Development of Triple Probe Diagnostics for Laboratory Pulsed Plasma

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Abstract

Real time measurement of mean plasma parameters and fluctuations in pulsed magnetized plasma, especially the electron temperature poses serious measurement challenges. The reason for this is primarily due to the large dynamic variance in impedance offered by pulsed plasma to the probe measurements against applied bias potential. The measurement of single probe is subjected to dynamic impedance variation from, nearly short circuit to very large impedance, attaining nearly infinite value at floating potential when probe is swept from positive to negative potentials [1, 2]. Whereas, for double probe configuration, this problem gets compounded as, two identical Langmuir probes are biased with respect to each other [3]. Due to the resistive and capacitive isolation limits possesses asymmetry, resulting in non-zero bias residual currents, despite having complete floating measurement setup and biasing. The symmetrical I/V characteristics of double probe diagnostics is necessary for the unambiguous measurements of electron temperature from triple probe diagnostics as third Langmuir probe measuring the floating potential [4].

This paper highlights the design and performance of newly developed triple probe diagnostics for real time measurement of mean electron temperature and temperature fluctuations in Large Volume Plasma Device (LVPD). Salient features of the diagnostics include measurements from extremely high input impedance ~ 100 GΩ, dynamic signal range of ≥ 150V, capacitive loading of < 10pf, large bandwidth ~ 1 MHz, settling time ~ 1 μs, slew rate > 200V / us and CMRR of ~ 100 dB for full range of power supply. The measurement scheme is developed based on battery bank. It is a floating dynamic sweeping power supply with bipolar drive to enhance ground isolation during sweep operation in pulsed plasma.

References: