Erosion of Target with a Groove Structure by Plasma Irradiation

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Abstract

Plasma was irradiated into a groove structure target by using plasma facility MAP. After irradiate, erosion and deposition was measured Ion flux profile by calculations agreed with erosion profile by experiments. But deposition profile by experiments did not agree with calculation without electric potential. This shows electric in the groove drops because electrons reach more deeply in the groove where electron temperature is high. As a result ions reach deeply in the groove.

1 Introduction

A sheath formed at complex surface in the magnetic field cannot be clear, because ion flux is not uniform at complex surface, and it is not clear that Bohm theory can be applied for its case. Sheath formation in the groove structure is complicated because ion and electron flux profile in the groove is not clear. Sheath formed at a flat surface wall can be estimated approximately by applying Bohm theory. From this point of view, groove structure target was chosen as a complex surface.

In this study, ion flux is estimated by measuring erosion and deposition profile at the target. The groove width was 1.5-3 mm that is about same as ion gyro radius and groove depth was 10 mm. MAP (Material And Plasma) facility was used for plasma irradiation, and the groove structure target was set verticality to the magnetic field.

2 Experiment

Groove structure target was irradiated by hydrogen plasma about 30-120 minute at plasma facility MAP. The plasma density was about 10^{18} m^{-3}, electron temperature was about 10 eV, and from electron temperature, ion temperature was estimated about 1 eV. The target was floated against the ground and a chamber. The base material of the groove structure target was copper and one side of the wall in the groove was galvanized by silver to see the erosion and deposition in the groove (Fig.1).

After irradiation, silver galvanization thickness was measured by Electronic Thickness Tester. By comparing silver layer before irradiation and after, erosion of silver layer was estimated. At the same time, deposition of silver on copper surface was measured.

3 Results

Ion flux was estimated by measuring erosion of silver galvanization layer. However and error of measurements of silver layer is so large that ion flux profile could not be specified in detail, and only tendency of erosion profile was obtained. Ion flux was calculated by simulating ion particle trajectory without electron potential. Fig.2 shows ratio of ion flux and erosion to those at top surface. Erosion profile by experiment agreed with ion flux profile by calculation.

Deposition layer of silver was too thin to measure its thickness by Electronic Thickness Tester. Deposition of silver was not seen 1-3 mm from the top surface. Silver deposition was found at lower area (Fig.3). The boundary between silver deposited area and non deposited area was very clear. Thus this means that the hydrogen ion reached this non deposited region.

At an area correspond to the center of the plasma, this boundary was seen more deep position. This indicate ion flux reached more deeply in the plasma center. In the plasma

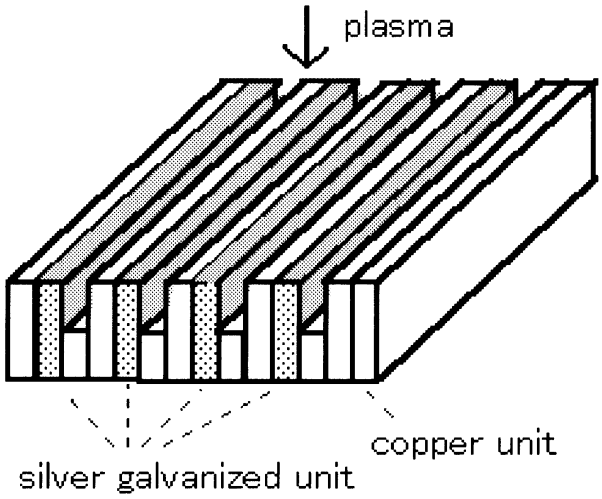

Fig.1: Groove structure target.

center electron temperature was high and electron reached more deep area in the groove. Therefore electric potential in the groove dropped and ion reached more deep area.

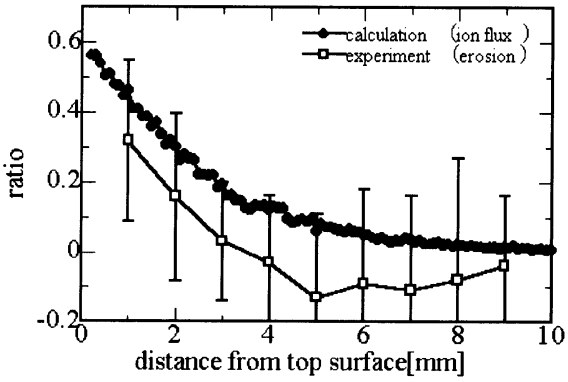

Fig.2: Ratio of in flux and erosion to those at top surface.

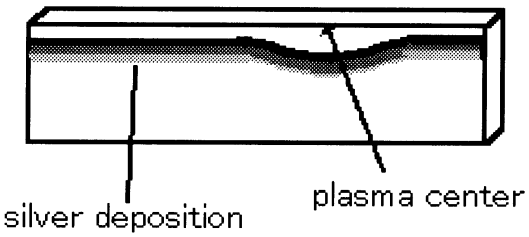

Fig.3: Silver deposition on the copper unit side (side of the groove).