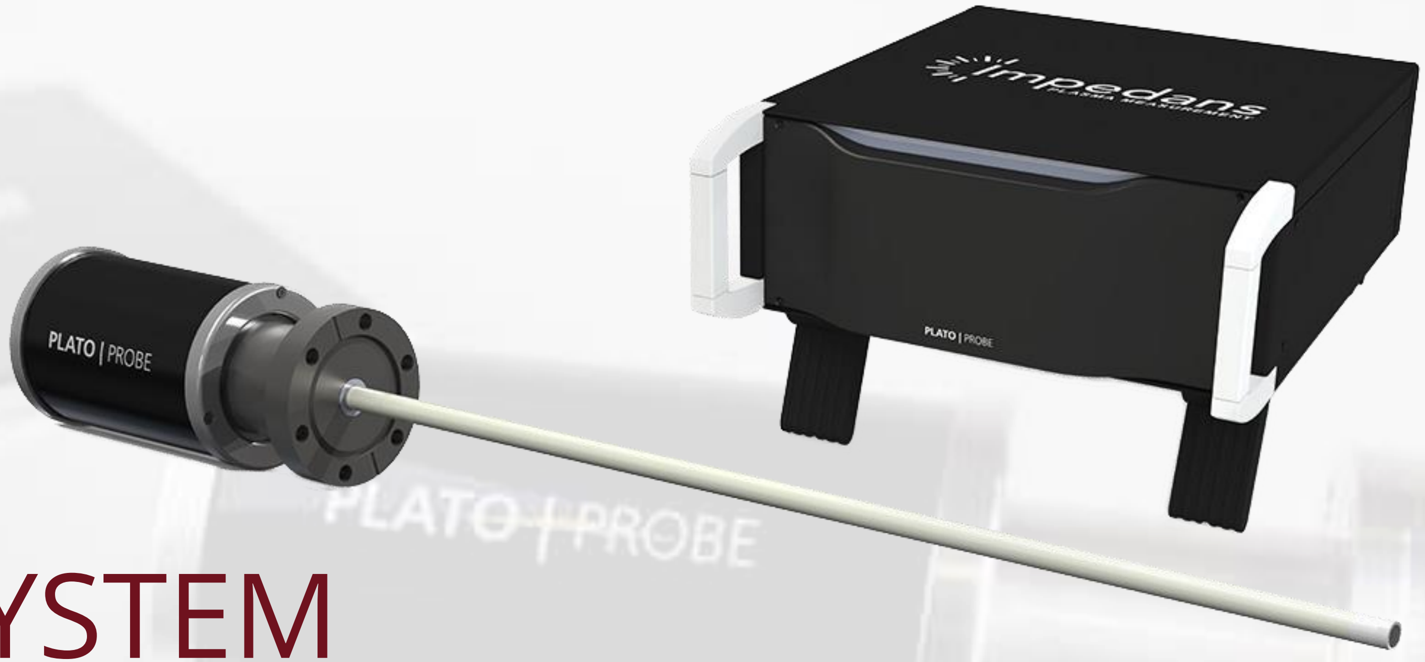


PLATO PROBE SYSTEM

A Novel Langmuir Probe for Deposition Plasmas

https://www.impedans.com/plato-probe

Impedans
PLASMA MEASUREMENT

The Plato Probe System

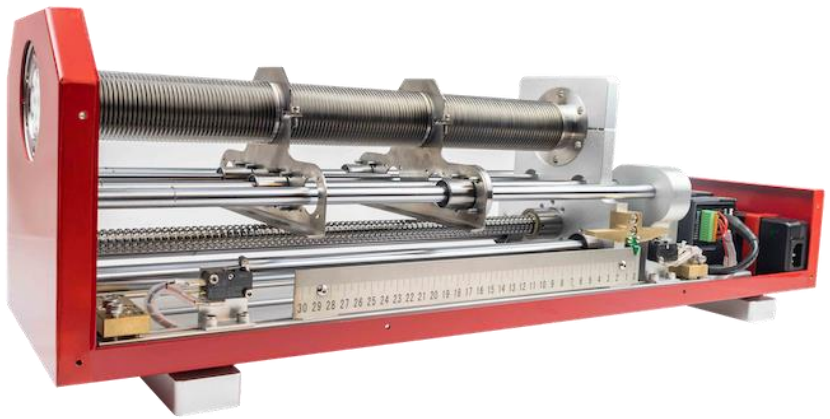
Measure the fundamental plasma parameters with the industry standard Langmuir Probe

Parameters Measured:

- ✓ Ion Density
- ✓ Electron Temperature
- ✓ Parameters can be measured as a function of time (down to 1 microsecond resolution) or position

Unique Planar Langmuir Probe:

- ✓ The Plato can take plasma measurements even when coated with insulating material up to 50 microns thick
- ✓ Accomplished using Octiv Suite technology
- ✓ The Octiv Suite data is processed using the Sobolewski method with compensation techniques of a Booth/Braithwaite probe

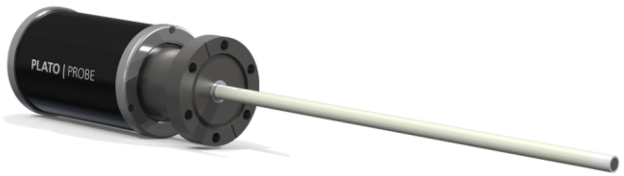


Key Features

Interchangable probe heads

Compatible with majority of plasma excitation methods

DC, pulsed DC, RF, pulsed RF, microwave and other plasma excitation methods.



Integrated RF compensation filters

RF compensated up to 5 frequencies in one probe.

Compatible with large deposition rates

Can tolerate up to 50 microns of an insulating layer and still measure plasma parameters

Integrated linear drive mechanism

Linear drive mechanism provides automatic spatial plasma uniformity.

Advanced software

State of the art plasma models built into software for automatic data analysis.

External pulse synchronization

Time averaged, time trend, synchronized pulse profile and triggered fast-sweep modes.

Intuitive and user friendly

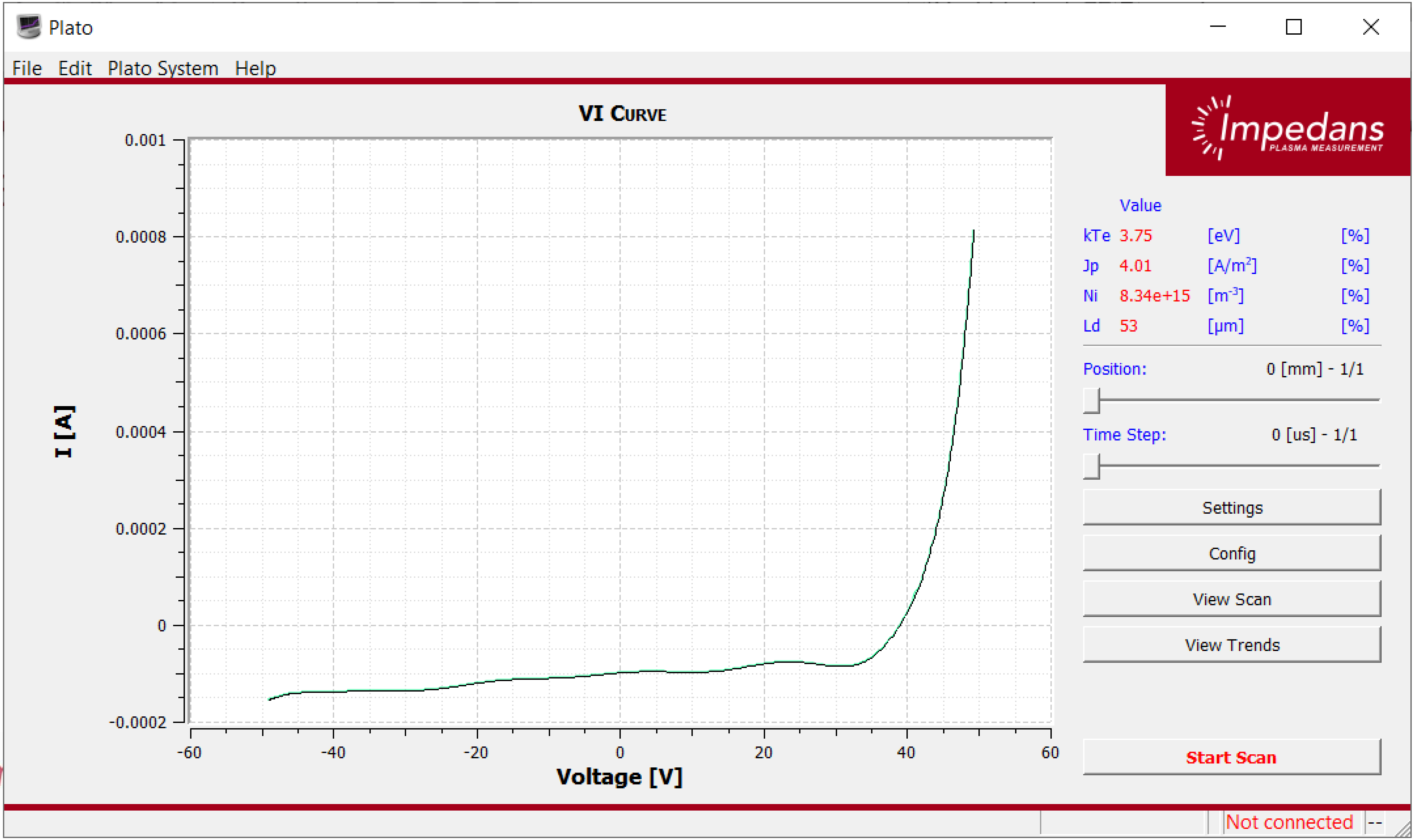
Impedans PLASMA MEASUREMENT

Technical Specifications

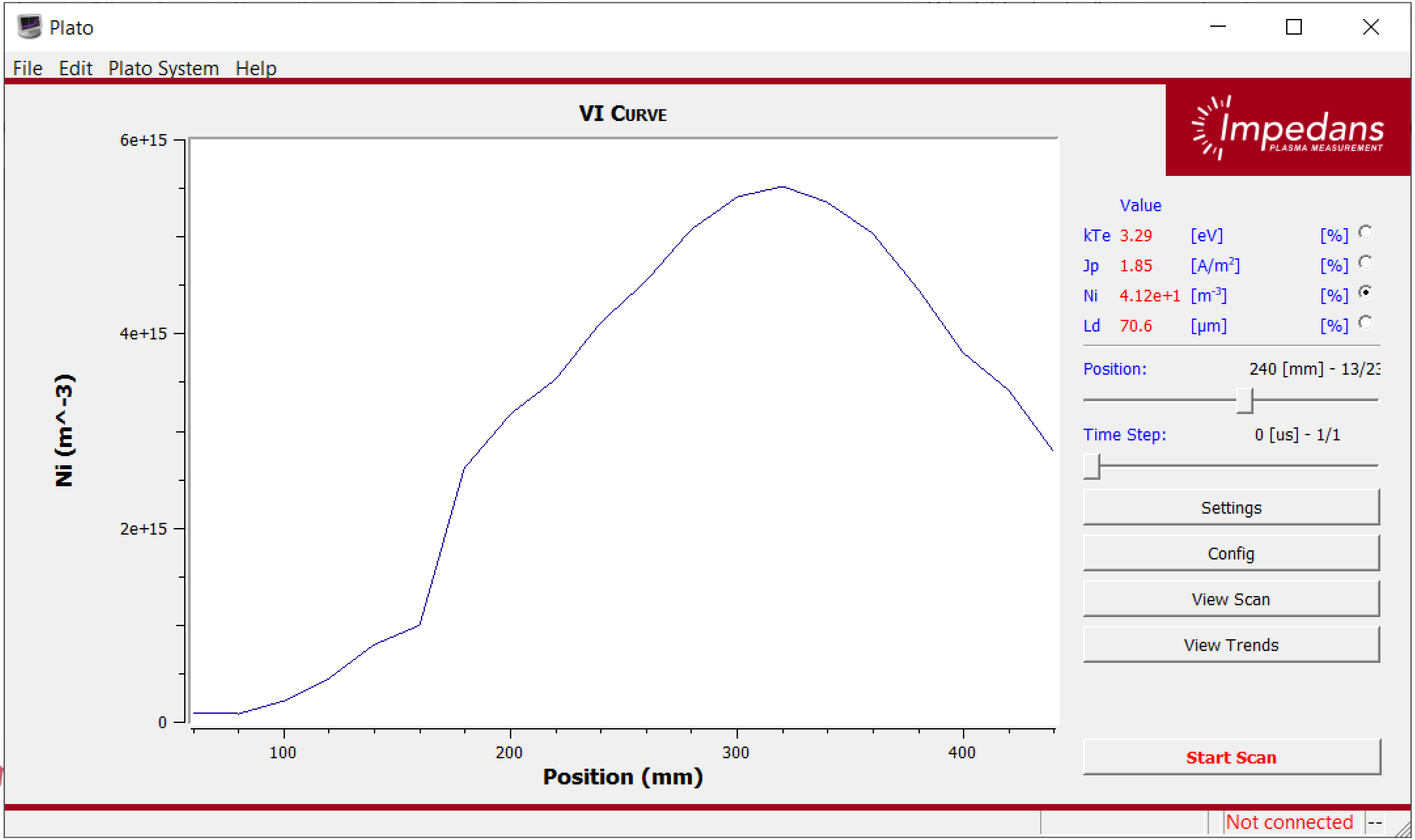
Parameters Measured	Range
Voltage Scan Range	Floating Potential +/- 30 V
Current Range	300 μA to 20 mA
Plasma Density	10^8 to 10^{13} cm^{-3}
Ion Current Density	26 $\mu A/cm^2$ to 300 mA/cm^2
Electron Temperature	0.1 eV to 15 eV
TTL Sync for Pulsed Processes	10 Hz to 50 kHz
Time Resolved Step Resolution	1 μs
Maximum Operating Temperature	230 C
Plasma Power Source	DC, RF, Microwave, Continuous, Pulsed
RF Frequency Range	5 MHz to 100 MHz

- ✓ For more detailed specifications and different models available, visit https://impedans.com/plato-probe
- ✓ To arrange a technical discussion, contact support@impedans.com

Example Data: Typical VI curve



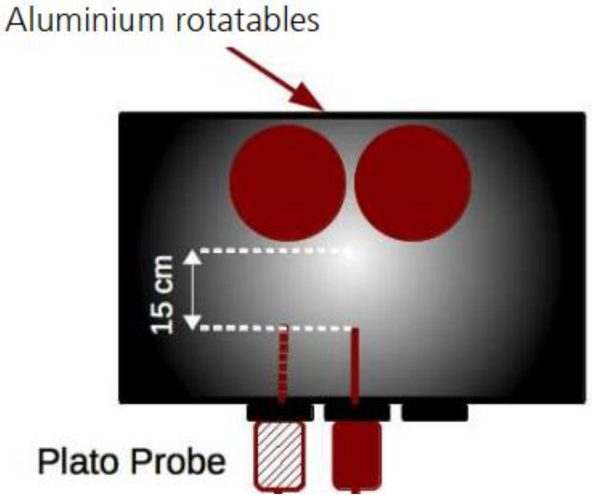
Example Data: Ion Density vs Position



Plato Applications

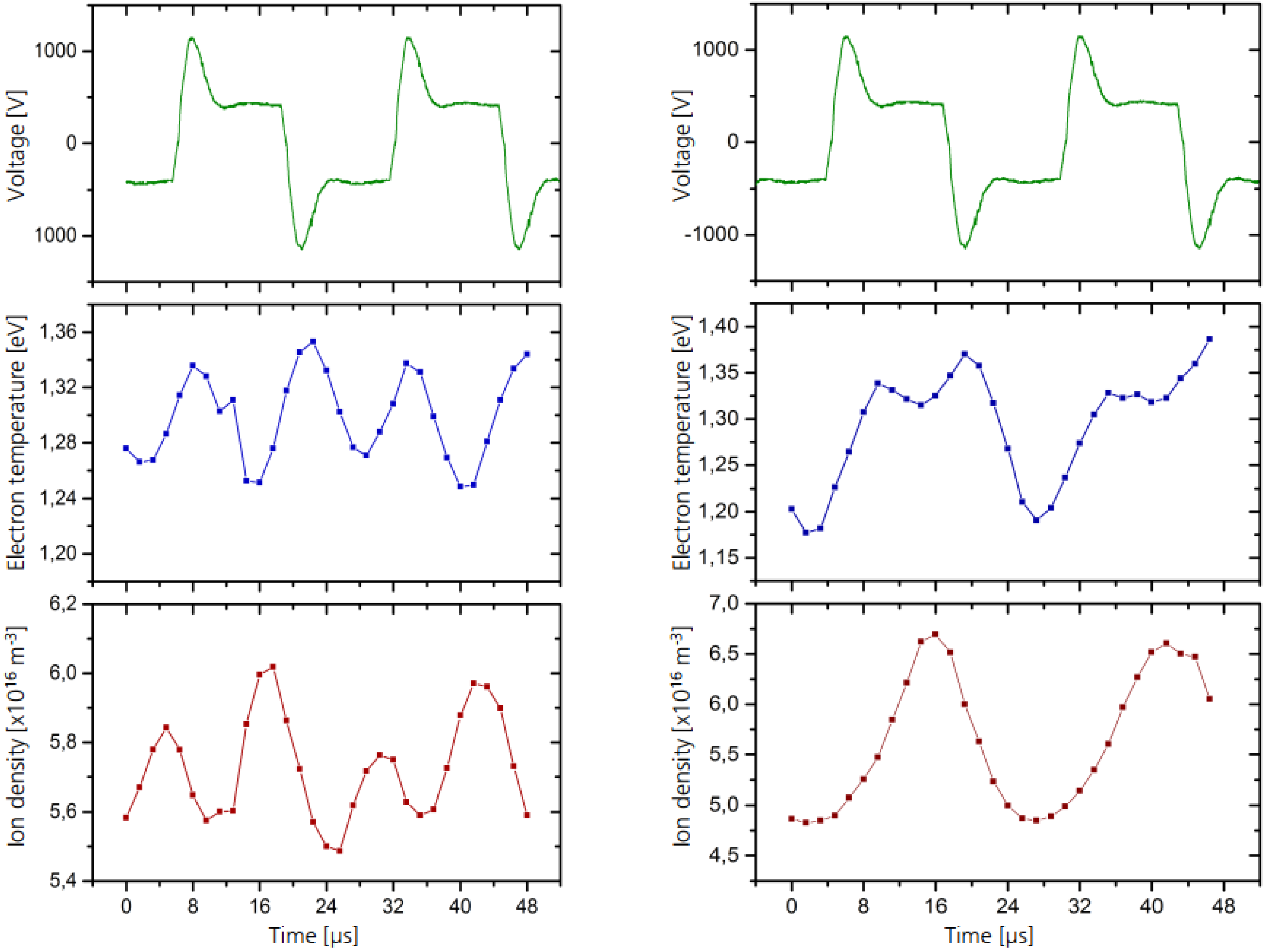
Time-Resolved Measurements in a Dual-Magnetron Metal Process

PLANAR LANGMUIR PROBE INVESTIGATIONS OF METALLIC AND REACTIVE BIPOLAR SPUTTERED ALUMINUM



The objective is to measure the plasma properties and thin film properties resulting in a dual magnetron source. Mid frequency excitation was used with 5 kW pulses and a 26 us period length.

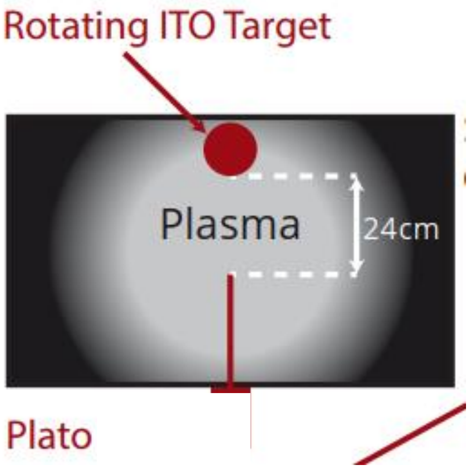
Some example data is shown to the right



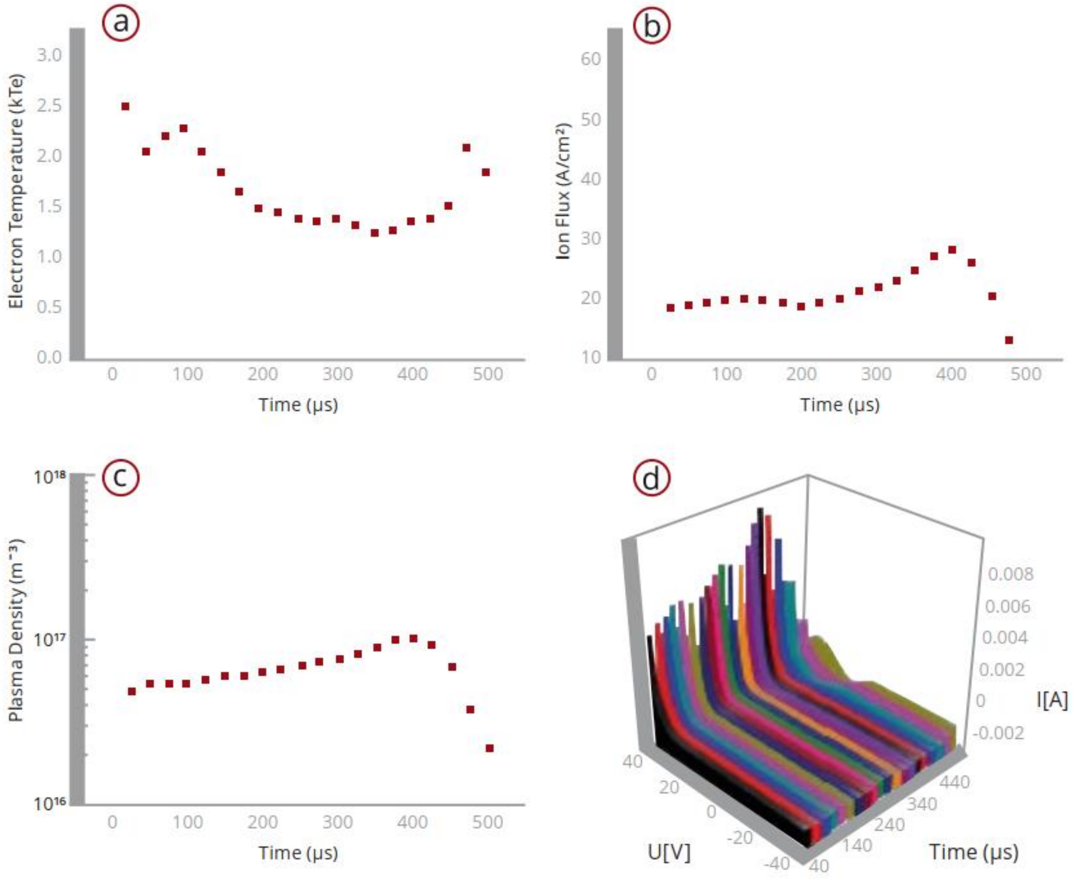
Voltage, Electron Temperature and Ion Density measured between (left) and in front of (right) a dual magnetron rotatable source in metallic mode.

Time-Resolved Measurements in a HiPIMS Process

Characterization of HiPIMS plasma via process compatible measurement probe



This study looks at the characterization of a HiPIMS plasma using a process compatible plasma measurement probe which can be used in situations which require measurements at a fast time resolution, where in some cases the application may be depositing insulating layers.



Measurements of the plasma parameters in a 2 kHz process with a 450 us off time, 25 us acquisition step. Sputtering target was a iridium tin oxide cylinder.

Plato Theory

Plato Probe Equations

Sobolewski Method:

$$I_{pe}(t) = -I_0 + I_e Exp\left[\frac{V_{ps}(t)}{T_e}\right] + C_s(t)\frac{dV_{ps}}{dt}$$

Ion Density:

$$n_i = \frac{I_{i,sat}}{A_p\ e}\sqrt{\frac{m_i}{kT_e}}$$

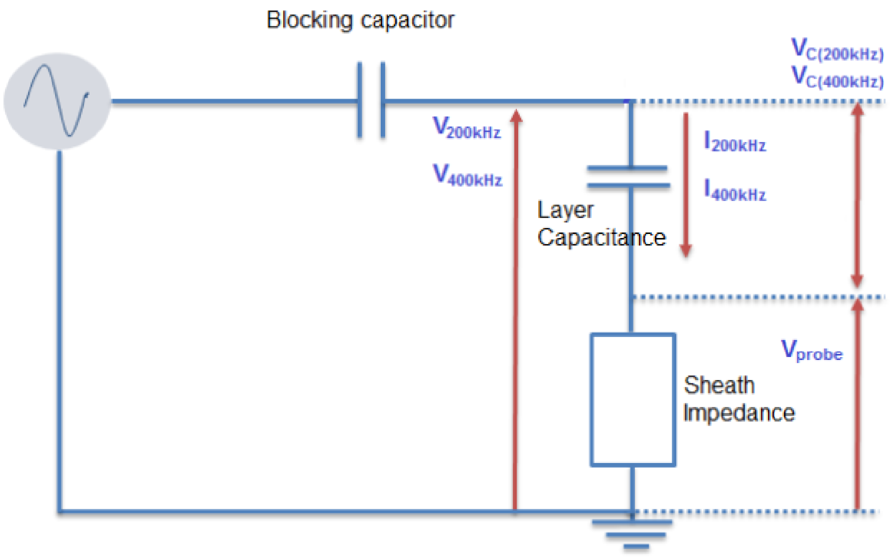
Booth & Braithwaite Method:

$$V_{probe,200} = V_{200\ kHz} - V_{C(200\ kHz)}$$
$$V_{probe,400} = V_{400\ kHz} - V_{C(400\ kHz)}$$

$$V_{C(200\ kHz)} = I_{C(200\ kHz)} X_{C(200\ kHz)}$$
$$V_{C(400\ kHz)} = I_{C(400\ kHz)} X_{C(400\ kHz)}$$

$$X_{C(200\ kHz)} = \frac{2(V_{C(200\ kHz)} - V_{C(400\ kHz)})}{2I_{C(200\ kHz)} - I_{C(400\ kHz)}}$$

$$V_{probe} = V_{measured} - X_{C(200\ kHz)}$$



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