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Production of Carbon Stripper Foil by Magnetron Sputtering Method
炭素荷電交換膜のスパッター蒸着形成

Shuichi Katoh, Toshiro Kasuya , Masahiro Yoshimoto,
and Motoi Wada
加藤周一[a]，吉本政弘[b]，粕谷俊郎[a]，和田　元[a]

[a]*Graduate School of Engineering, Doshisha University*
1-3 Tatara Miyakodani, Kyotanabe-shi, Kyoto 610-321, Japan
同志社大学工学研究科　〒610-321　京田辺市多々羅都谷1-3
[b]*J-PARC Center, Japan Atomic Energy Agency*
2-4 Shirakatashirane, Tokai-mura,Naka-gun, Ibaragi 319-1195, Japan
日本原子力研究開発機構 J-PARCセンター　〒319-1195　茨城県那珂郡東海村白方白根2-4

The Japan-Proton Accelerator Research Complexes (J-PARC) requires long lifetime carbon stripper foils against irradiation of high intensity and high energy beam of MW class accelerator. It has been reported that boron doping into carbon foils during deposition processes enlarges the strength of the produced foils. Magnetron sputter deposition method has been adapted for carbon foil preparation as it has the capability of on-time doping during material preparation. Initial data obtained from a compact DC magnetron sputtering device are reported.

1. Introduction

Carbon stripper foils convert H^- beam to H^+ beam at J-PARC. The strength and lifetime of stripper foils are critically important in reliable operation of the entire accelerator facility. The fundamental mechanism of foil degradation under exposure to an intense beam irradiation has not been fully understood yet, thus an experimental apparatus that can prepare a boron doped carbon thin foil has been assembled to supply samples for experiments to study foil degradation induced by ion beams.

2. Experimental

2.1 *Foil preparation*

Figure 1 shows a schematic of the experimental setup of DC magnetron sputtering deposition. At the center of the discharge chamber, a 50 mm diameter carbon disk was placed on top of the magnetron cathode shielded with a Pyrex® glass tube. The chamber wall served as the anode of the discharge, and a 100 Ω ballast resister was inserted between the negative terminal of the DC discharge power supply, and the magnetron cathode electrode. The chamber was pumped down to 2.0×10^{-4}Pa before the DC glow discharge and the carbon deposition process. Discharge power was controlled by adjusting discharge voltage, while discharge current can be also adjusted by changing the Ar pressure.

2. 2 *Surface conditions and thickness*

Surface morphology of the produced carbon film was investigated by a laser microscope. Wrinkles were observed on the surface of the foil, indicating residual stress of the produced film. In fact, as the foils were exfoliated from the glass substrate, it has disintegrated into small fragments. Attempts are made to reduce the residual stress.

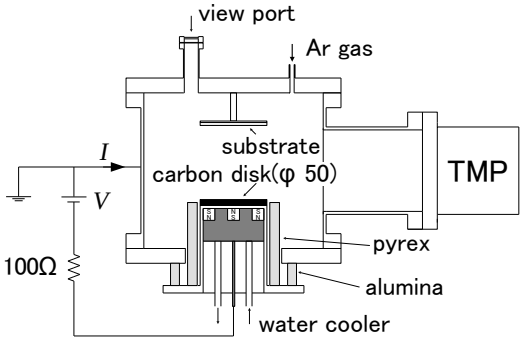

Fig.1. Simplified schematic of the experimental setup of DC magnetron-sputtering coater

Table.1. Thickness of carbon foils prepared by DC magnetron glow discharge evaporation process

Parameter	
Applied DC voltage; *V*	680 V
Current; *I*	30 mA
Deposition time	180 min
Pressure	6 Pa
Measuring Point	**Thickness(nm)**
Near the target center	250
Near the target edge	140