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Characteristic of oxygen plasmas for developing new plasma processing using negative oxygen ions

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Despite an oxygen anion radical (O^-) has remarkably strong oxidizing power and reactivity [1], the negative charged O^- has caused damage to thin films in plasma sputtering. To solve this problem, we recently proposed a new plasma processing using only O^- ions, which may provide less damage to thin films by controlling the energy of O^- ions with keeping their strong oxidizing power. Also, the proposed plasma processing may lower the process temperature and shorten the process time.

To explore a new plasma processing by use of negative oxygen ions (O^-) experimentally, we have developed a machine. To avoid contamination of impurities in the discharge room of the machine owing to electrodes, we use a high frequency current of 13.56 MHz that passes through an external antenna by which an oxygen plasma is generated inductively [2]. A longitudinal magnetic field is externally applied to the discharge room, which reduces the gas pressure required for the discharge. A magnetic filter is vertically applied to the outlet of the discharge room, by which the electron temperature on the upstream side of the magnetic filter is set above 5 eV and approximately 1 eV in the downstream side. Through dissociative electron attachment process, O^- ions are then generated. Fig. 2 Axial profiles of induced electric field by different spiral antennas.

Although there are many types of antenna for generating inductively coupled plasmas (ICP), we adopt a planar spiral antenna. To find out the best configuration of the antenna, we experimentally test several types of antennas, as shown in Fig. 1. Since each antenna has its

Fig. 1 A photograph of spiral antennas employed to the presented experiments.

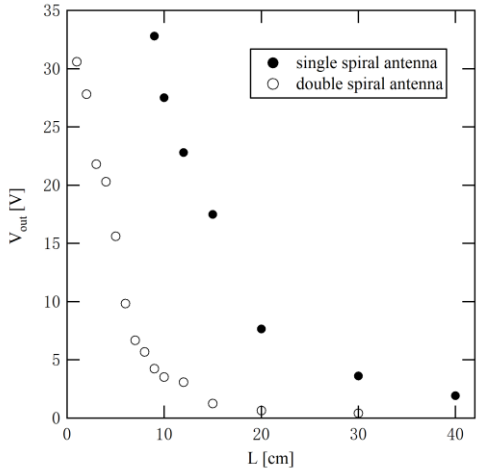

Fig. 2 Axial profiles of induced voltage by two different types of spiral antennas.

own inductance, dependences of those antennas on the impedance matching are investigated in experiments. Furthermore, dependences of the distance between the spiral antenna and the discharge room on the strength of the induced electromagnetic field are measured, as shown in Fig. 2.

Currently, we are going to exactly measure the plasma density and electron temperature of the produced oxygen plasmas by changing several discharge parameters. From the preliminary data, the electron confinement seems to be improved. In this conference, the detail of oxygen plasmas produced in our new machine will be presented.

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