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Investigation of Grid Erosion Due to Low Energy Xe Bombardment

低エネルギーXeビームによる炭素グリッドの損耗調査

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Sputtering erosion of Carbon grid due to Xenon ion bombardment determined ion engine lifetime. To investigate the grid sputtering mechanism experimentally, Xe^+ beam with the energy smaller than 1 keV is bombarded to an isotropic C target. The extracted Ar ion beam showed a very large divergence due to space charge. The spread can be made sharper by change neutralization, and this effect has been tested by increasing Ar gas pressure.

1. Introduction

Ion engines equipped to small exploration satelites often employ Xenon as the propellant and Carbon as the acceleration grid material. The Xe-C sputtering has measured during Xe ion bombardment under the threshold energy[1]. This experiment was done by a plasmasputtering method by generating plasma in front of target. Meanwhile, the measurement at a low energy ion beam bombardment has been performed [2]. The result of this measurement has showed that the accumulation of incident Xe^+ after starting bombardment affected C sputtering.

In these experiments, the incident ions must include ions other than Xe^+ because the incident ions to the target have not been mass separated. Therefore, extracted ion is bombarded to a target after traveling mass analyzer.

2. Experimental apparatus

As shown in Fig. 1, schematic illustration of experimental system is composed of the ion source, the beam extractor section, the beam transport section and the measurement section. The ion beam extracted from the ion source travels toward the Faraday cup or a target in the measurement section after going through the magnetic mass analyzer.

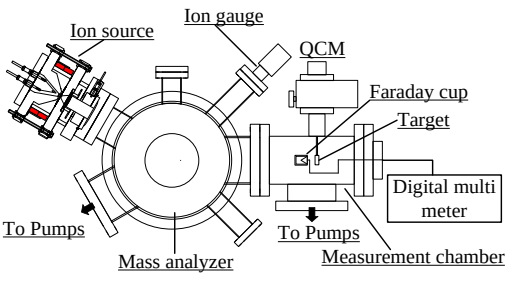

Fig.1. Schematic illustration of experimental system.

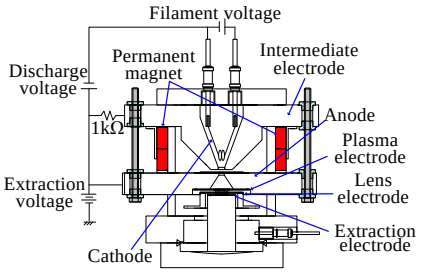

Fig.2. Schematic diagram of duoplasmatron ion source.

Figs. 1 and 2 show the current configuration of the apparatus and Fig.3. shows mass spectrum of Ar^+ beam at gas pressure 7.0×10^{-6} Torr, 9.0×10^{-6} Torr, 4.0×10^{-5} Torr and discharge current 1.0 A constantly. The spectrum became sharper against increasing gas pressure. To improve the beam divergence, plasma will generated in whole beam line region to neutralize the space charge. A quadrupole magnetic lens will be attached for controlling beam focus.

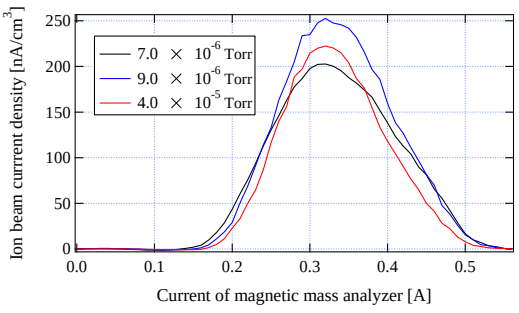

Fig.3. Mass spectrum of Ar^+ beam.

References

[1] R. P. Doerner, D. G. Whyte, D. M. Goebel, J. Appl. Phys. **93** (2003) 5816.
[2] R. D. Kolasinski, J. E. Polk, D. Goebel, L. K. Johnson, Appl. Surf. Sci. (2008)2506.