

## 2-4. Safety Management in Fusion Facilities and Environment

Research and development on the Safety and environment are the major issues for fusion facilities. The variety of issues should be surveyed not only in the field of radiation safety management and radiation protection but also in the field of general safety science, health and environment. Topics of these activities during FY 2010 are summarized below. And it should be pointed out that some of these scientific investigations have been successfully carried out as collaboration with researchers of many universities, research institutes and companies.

### (i) Hydrogen isotope separation and removal technology

Tritium treatment is a main issue for fusion facilities. Isotope separation is one of key technologies for the fueling cycle and the tritium removal. To evaluate the hydrogen isotope retention in the fusion device is also important issue from viewpoint of fuel control and safety. Many researches and developments are carried out by the collaboration with many universities. These are multi-column pressure swing Adsorption System by Kyushu University, sensing using proton conducting oxide by IFRC in Kyushu University, hydrogen transport analysis in a proton conductor by NIFS, research on the effect of SnO<sub>2</sub> wash coat in honeycomb-type Catalyst by NIFS, hydrogen isotope oxidation process by atmospheric pressure plasma by Nagano National College of Technology, and study on carbon and hydrogen isotope behavior in the exhaust system by Kyushu University.

### (ii) Tritium measurements

Since the radiated energy of  $\beta$ -ray from tritium is small, it needs a special technique to detect tritium. Non destructive and quantitative tritium measuring method in a plasma facing materials was developed by Pharm. Sci., Tohoku University. This method can detect  $\beta$ -ray from tritium separated from  $\gamma$ -ray from some  $\gamma$ -nuclides. Monitoring of tritiated gas is also a key technology for safety. Tritiated water monitoring system using plastic scintillator and photon counter investigated by Ochanomizu University. This method has an advantage to reduce radioactive liquid organic waste.

### (iii) Fueling

Fueling is a key issue for a fusion plant. To evaluate the required value for the tritium, taking account of the tritium consumption in a fusion reactor and initial inventory of a next reactor, is important. Continuous supply of tritium will be secured by Li-neutron reaction in tritium breeder. Then enrichment of lithium-6 is necessary technology to establish the breeding of tritium by a blanket in a fusion reactor. Displacement chromatography using criptand resin for lithium isotope separation was investigated by experiments and numerical simulation by the collaboration with Nagoya University. The isotope ratio of lithium extracted from sea water was measured by the University of Kitakyushu.

### (iv) Safety in environment

In order to assess the influence of tritium released from nuclear facilities to the environment, it is necessary to confirm the effect of tritium appearing overlapped on background tritium levels. Dynamic compartment model has been developed to predict the tritium behaviors in 'atmosphere – soil – river and groundwater flow' system at the site of NIFS by Kyoto University. These are necessary to understand the behavior of tritium in terrestrial environment for estimation of dose by ingestion of tritium.

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### List of Reports

1. "Experimental Study on Performance of Multi-column Pressure Swing Adsorption System for Hydrogen Isotope Separation", Kotoh, K. (Kyushu Univ.)
2. "A study for hydrogen isotope separation and sensing using proton conducting oxide", Matsumoto, H. (IFRC, Kyushu Univ.)
3. "Extraction of Hydrogen into Vacuum by Electrochemical Hydrogen Pump for Hydrogen Isotope Recovery", Tanaka, M. (NIFS)
4. "Hydrogen and Methane Oxidation over Honeycomb Filter Platinum Catalysts Supported on SiC : Effect of Water Vapor", Tanaka, M. (NIFS)
5. "Investigation of hydrogen isotope combustion processes in atmospheric pressure plasma", Ezumi, N. (Nagano National College of Tech.)
6. "A Study on hydrogen isotope and carbon behavior in exhaust system", Katayama, K. (Kyushu Univ.)
7. "Tritium measurement in components activated by neutron by an imaging plate", Yoshida-Ohuchi, H. (Pharm. Sci., Tohoku Univ.)
8. "Tritiated water measurement with high measurement efficiency by plastic scintillator", Furuta, E. (Ochanomizu Univ.)
9. "Lithium Isotope Separation with Displacement Chromatography using Cryptand Polymer", Sugiyama, T. (Nagoya Univ.)
10. "Measurement of the isotope ratio of lithium extracted from sea water", Yoshizuka, K. (The Univ. of Kitakyushu)
11. "Study on model to predict tritium behavior in environment at NIFS site", Takahashi, T. (Kyoto Univ. Research Reactor Inst.)