§43. Reduction of Hydrogen Content in Boron Film by Controlling Glow Discharge Conditions

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It was reported that the hydrogen content in boron film resulted in a DC toroidal discharge could be suppressed by controlling flow rate and discharge power at moderate temperature (>200°C)[1]. However, in Large Helical Device (LHD), boronization can be performed only at temperature lower than 100°C. Therefore, Control of hydrogen content in boron film produced with DC glow discharge were investigated at room temperature in Plasma Processing Teststand(PPT) by measuring dependences on decaborane $B_{10}H_{14}$ flow rate, mixing ratio in helium, discharge power, and total pressure. The film thickness was monitored by a quartz oscillator and the hydrogen concentration was analyzed by using an in situ flash-filament desorption method.

Figure's 1 to 5 show the parameter dependences of boronization characteristics measured in present work. It can be observed in each figure, that the hydrogen content is relatively low when the film growth rate is high. This results can be explained that, if the sticking probability of hydrogen dissociated from $B_{10}H_{14}$ molecules is much lower than boron containing gas species, the opportunity of hydrogen incorporation into film layer is low as the film growth rate is high. Thus, the hydrogen content in the film deposited with high growth rate is low. However, the mechanism of hydrogen suppression with high growth rate is not clear yet.

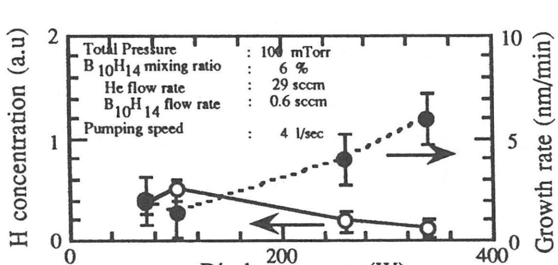

Fig. 1 The discharge power dependence under standard condition of the hydrogen content and the film growth rate.

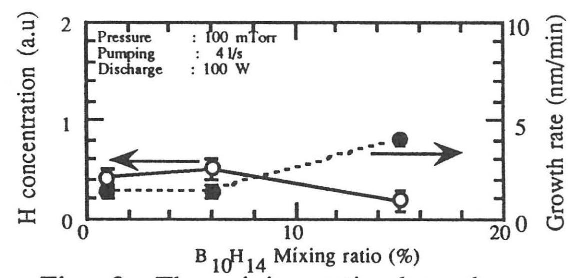

Fig. 2. The mixing ratio dependence under standard condition of the hydrogen content and the film growth rate

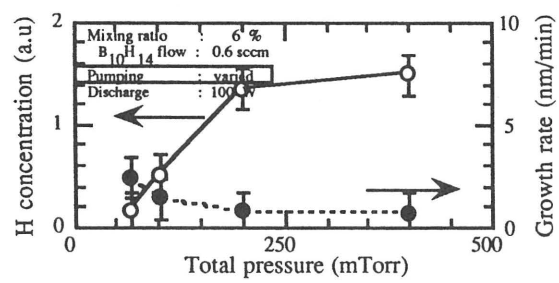

Fig. 3. The total discharge pressure dependence with constant flow rate of the hydrogen content and the film growth rate

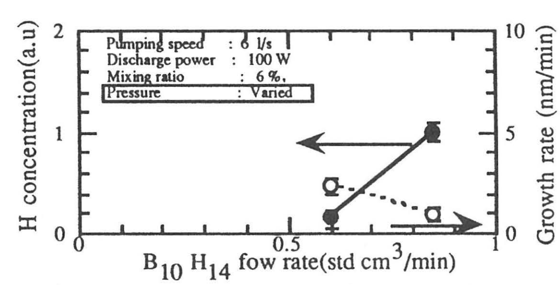

Fig. 4. The decaborane flow rate dependence with constant pumping speed of the hydrogen content and the film growth rate.

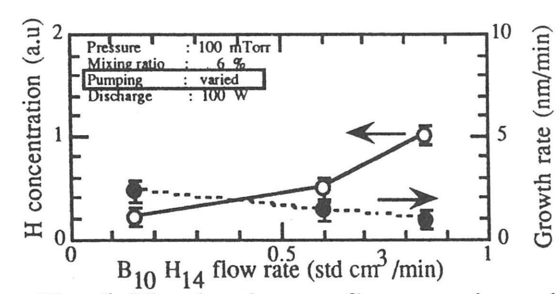

Fig. 5. The decaborane flow rate dependence with constant pressure of the hydrogen content and the film growth rate (pumping speed varied).

Our boronization experiments conclude that hydrogen content in the film formed at room temperature can be reduced by controlling discharge conditions.

Reference

[1]. H. Toyoda, et. al. Appl. Phys. Lett. 51, (1987)11.