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Plasma characteristics of partially magnetized cylindrical CCRF discharge

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Abstract

Capacitively coupled RF discharges are extensively used in microelectronic industries, due to its ability to produce high plasma flux that are required for atomic layer etching, deposition and sputtering of thin films on silicon substrates. For processing of dielectric films low energy electrons are important to avoid damages to the growing films. Beside low electron temperature enables to increase the efficiency of negative ion production. In recent works by Jay et al, have shown that a capacitive discharge created using cylindrical electrode and an axial magnetic field result in the formation of uniform plasma column, which radially varying electron temperatures. Magnetized CCRF discharges are also becoming popular as the magnetic field can provide an additional controlling knob to control the discharge properties.

In this work, we present a unique plasma source consisting of a large cylindrical electrode along with a pair of ring electrodes which has been driven in push-pull configuration in presence of an axial magnetic field. The plasma is characterized using RF compensated Langmuir probe, emissive probe including EEDF measurements by second harmonic method and radial electric field measurement by drift wave analysis. The preliminary results suggests that the electron temperature in argon remains at 1.5 eV to 2.0 eV over a significant discharge volume of 700 cm^3 at pressures ranging from 0.3 Pa to 3.0 Pa; whereas hotter electron temperature is largely found in the peripheral region with increase in the magnetic field strength up to B = 15 mT .

An analytical model is given to explain the overall trends in the radial electron density and potential inside the discharge volume; which also briefly illustrate the electron dynamics in the discharge.

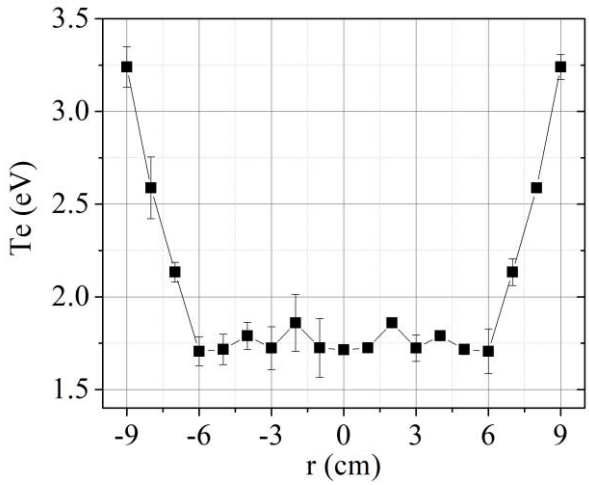

Fig1 Radial temperature profile in presence of magnetic field (7.8mT)

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