§41. Conditionings for Boron-carbon Plasma Facing Material

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B4C overlaid/converted graphite has been regarded as one of candidate plasma facing materials for next devices such as LHD and ITER. This B4C overlaid graphite has several advantages such as oxygen gettering and reduction of chemical sputtering. However, the hydrogen retention properties have not been systematically examined yet.

In the present study, we first examined the temperature dependence of retained hydrogens by using the ECR hydrogen ion irradiation apparatus. A technique of thermal desorption spectroscopy was employed to measure the amount of retained hydrogens. Following that, helium ion irradiation experiment was conducted to evaluate the effect of helium ion impact desorption.

It was found that the hydrogen injected was trapped in form of B-H bonding or C-H bonding. From the temperature dependence of retained hydrogens obtained after the hydrogen ion irradiation at RT, it was observed that the fraction of retained hydrogens in from of B-H bonding decreased, more rapidly compared with the case of C-H bonding. The hydrogens trapped in forms of B-H bonding and C-H bonding desorb at temperatures of 300°C and 700°C, respectively[1]. This result shows that the conditioning due to baking is very much easier for the boron component.

After the hydrogen ion irradiation, the helium ion irradiation was carried out by changing the fluence to reduce the retained hydrogen[2]. The hydrogens trapped in form of B-H bonding was significantly reduced by the helium ion irradiation, although the reduction of the hydrogen in form of C-H bonding was observed to be small.

Above results suggest that the hydrogen trapped in the boron is relatively easily eliminated by the baking or the helium discharge cleaning. Based on the experimental results, the required baking temperature or the current density of helium ion was analyzed by using a model for hydrogen desorption[1]. Fig.1 shows the decay time constants of hydrogen trapped in forms of C-H bonding (τ_1) and B-H bonding (τ_2) versus the baking temperature, for several values of helium current density. In a case that the hydrogen has to be reduced to 1/e within 1hr, the baking temperature of 300 °C is acceptable for the boron and the current density can be one order of magnitude smaller than the case of graphite.

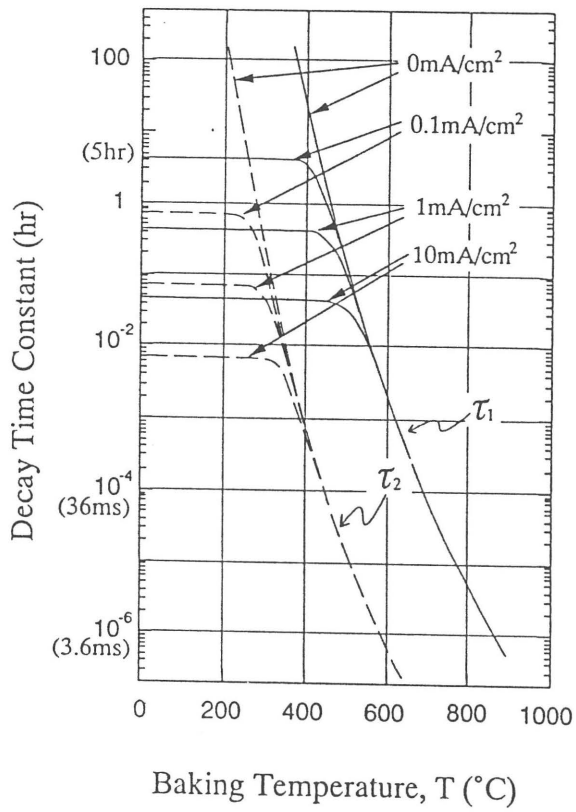

Fig.1. Decay time constants for graphite (τ_1) and boron (τ_2) versus baking temperature for several helium ion current density.

References

1)Hino,T. et al, To be appeared in J.Nul.Mater. (1994).
2)Yamauchi, Y., Hino, T., et al, Proceedings of 11th PSI Conference, P.164, Mito, May 1994.