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High Current Operation on Inertial Electrostatic Confinement Fusion Device with Ion Source
放電型プラズマ中性子源でのイオン源を用いた大電流運転

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The Inertial Electrostatic Confinement Fusion (IECF) device is a neutron source which is used the deuterium – deuterium fusion reaction. The glow discharge plasma from deuterium gas should be produced efficiently in the IECF device. Ion source is equipped for making high discharge current and high energy of ions. In this study, improved new cathode is tested for driving more ion from ion source. The cathode is cylindrical Skelton structure and designed by the aid of ion orbital calculation. The high current of 52A, 24kV and 1.0 Pa is achieved at the experimental test with the improved cathode in hydrogen gas. This high current operation will lead to increase the collision of deuterium ion beam – deuterium ion beam. The neutron production rate will be raised at low gas pressure area because of the counter collision of ion beams.

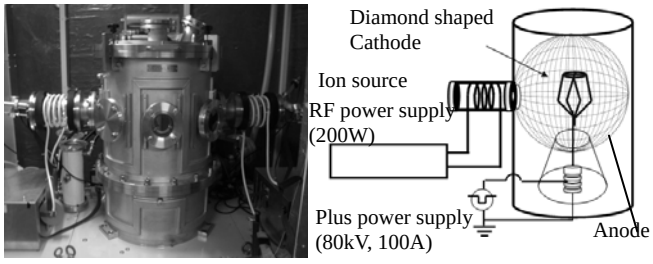
1. Introduction

Inertial electrostatic confinement fusion (IECF) device have been studied by many researchers. The IECF device for high current operation at Kansai University are shown in Fig.1 (a), and the schematic view is given by Fig. 1 (b). This device consists of the vacuum chamber, the grounded spherical anode and the skeleton wire frame cathode (diamond shaped or cylinder shaped) setting at the center, the vacuum pump, the gas feeder, the power supply(80kV, 100A) for ion acceleration and the RF ion source for the high current operation. The deuterium gas of about 1Pa is filled in the vacuum chamber. A pulse power supply applies a high negative voltage greater than several ten kV to the cathode.

The glow discharge between the anode and the cathode produce the ions accelerated to the cathode. Some of them have the high energy enough to cause the fusion events with the deuterium molecules or themselves. The current of 25A at 30kV, 1.0Pa is achieved at the previous experiment in which the diamond shaped cathode is used. The neutron production rate is about 7.2×10^4 (1/sec) as a steady state (plus of 20Hz, 6 usec).

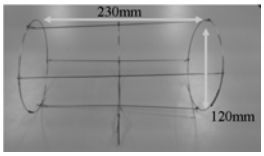
2. Improved cathode

Figure 2 (a) shows the improved cylindrical cathode which width is 230 mm and diameter is 120mm. The base ring is set toward ion source and makes the potential which attract the more ion beam into the main chamber.

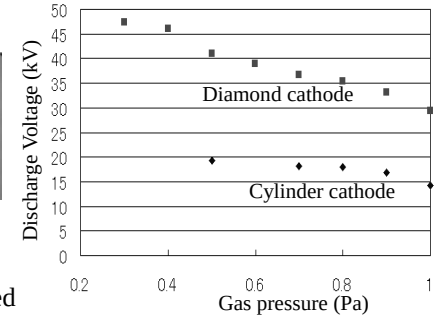


(a) Appearance (b) Schematic view

Fig. 1. IECF device with ion source for high current operation



(a) Skelton-wire framed cylinder cathode



(b) Discharge characteristic compare with the diamond

Fig. 2. Discharge characteristic of improved cylinder cathode

3. Experimental results and conclusion

The experimental result of fig.2 (b) shows that the discharge voltage of Cylinder cathode is lower than the one of diamond shaped cathode. The high current of more than 50A is flowed, the plus power supply is limited the discharge voltage because of shortage about watt performance. It means the new cathode is attract the ion beam effectively from the ion source.