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RF Impedance of a Spherical Probe at High and Low Gas Pressure[1] R.F. FERNSLER, D.N. WALKER, SFA, Crofton, MD, D.D. BLACKWELL, W.E. AMATUCCI, Plasma Physics Division, Naval Research Laboratory, S.J. MESSER, NRL-NRC Postdoctoral Associate — The plasma electron density n_{eo} is most often determined using a Langmuir probe to measure the dc current as a function of the applied dc voltage V_{dc}. The dc impedance Z_{dc} varies strongly with V_{dc}, and models are needed to relate Z_{dc} to n_{eo}. Secondary electron emission, ion collisions, and other effects further complicate the analysis. Alternatively, a variable rf voltage can be applied while holding V_{dc} fixed. As long as the rf voltage is small, the rf impedance Z_{rf} varies with the frequency f but not the amplitude of the voltage, and for a fixed frequency, Z_{rf} depends only on $n_e(r)$ and the neutral gas density N. In this talk theoretical and experimental results for Z_{rf} are related to n_{eo} for a small spherical probe. At low N, Z_{rf} becomes resistive whenever f equals the local plasma frequency, and both the real and imaginary parts of Z_{rf} peak when f equals the bulk plasma frequency. The peaks make n_{eo} easy to determine, and the resistance at lower frequencies can be used to determine $n_e(r)$ within the sheath and presheath. At high N, the resistance depends mainly on n_{eo}/N, so n_{eo} is again easy to determine. Theoretical and experimental results for several spheres will be compared with Langmuir-probe data at high and low gas pressure.

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