§23. Suitability of Boron-Titanium as First Wall Material

Hino, T., Hashiba, Y. (Hokkaido Univ.),
Nishimura, K., Ashikawa, N., Masuzaki, S., Sagara, A., Noda, N., Ohyabu, N., Komori, A.

Boronization and titanium flash have been employed to reduce fuel hydrogen recycling and oxygen impurity concentration in plasma. If both boronization and titanium flash are conducted, the boron-titanium is produced on the first wall surface. The fuel hydrogen retention of this material has not been investigated so far. In the present experiment, the boron-titanium was prepared using electron beam evaporation, and irradiated by deuterium ions. After the deuterium ion irradiation, the deuterium retention and desorption behavior was investigated.

The boron-titanium was prepared by the titanium deposition followed by the boron deposition on stainless steel substrate. The annealing at 1000 K was conducted to mix the boron and the titanium. The boron-titanium was irradiated by deuterium ions with energy of 1.7 keV and fluence of $1x10^{18}$ D/cm^2 at RT. After the irradiation, the thermal desorption spectrum of deuterium was obtained using a technique of thermal desorption spectroscopy. Similar experiments were carried out for the boron film and the titanium film prepared by electron beam evaporation, and for titanium boride, TiB_2.

Figures 1 (a) and (b) show the depth profiles of atomic composition for the boron–titanium and the titanium boride, respectively. The ratio of atomic composition, B/Ti, is approximately 2 in the titanium boride. The boron concentration was approximately twice of the titanium concentration at the surface in the boron-titanium.

Figure 2 shows the desorption spectra of deuterium for boron, titanium, boron-titanium and TiB_2. The scale for titanium in this figure is 1/20 of the actual value. The desorption peaks of the boron-titanium were 500 K and 600 K. The former peak corresponds to the de-trapping of deuterium from B-D-B bond, and the later one from Ti-D bond. The amount of retained deuterium in the boron-titanium was twice or triple times smaller than that of boron or titanium, and comparable with that of TiB_2. The desorption temperature in the boron-titanium was lower than that of boron, titanium or TiB_2. In the present experiments, it is clearly shown that the amount of retained deuterium in the boron-titanium is small and that the desorption temperature is low.

The present results suggest that both fuel hydrogen retention and a baking temperature required for reduction of hydrogen retention can be reduced by an use of boron-titanium.

A further study will be conducted to clarify the reason why the boron-titanium has a low desorption temperature, using surface analysis techniques.

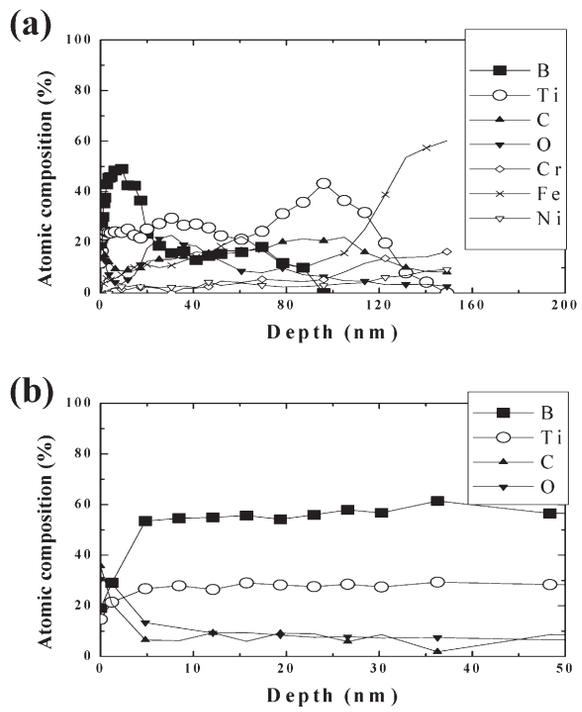

Fig. 1 Depth profiles of atomic composition for boron-titanium **(a)** and titanium boride **(b).**

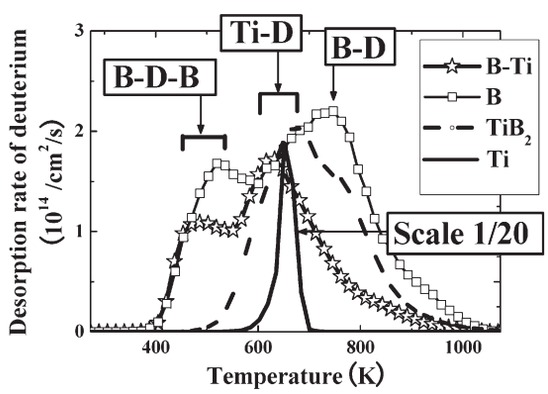

Fig. 2 Thermal desorption spectra of deuterium after deuterium ion irradiation for boron-titanium (**B-Ti**), boron (**B**), titanium (**Ti**) and titanium boride (**TiB_2**).

References

(1) Hino, T., Hashiba, Y., et al, Fusion Eng. and Design, **81**(2005)127-131.

(2) Hino, T., Hashiba, Y., Ashikawa, N., et al, Presented in 17th PSI Conference, Hefei, China, (2006)