
Measurement of Electron Density of the Cutoff Probe in High Pressure Plasma

SiJun Kim ¹, JangJae Lee ¹, YoungSeok Lee ¹, ChulHee Cho ¹, SeungWan Yoo ¹, JungHyung Kim ², and ShinJae You ¹

¹Applied Physics lab for PLasma Engineering (APPLE), Department of Physics, Chungnam National University, Korea, Republic of

²Advanced Instrumentation Institute, Korea Research Institute of Standards and Science (KRISS), Korea, Republic of

A cutoff probe measuring a cutoff frequency in transmission microwave frequency (TMF) spectrum to infer electron density in plasma has received a great attention as a promising plasma diagnostics among microwave probes, due to its properties: high reliability, reproducibility and lowest assumption for inferring electron density. Although this technique measuring the cutoff frequency has been developed, this is applicable in low pressure plasma. In order to expand the measurable pressure range of the cutoff probe, we propose a method measuring a frequency that is a crossing point between the TMF spectra with and without plasma. This method is investigated by the simulations (a circuit and 3D electromagnetic (EM) wave simulation) as well as experiments, and compared with the previous method measuring the cutoff frequency. As a result, the proposed method shows the higher measurable pressure range than the previous method in both the simulations and experiments. Moreover, through the 3D EM wave simulation, we apply the proposed method to a planar cutoff probe which is a plasma monitoring instrument having planar antenna rather than invasive tip. In conclusion, the proposed method seems to be applied for the monitoring of electron density in high pressure plasma processing.

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