kimura, Kyoto Univ. (H. Kurishita)
(91) Conceptual design of neutron irradiation capsule in liquid lithium environment: K. Fukumoto, Fukui Univ. (M. Hatakeyama)
(92) Influence of displacement damage and transmutation elements on irradiation behavior of tungsten alloys for plasma facing components. A. Hasegawa, Tohoku Univ. (H. Kurishita)
(93) Mechanism underlying trapping of hydrogen isotopes in neutron-irradiated plasma facing materials, Y. Hatano, Toyama Univ. (H. Kurishita)
(94) Establishment of critical current measurement techniques using a 15.5 T conduction-cooled super conducting magnet, T. Takeuchi, NIMS (H. Kurishita)
(95) Irradiation characteristics of optical materials for fusion plasma diagnostics, M. Nishiura, NIFS (M. Narui)
(96) Radiation damage of organic electric insulation material for fusion superconducting magnet, S. Nishijima, Osaka Univ. (H. Kurishita)
(97) Irradiation effect on superconductng magnet materials for fusion, A. Nishimura, NIFS (T. Shikama)

Each study had been well performed until early March, 2011, but it had to be stopped because of the unprecedentedly devastating earthquake that hit the eastern region of Japan on the 11th, March, 2011. Therefore, some of the remaining works were carried forward to the 2011 activities. The reports for each study should be made separately. The following is the report of proposal (89), which is the fundamental project for all of the proposed studies (Kick off meeting: May 27, 2010).

The feature of fusion reactor environments is that helium and hydrogen are produced by nuclear transmutation and the transport and retention of hydrogen isotopes, helium from the core plasma and tritium produced from the blanket occur under neutron irradiations. It is hence indispensible to clarify the effects of neutron irradiation on the behavior of hydrogen isotopes and helium in the candidate materials to assess the feasibility of their use in the fusion reactor environments. However, the currently available hardware and software in the Center to study the behavior of hydrogen isotopes and helium in materials are insufficient. Therefore, we have been upgrading the research facilities in the Center. For this, a TDS (Thermal Desorption Spectrometer) apparatus has been newly installed in a radiation controlled laboratory in the Center (see Fig.1). The apparatus allows us to obtain thermal desorption spectra, thereby enabling the identification and quantification of hydrogen isotopes and helium contained in radioactive materials following reactor or accelerator irradiations. In 2011, an ion gun to inject hydrogen isotopes or helium into neutron irradiated specimens will be equipped with the TDS apparatus.

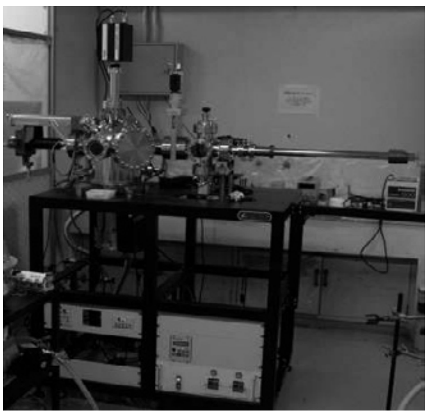

Fig. 1 TSD equipment installed in the radiation controlled area in the Center.