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Expanding the Functionality of Plasma Diagnostics[1]

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As plasma processing demands grow, so does the range of conditions that plasma sources need to operate in. Higher sheath potentials, multi-frequency power delivery, transient operation, complex chemistries, engineered plasma facing surfaces, and extended pressure ranges all come together in some combination to enable fabrication of next generation devices using more exotic materials laid out with extraordinarily challenging topologies. These challenging conditions place demands on experimental diagnostic capabilities. In this talk, efforts to extend the operating capabilities and breadth of information obtained for three commonly used LTP diagnostics are summarized. 1.) extension of microwave hairpin probe diagnostic capability into high pressure regimes and transient conditions, where analysis techniques to measure collision frequency, plasma transients in pulsed RF operation, and direct measure of plasma perturbation due to the probe will be presented, 2.) extension of retarding field energy analyzers to high voltage operation by extending the spacing between grids, where a novel analysis technique that minimizes the distortion of reconstructed IEDF shape due to space charge accumulation between plates with sufficient separation for high voltage operation can improve measurement in this regime, and 3.) extension of Stark broadening measurement of electron density using Doppler Free saturation spectroscopy, where DFSS techniques are combined with Stark induced line shape and broadening analysis to estimate electron densities in the range of 10^{12} cm^{-3} with excellent comparison to Langmuir probe measurements in both magnitude and trend.

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