Basic Studies on new neutron multiplier and breeder materials

Kenzo MUNAKATA[1)], Kohei WADA[1)], Ayano NAKAMURA[1)],

Jae-Hwan KIM[2)], Masaru NAKAMICHI[2)], Regina KNITTER[3)]

[1)]*Faculty of engineering and resource science, Akita university, 1-1, Tegatagakuen-cho, Akita, 010-8502, Japan*

[2)]*Fusion Research and Development Directorate, Japan Atomic Energy Agency, 2-166, Omotedate, Obuchi, Rokkasho, Kamikita, Aomori, 039-3212, Japan*

[3)]*Karlsruhe Institute of Technology, Institute for Applied Materials (IAM-WPT), Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen*

The neutron multiplier is indispensible for generation of tritium that is a fuel of fusion reactors. Metallic beryllium is considered as a candidate for the neutron multiplier. Titanium beryllide is an alternative of metallic beryllium as the neutron multiplier of the fusion reactor blanket. The authors examined oxidation resistance of the titanium beryllide, $Be_{12}Ti$, samples fabricated by the spark plasma sintering method. The titanium beryllide samples were placed in a reactor. A H_2O/Ar (10,000 ppm) gas was generated by passing a (10,000 ppm) H_2/Ar gas to a copper oxide bed held at 623 K, and then it was introduced to the reactor with the flow rate of 300 cm^3/min. Experimental temperature of test tube was raised up to 1273 K by the constant rate of 5 K/min using a electric furnace. The reactor temperature was held at 1273 K until generation of hydrogen was terminated. The concentrations of hydrogen in the outlet streams of the reactor were measured with gas chromatograph or mass spectrometer. Thermo-gravitational apparatus was also used to examine the oxidation behavior from the viewpoint of weight gain. The state of the sample surface oxidized during exposure to water vapor was characterized by means of the X-ray diffraction analysis (using Ultima IV manufactured by RIGAKU Co. LTD.) and electron probe micro analyzer (using JXA-8230 manufactured by JEOL Co. LTD.).

New breeder materials were supplied by Karlsruhe Institute Technology (KIT). They are complex oxides of Li, Si and Ti. With regards to these breeder samples, the ratio for contents of Si and Ti were varied a bit. The authors had restarted out of pile tritium release experiments on these new breeder materials utilizing the Kyoto University Research Reactor. In the experiments, a 0.1% H_2/Ar gas was used as a sweep gas to avoid chemical interaction of sweep gas and breeder materials (the authors previously used nitrogen as a carrier gas), and two ion chambers were used to separately measure the concentration of molecular form of tritium and tritiated water vapor. Experimental temperature of test tube was raised up to 1173 K by the constant rate of 5 K/min using an electric furnace. The reactor temperature was held at 1173 K until tritium release terminated. At the temperature of 1173 K, the sweep gas was switched to a 0.5% H_2O/Ar gas to ensure whole release of tritium bred in the breeder pebbles.

The summary and more details of the experimental results for neutron multiplier and breeder materials shown above are talked on our presentation.