

§75. Surface Probe Analysis for Boronized Wall of LHD

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Boronization experiments were conducted in the 5th and 6th experimental campaigns. After the boronization, oxygen impurity concentration was significantly reduced and the plasma density limit was extended. During the 6th experimental campaign, material probes were installed at the inner walls along the toroidal and poloidal directions. After the campaign, the thickness of boron film and trapped amount of oxygen were analyzed by using Auger electron spectroscopy.

The thickness of boron film largely depended on the toroidal direction. Thick boron film with thickness of 50-400 nm was observed at the wall in the vicinity of anodes and gas inlets. At the other wall, the thickness was only several nm. The fraction of the wall with thick boron film to entire wall was approximately 30%. At the wall with thick boron film, a large amount of oxygen was trapped. This amount was as high as approximately 10^{18} O/cm². These results are shown in Fig. 1. The present result shows that the boronized wall contributed to the reduction of oxygen impurity concentration in the plasma.

The amounts of retained helium and hydrogen were measured by using a technique of thermal desorption spectroscopy. The amount of retained helium was larger at the walls close to the anodes and smaller at the walls far from the anodes as shown in Fig.2. This result suggests that a large amount of helium was trapped during the helium glow discharges. The amount of retained helium was comparable with the case before the boronization in the 4th experimental campaign.

The amount of retained hydrogen showed a different tendency, compared with the case of helium retention. The amount of retained hydrogen was one order larger than that of helium as shown in Fig.3. This reason is owing to the hydrogen glow discharges conducted in the last phase of the 6th experimental campaign. The amount of retained hydrogen was relatively smaller at the boronized wall. Namely, the hydrogen retention of the boron film was lower than that of stainless steel.

The present results show that the boron film has helium retention comparable with that of stainless steel and hydrogen retention lower than that of stainless steel. Hence, the boronized wall may contribute to the improvement of fuel hydrogen recycling as well as reduction of oxygen impurity concentration.

The surface of the boronized wall was observed by using an atomic force microscope. The formation of blisters was clearly observed. The blister formation is owing to the trapping of helium.

Further material probe analysis will be conducted for the 7th and 8th experimental campaigns.

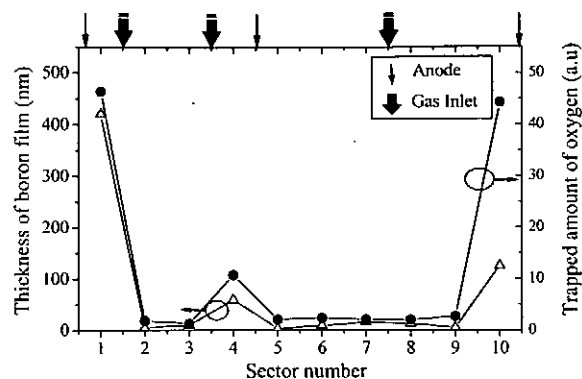


Fig.1 Thickness of boron film and trapped amount of oxygen versus position of material probe placed along toroidal direction.

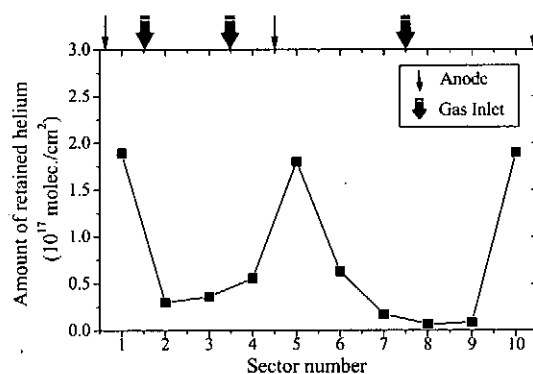


Fig. 2 Amount of retained helium versus position of material probe.

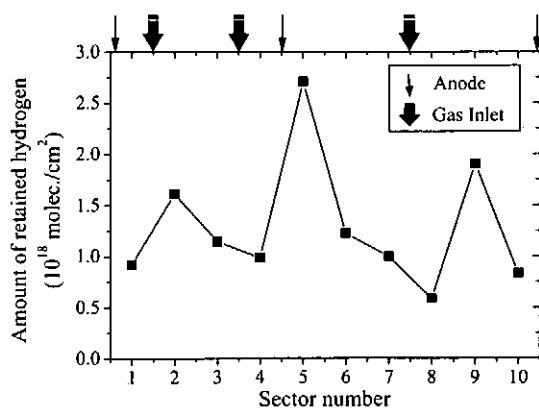


Fig. 3 Amount of retained hydrogen versus position of material probe.

References

- 1)Hino, T. et al, Nuclear Fusion **44**, (2004)496
- 2)Nobuta, Y. et al, Submitted to ISFNT-7, Tokyo, (2005)