§49. Recycling Control Using Low Z Coating for LHD

Natsir, M., Tsuzuki, K. (The Graduate University for Advanced Studies)
Sagara, A., Motojima, O.

Aiming at control of hydrogen recycling, which is one of key issues to achieve high plasma performance in LHD, reduction of hydrogen contents in low Z coating at room temperature has been systematically investigated by using the in-situ hydrogen analysis method with flash filament (FFM) and residual gas analysis (RGA) as a complementary method[1].

Within experimental results on boron films produced from $B_{10}H_{14}$+He or B_2H_6+He and carbon films from pure CH_4, the hydrogen content is successfully reduced with the increase of the film growth rate by controlling DC glow discharge conditions as shown in Figs. 1, 2 and 3. As the practical conditions in case of decaborane, for instance, higher power of discharge and lower pressure of working gases with higher pumping speed are better to reduce H concentration in films, as seen in Fig. 1. It is also observed in the figures 2 & 3 that the films prepared with B_2H_6 or CH_4 result in low hydrogen content with high growth rate. The RGA results in table 1 show that both H/B and H/C ratios decrease with the increase of the B or C deposition ratio, namely the film growth rate, by increasing the discharge power as observed in Figs. 2 (a) and 3 (a) with FFM. It is presumed that the hydrogen content in coated films mainly depends on both processes of molecular dissociation or ionization resulting in deposition of coating gas and atomic recombination resulting in evacuation of H_2 gas. Mechanisms on these coupled processes should be made clear in future works.

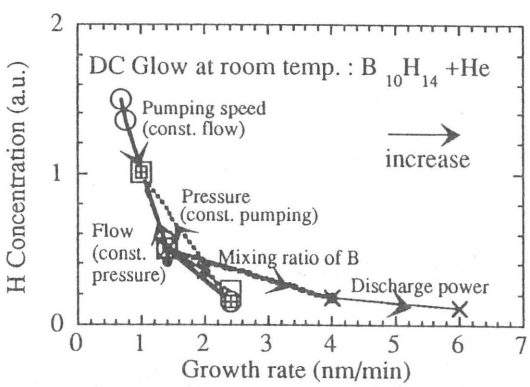

Fig. 1. Relation between H concentration and film growth rate measured in boronization with $B_{10}H_{14}$ under variuos dependence on discharge conditions (discharge power, total pressure, flow rate, mixing ratio, and pumping speed).

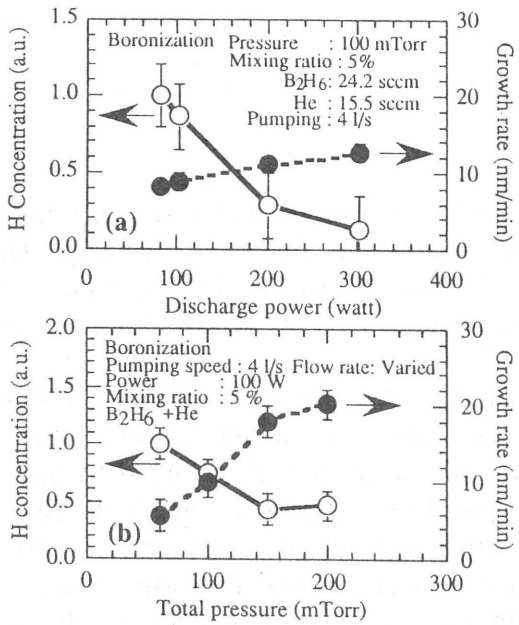

Fig. 2. H concentration and growth rate of boron film prepared by B_2H_6 as a functions of (a) discharge power, (b) total pressure. H concentration is normalized by highest value

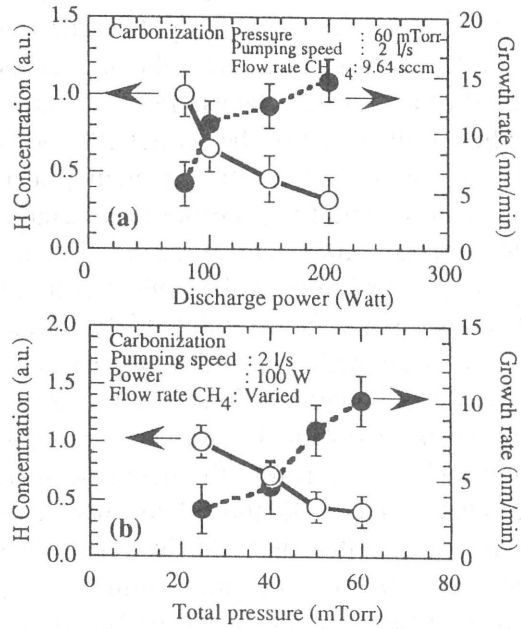

Fig. 3. H concentration and growth rate of carbon film prepared by CH_4 as a functions of (a) discharge power, (b) total pressure. H concentration is normalized by highest value

Table 1. The discharge power dependence of H/B or H/C, deposition ratio measured with residual gas analysis.

Starting gases	Discharge Power(W)	Deposition ratio of B or C	H/B or H/C in film
B_2H_6	80 → 200	0.62 → 0.79	2.29 → 1.68
CH_4	80 → 200	0.41 → 0.57	3.44 → 2.60

Reference

[1] M. Natsir,et.al. Transaction of Fusion Tech. 27(1995)527