§24. Suitability of Boron-titanium as First Wall Material

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Boron and titanium have been employed to control fuel hydrogen recycling and oxygen impurity level in plasma. If both boronization and titanium flash are used, the boron-titanium is produced on the first wall. The fuel hydrogen retention of this material has not been studied so far. In the present experiment, the boron-titanium was prepared using electron beam evaporation, and irradiated by deuterium ions. After the deuterium ions 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. Figure 1 (a) shows the depth profile of atomic composition. The boron concentration was approximately twice of the titanium concentration at the surface. The boron-titanium was irradiated by deuterium ions with energy of 1.7 keV and fluence of 1×10^{18} D/cm^2 at RT. Figure 1 (b) shows the depth profile of atomic composition after the deuterium ion irradiation. The boron rich layer with a thickness of 20 nm was sputtered.

The boron-titanium irradiated was transferred to the chamber of thermal desorption spectroscopy. Here, the sample temperature was increased to 1100 K, and the deuterium desorbed during the heating was measured. In order to compare the retention and desorption behavior with cases of titanium and boron, the similar experiments were conducted for both titanium and boron films prepared by electron beam evaporation.

Figure 2 shows the desorption spectra of deuterium for boron, titanium and boron-titanium films. 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. It is seen that the desorption temperature was lower than those of the boron and the titanium. The deuterium amount retained in the boron-titanium was 1/2 in the boron and 1/3 in the titanium.

The present results indicate that the use of boron-titanium reduces the fuel hydrogen retention and the baking temperature for reduction of hydrogen retention becomes low.

Further study on the relation of fuel hydrogen retention in the boron-titanium with the structure will be conducted.

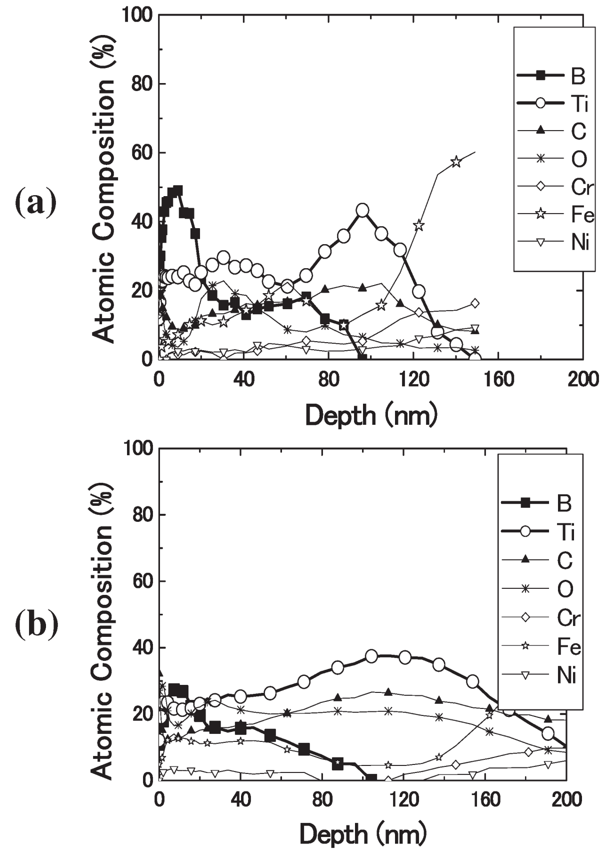

Fig. 1 Depth profiles of atomic composition after annealing (**a**) and after deuterium ion irradiation (**b**).

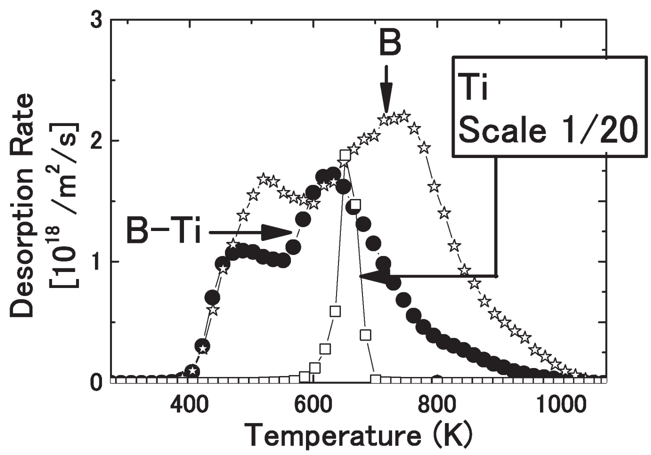

Fig. 2 Thermal desorption spectra of deuterium after deuterium ion irradiation for boron-titanium (**B-Ti**), boron (**B**) and titanium (**Ti**).

Reference

1) Hino, T., Hashiba, Y. et al, To appear in Fusion Eng. and Design, (2005)