異周波のハイブリッド結合による大容量,大口径誘導熱プラズマの発生

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GENERATION OF LARGE AREA INDUCTION THERMAL PLASMA BY SUPERIMPOSING 50-KHz OSCILLATING FIELD

Research Project

Project/Area Number

06650322

Research Category

Grant-in-Aid for General Scientific Research (C)

Allocation Type

Single-year Grants

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電力工学・電気機器工学

Research Institution

KANAZAWA UNIVERSITY

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Research Abstract

The inductively-coupled radio frequency thermal plasma produced with a power over a hundred kW is now becoming gradually an important source with high-temperature and high-reactivity either for processing of new functional materials or for destruction of circumstance depleting substance. Although the volume of the plasma is restricted to 50 to 60 mm in diameter by the applied frequency of the generator of MHz order, a large area plasma is required strongly for higher rate of processing as a future technology. In this project, an attempt is made to expand the high temperature plasma field by superimposing a low-frequency (50kHz) magnetic field on a small area dc plasma. Because the penetration depth of such a low frequency field is as long as a few hundreds mm, a more wider plasma in diameter can be produced.
Numerical simulations based on the dynamic plasma model showed that the minimum power to motivate the plasma expansion and sustain a wider plasma of 100 mm in diameter was found to be around 90 and 60kW for the pressure of 760 and 76 torr, respectively. The calculation also showed

that the time necessary for reaching a new steady state is around a few tens of ms and after this the wide area plasma is kept stationary by 50-kHz field even without dc power input. Experiments were carried out with using a power supply of 50-kHz frequency and 300-kW maximum power. Two ArI spectral intensities of 794 and 801 nm were observed by using a monochromator to analyze the transient phenomena quantitatively. Through several shots of experiments carried out under 60 torr soft vacuum condition, the small size dc plasma with 1-kW power was found to expand at the 50-kHz power indicator level of 55 to 60 kW,as expected and a new steady state of the plasma was achieved 20 ms after the initiation of the expansion. A quite uniform profile of the plasma temperature of 8,000 to 10,000 K was produced successfully in steady mode over 10 cm diameter.

Research Products (9 results)

All | Other

All | Publications (9 results)

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