§76. Hydrogen Retention of Boron Oxide Film

Hino, T., Eiki, H., Hirohata, Y. (Hokkaido Univ.)
Tsuzuki, K., Inoue, N., Sagara, A., Noda, N., Motojima, O.

Boronization has been suggested for the plasma facing wall of LHD to reduce a level of oxygen impurity. The capability of boron film for gettering of oxygen has been demonstrated, and the hydrogen retention properties also have been examined in the dc glow discharge apparatus, Surface Modification Teststand (SUT), in National Institute for Fusion Science.

Although the hydrogen retention for pure boron film made by the boronization is known, there is a question on the hydrogen retention of oxidized boron film. In the present study, we examined the hydrogen retention of oxidized boron film by using SUT.

The boron film was prepared on the liner in SUT by the glow discharge with a mixture gas of diborane and helium. This boron film was exposed to the oxygen plasma produced in the same apparatus. The oxygen concentration at the surface was 35 at.%. The oxidized boron film was exposed to the hydrogen plasma. During the hydrogen plasma irradiation, the change of H_2 pressure was measured(Fig.1), and the retained amount of hydrogen was obtained. After the hydrogen plasma irradiation, the liner with the oxidized boron film was measured(Fig.2). Similar experiment was conducted for a case of non-oxidized boron film, e.g. pure boron film.

Retained amount of hydrogen in the non-oxidized boron film was 1.0×10^{17} H/cm^2. The oxidized boron film had the retained amount of hydrogen, 7.5×10^{16} H/cm^2. The retained amount was 25% reduced by the surface oxidation. In the desorption spectrum, the hydrogen desorption amounts of the non-oxidized and the oxidized boron films were 9.9×10^{16} H/cm^2 and 6.6×10^{16} H/cm^2, respectively. The desorption data were consistent with those of residual gas analysis.

It is known that hydrogen implanted into boron is trapped in form of B-H bond. If there is a stable oxide layer of boron oxide (B_2O_3), it may not easy to from the B-H bond. In addition, the implanted depth of hydrogen ion is smaller in the case of the oxidized boron, compared with a pure boron. These may be reasons why the retained amount was approximately 30% reduced by the surface oxidation.

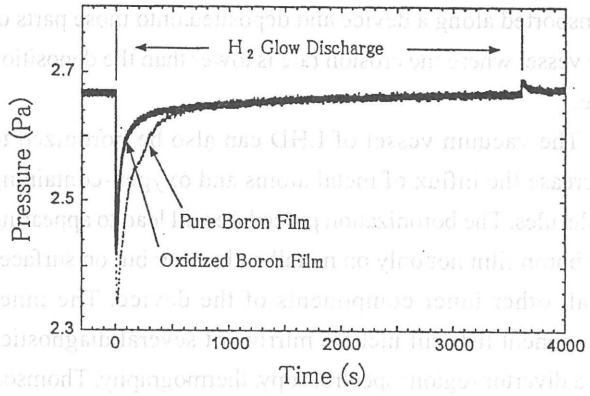

Fig.1 Change of H_2 pressure during hydrogen discharge for cases of pure boron film and oxidized boron film.

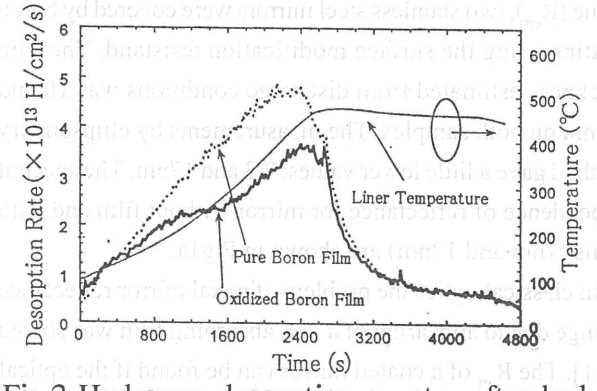

Fig.2 Hydrogen desorption spectra after hydrogen discharge for cases of pure boron film and oxidized boron film.

References

1) Eiki, H. et al, J.Vac.Soc. in Jpn, To be appeared (1998)