低周波重畳による高周波誘導熱プラズマの高温反応場の広域化に関する研究

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EXPANSION EFFECTS OF HIGH TEMPERATURE FIELD OF INDUCTION THERMAL PLASMA BY SUPERIMPOSING LOW FREQUENCY MAGNETIC FIELD

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Research Abstract

The induction thermal plasma provides a high reactivity plasma source with a high temperature beyond a ten of thousand Kelvin, and is becoming an important technique for plasma processing of new functional materials. The dimension of the field is, however, restricted only within about 50-mm diameter by a limit of the operating frequency with a high order of MHz. This project concerns with a plasma torch producing a widened high temperature region which can be used for high capacity and high rate plasma processing. This torch consists of a high(radio frequency) and a low frequency induction plasma parts. The magnetic field with a lower frequency of several tens of KHz penetrates inside the r.f. plasma with its long skin depth and widens the radius of the

r.f. plasma as a superimposing effect. The results are summarized as follows.
1. The inductively coupled r.f.(13.56MHz) plasma part was first designed and tested. The plasma was established in stable with a power of 15kW within a cylindr ical quarz tube of 30-mm diameter under the pressure condition of 300 to 750 torr. The temperature of the plasma thus produced was measured as more than 10,000K from the spectral observation. The temperature and thus the electrical conductivity of the r.f. discharge part is quite enough for being coupled with the low-frequency magnetic field.
2. A newly developed computer program for analyzing the power flow from the generator to the plasma load reveals that with using a 3-turn coil of 85-mm diameter and 72-mm length as the second low frequency coil, the plasma field can be expanded by absorbing the 60 kHz magnetic energy generated by a high coil current of 10,000 amperes.
3. Experimental approach was carried out by using single pulse current waveform with a peak current of 5,700A and a duration of 100 micro second which is provided an LC oscillating circuit. The emission light strength from the plasma was observed to be enhanced weakly by superimposing the low frequency magnetic field. A further experiment should be performed to verify the coupling effect more clearly and quantitatively, with doubling the amplitude or duration of the pulse current.▲ Less

Research Products (10 results)

All Other

All Publications (10 results)

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[Publications] T.Sakuta: "Spheroidization of Nickel Alloy Powders by Using Induction Thermal Plasma" Proc.Jpn.Symp.on Plasma Chemistry. 5. 269-274 (1992)

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