

Development of a Double Compression Type Plasma Cathode for Sheet Plasma Production

シートプラズマ生成用二重圧縮型プラズマカソードの開発

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8cm diameter 9 cm long size duoplasmatron type plasma cathode is developed in order to generate a sheet plasma. The sheet shape plasma, having dimensions of 40~50 mm for the width and 5~6 mm for the thickness, is produced under a discharge current of 2 A, H₂ gas pressure of about 2 × 10⁻² Pa.

1. Introduction

Sheet shaped plasma is produced either by arranging floating electrode with shaped opening, or compering a plasma by a pair of permanent magnets that forms a magnetic null point in a liner magnetic field. This structure can produce steep gradient of density and temperature with large expanse area. This characteristic shape is suited to rapid sputtering of target materials, and the produced flux of sputtered atoms can form thin functional films. The homogeneity of sheet shape plasma is also advantageous for simultaneously surface treatment covering a wide area.

Plasma cathode is an electron source that extracts electrons as discharge current from plasma. This type of cathode produced high discharge current density. The electron emission characteristic of a plasma cathode is dependent upon the gas pressures, the magnetic field, the accelerating voltage and the discharge current. The present study deals with the problem associated with reliable operation of high density plasma produced by a plasma cathode.

2. Experimental apparatus

Fig.1 shows the schematic diagram illustrating the structure of duoplasmatron type plasma cathode. Tungsten filaments ($\phi=0.35$) excited a discharge for the cathode plasma. The cathode contains magnetic circuit and nozzle shape intermediate electrode and the anode. Plasma is compressed by the electric field of intermediate electrode and magnetic mirror between the intermediate electrode and anode to enhance ionization. The assembled cathode was attached to liner magnetic plasma device. Fig2 shows the primary discharge current characteristic that runs between the cathode and the anode shown in Fig.1. The secondary discharge current increased above about 40V discharge voltage, which is applied between the anode and the reflector placed at end of liner magnetic plasma device.

Fig.2 shows Test operation of the cathode. Sheet plasma was produced using the assembled cathode. The sheet plasma, having dimensions of 40~50 mm for the width and 5~6 mm for the thickness. Plasma parameters such as electron density, electron temperature and plasma potential are currently being measured.

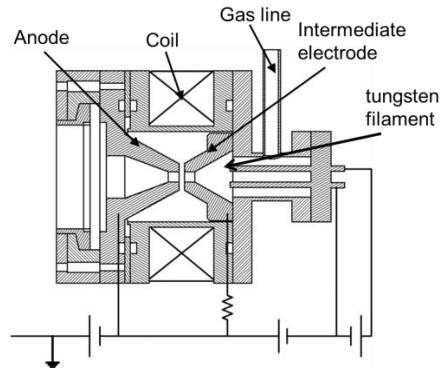


Fig.1. Schematic diagram of duoplasmatron type plasma cathode

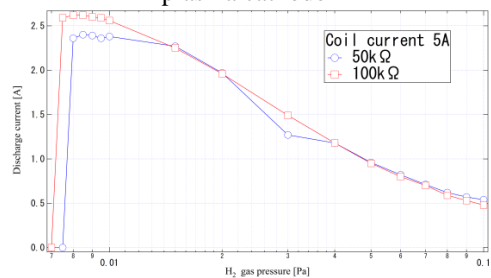


Fig.2. H₂ gas pressure characteristics of duoplasmatron plasma cathode

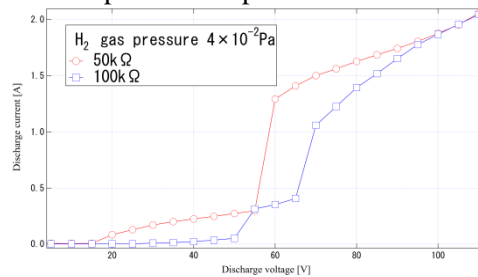


Fig.2. Discharge characteristics of duoplasmatron