Contribution ID: **180** Type: **Poster presentation**

Ion Beam and Discharge Characteristics of a Multi-Cusp Ion Source with Various Magnetic Field Configurations

Wednesday, 18 October 2017 18:45 (15 minutes)

Magnetic confinement of plasma is of importance for improving the ionization efficiency particularly for hot cathode discharge plasma [1]. In this contribution, we present an investigation on the effects of varying multicusp configuration of annular SmCo magnets on plasma confinement for hot cathode plasma and its consequences on ion beam generation. Hot cathode plasma was subjected to a magnetic field via an adjustable multicusp configuration of permanent magnets creating an axial magnetic field with a maximum surface flux density of 3660 Gauss. This configuration consequentially confines and creates a virtually magnetic field-free area for the bulk plasma [1]. For broad ion beam extraction, the ion beam density as well as beam uniformity becomes important for various applications such as thin film deposition. Thus, tuning the magnetic field configuration is crucial in the ion source chamber.

Argon (Ar) plasma was excited using two 0.3mm diameter tungsten wires as hot-cathodes. Langmuir probe measurement via a cylindrical wire probe was employed to determine the effect of varying the magnetic field configuration of the upstream chamber. This was correlated to the discharge characteristics in terms of electron temperature, plasma potential, and plasma density. In this work, low pressures are utilized to yield high degree of ionization and reduce the energy spread of incident ions [2]. Moreover, plasma density is significantly influenced by varying working pressures, especially when interacting with an external magnetic field. The plasma was also operated at low discharge currents for a homogeneous plasma discharge [3,4]. A retarding potential analyzer was used to correlate the extracted ion beams with the upstream discharge characteristics and magnetic field configuration.

References

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Session Classification: Poster Session 3

Track Classification: Beam extraction, transport, and diagnostics