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Study on Validity and Reliablity of the Cutoff Probe and Langmuir Probe via Comparative Experiment in the Processing Plasma

D.W. Kim[1], S.J. You[2], K.H. You[3], J.W. Lee[2,3], J.H. Kim[2], H.Y. Chang[3], W.Y. Oh[1]

[1]Department of Mechanical Engineering, Korea Advanced Institute of Science and Technology,
[2]Vacuum center, Korea Research Institute of Standards and Science,
[3]Department of Physics, Korea Advanced Institute of Science and Technology

Recently, diagnostics of plasma becomes more important due to requirement of precise control of plasma processing based on measurement of plasma characteristics. The Langmuir probe has been used for the diagnostics but it has an inevitable uncertainty and error sources such as incorrect tip length and RF noise. Instead of the Langmuir probe, various diagnostic methods have been developed and researched. The cutoff probe is promising one for plasma density using microwaves and resonance phenomenon at the plasma frequency. The cutoff probe has various advantages as follows; (i) it is simple and robust, (ii) it uses few assumptions, and (iii) it is free from deposition by reactive gas. However, the cutoff probe also has uncertainty and error sources such as gap between tips, tip length, direction of tip plane, and RF noise. In this study, the uncertainty and error sources in manufacturing both probes and in diagnostics process were analyzed via comparative experiment at various discharge conditions. Furthermore, to reveal the user dependence of both probes, three well trained Ph. D students made the Langmuir probe and the cutoff probe, respectively, and it were analyzed. Thought this study, it is established that reliability and validity of the Langmuir probe and the cutoff probe related with not only the intrinsic characteristics of probes but also probe user.

Keywords: Langmuir probe, Cutoff probe, Diagnostics reliability and validity