

BN deposition plasma device

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Boron and nitrogen plasma device using multi cusp magnetic field has been developed for boron-nitride (BN) deposition [1,2]. BN is a compound of boron and nitrogen and has a carbon-like crystal structure. c-BN is a diamond-like crystal and has hardness next to diamond. It is used for coating of tools etc. h-BN is a graphite-like crystal and is an insulator having a two-dimensional structure. It is expected as an insulating layer of an electronic substrate. A plasma source with only nitrogen and boron as a raw material has been proposed in order to reduce the infrastructure such as cabinets and exclusion devices and the required legal procedures.

Microwave source (2.45 GHz, maximum power is 1 kW) is used for generating plasma and heating the plasma on the electron cyclotron resonance surface. In the cusp field plasma, the hot electrons are generated by the electron cyclotron heating (ECH) and form deep electrical potential near the electron cyclotron surface [3]. The ECH region of this plasma device is near the wall of a cylindrical vacuum chamber and is remote from the microwave window. The microwave from the open wave-guide antenna is used to generate the plasma at the near-area of the microwave window. The microwave is not transferred to the ECH region. The 4 sets of the cross-slot antenna have been designed by the finite element method in order to propagate the micro-wave into the ECH region as shown in Figure 1. This antenna system reduces the damage of the microwave window by separating the radiation area. The measurement of the double probe installed on the plasma device have indicated the presence of the high energy electrons.

Boron is a base metal and fragile. It is difficult to construct an electrode. Several types of the boron electrode have been developed and the boron is connected to the copper electrode covered with the BN. Boron and BN are faced to the plasma, and the

impurities from the boron electrode are reduced. A fixing structure for the boron electrode to copper electrode will be presented at the conference.

At the conference, detail of the microwave plasma source and the plasma characteristics. The characteristics of the deposited material such as the Raman spectrum will be presented.

References

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- [3] H. Koguchi, H. Sakakita, S. Kiyama, T. Shimada, Y. Sato, and Y. Hirano, *Rev. Sci. Instrum.* **85**, 02C309 (2014).

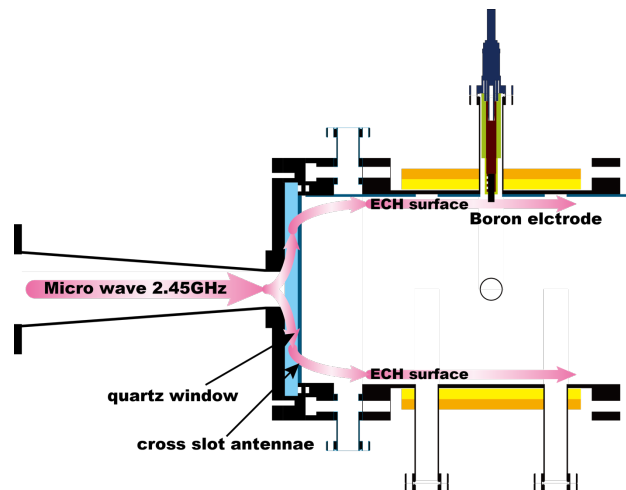


Figure 1. Schematic drawing of the cusp magnetic plasma system.