

CubeSat with Cylindrical Langmuir Probes to Characterize Ionosphere and Thermosphere Plasma

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CubeSat specifications to endorse and develop the services necessary for the design, manufacture, and testing of small satellites intended for low Earth orbit (LEO) that perform a number of scientific research purposes and explore new space technologies. Nobel Laureate Irving Langmuir pioneered the use of electrostatic probes to measure the electron temperature, number density, floating potential, and plasma potential in ionized gases (in the 1920's). Langmuir probe is comprised of an exposed conductor (e.g., wire) immersed within a plasma. The theory of interpreting the data acquired (namely the current drawn from the plasma at a sequence of different bias voltages) from Langmuir probes is well established. Druyvesteyn noted that the second derivative of the probe current with respect to the bias voltage is proportional to the electron energy distribution function. The analysis by Laframboise enabled accurate evaluation of experimental data for cylindrical and spherical probes regardless of sheath size. PEPL makes extensive use of planar and cylindrical Langmuir (single, double, and triple) probes for evaluating plasma properties in the plumes of thrusters and in near electrode regions. The small size of typical Langmuir probes coupled with their relatively simple theory of operation make them an indispensable and widely used plasma diagnostic. We can construct custom probes sized to each experiment, commercially available systems do exist. This research paper explores the reliability, validity and susceptibility of small dimensional Langmuir Probe in CubeSat and Pico-Satellite for Ionosphere Characterizations. There is no general theory of Langmuir probes which is applicable to all measurement conditions, because it depends on the probe size and geometry, plasma density and temperature, platform velocity, and other factors. The actual design of the probe is usually determined by considering the relationship between the probe dimensions and the Debye length of the plasma.

Key words: Ionospheric Plasma, CubeSat, Langmuir Probe, Plasma Characterization