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JENION

Plasma Analysis with PlasmaMon 3

(Product Information 2021)

1. Plasma Analysis with PlasmaMon 3

First plasma analysis devices from Jenion had been manufactured in 2001. (PlasmaMon 1 for 16 plasma sheet probes). In 2008 followed the PlasmaMon 2 which also did enable ion energy measurement with a Retarding Field Analyzer (RFA). The RFA was driven with the same electronic as the plasma sheet probes, so that ion energy analysis was limited to 200eV.

Now PlasmaMon 3 is available with some improvements:

- Separate electronics for the RFA, enabling ion energy analysis up to 800 eV for positive or negative ions,
- Separate connection boxes with integrated preamplifier for higher sensitivity,
- Measurement of the floating potential with linear plasma probes,
- Linear plasma probes operating at sputter plasmas with metallic targets.

2. Components of the System

2.1 Overview

Fig.2.1. shows the arrangement of PlasmaMon 3 for plasma analysis. A Retarding Field Analyzer and a linear plasma probe are installed at a vacuum chamber, containing the plasma. Also the single operation of a RFA or a plasma probe is possible.

The Electronic Control Unit (ECU) generates all the required voltages for plasma probe - and RFA-operation. It is coupled via a serial interface (RS 232) to a computer with the control software. To ensure a stable measurement of the small signals from the plasma for each sensor a connection box containing the electrical vacuum feedthrough and a preamplifier is installed directly at the vacuum chamber.

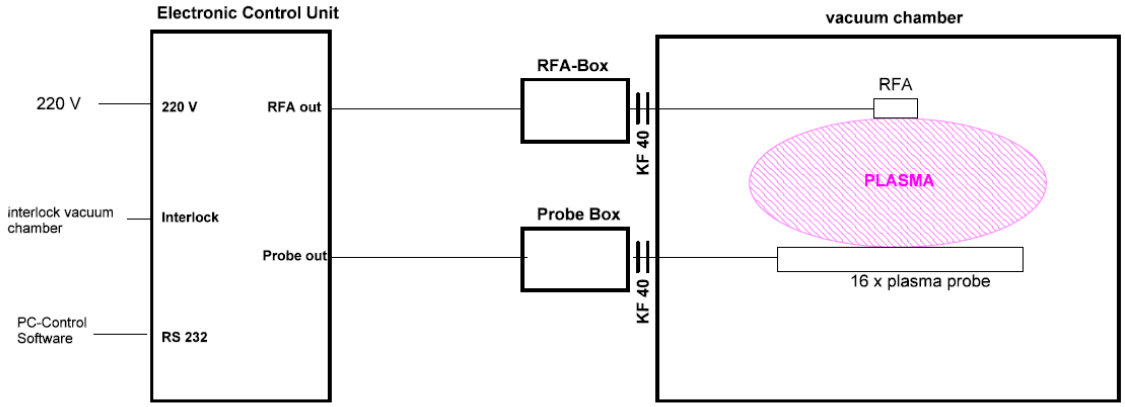

Fig. 2.1: Schematic arrangement of PlasmaMon 3

2.2 Electronic Control Unit (ECU)

Fig. 2.2. shows the Electronic Control Unit. It is microprocessor controlled and operates all measuring processes of PlasmaMon 3. Over a serial interface (RS232) the measured data are transferred to a computer with the control software. Mostly an additional USB to serial converter is plugged in into a free USB port of the PC to convert the RS 232 signals to USB.

Fig. 2.2: Electronic Control Unit PlasmaMon 3 from backside

2.3 Vacuum Connection Boxes (Probe Box and RFA Box)

Fig. 2.3. shows one of the connection boxes. Both boxes consist of a box of aluminium with a flange KF40 on front for direct vacuum connection. There the cable from plasma probes or from the RFA is plugged in.

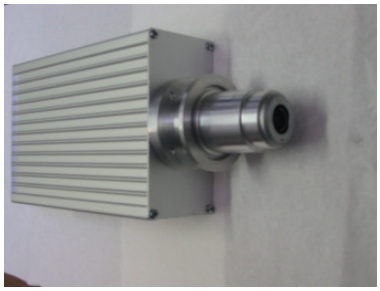

Fig. 2.3: Probe connection box with vacuum flange KF 40

The connection cables to the ECU (5 m length) are plugged in at the backside of the boxes.

2.4 Plasmasheet Probes

Fig. 2.4. shows a typical plasma sheet probe with 16 probes, arranged at a distance of 20 mm, so that the overall length of the linear probe is approx 350 mm. Therefore this linear plasma probe is well suited for homogeneity analysis of most plasmas up to a dimension of 300 mm.

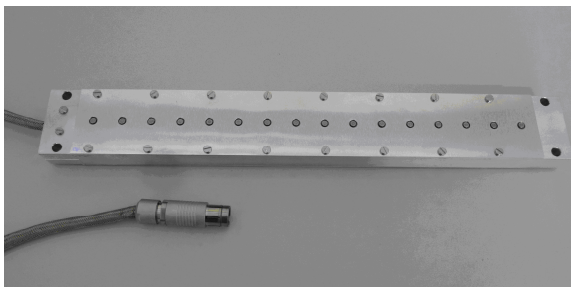

Fig. 2.4: Linear plasma sheet probe 16 x 50 mm

The smallest probe distance is 10 mm corresponding to an overall probe length of approximately 180 mm. Also large probe distances up to 100 mm can be realized. Other customer specified probe dimensions can be manufactured.

Fig. 2.5. shows a plasma probe with 8 probes in x- and 8 probes in y-direction, so that with this probes an ion beam profile of a broad ion beam source e.g. can be measured.

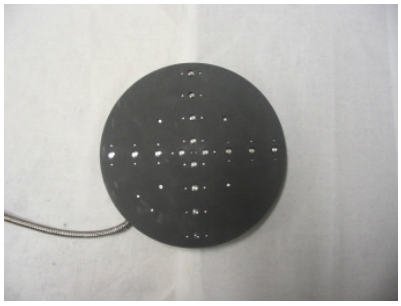

Fig. 2.5: Arrangement of two linear faraday cup lines for ion beam profile analysis (2 x 8 x 20 mm)

The plasma sheet probe shown at Fig. 2.4 consists of circular plasma probes of 5 mm diameter embedded in a conducting housing at ground potential of the vacuum chamber. The measured floating potential is in this case close to ground.

To measure the floating potential distribution over larger isolated areas, where a floating potential distribution unequal zero exists, the probes have to be embedded in an isolating housing of the linear probe. This can be done by customer specified laser cutted overlays e.g. for the probe, shown at Fig. 2.4. .

Different constructions of the plasma sheet probes can be delivered:

- Simple 5 mm probe with open isolator,
- 5 mm probe with background isolators for sputter plasmas of conducting layers.

All probes operate up to 250℃ and have normally an internal cable of 2 m length

The plasma probes also can be used at sputter processes of conducting layers.

2.5 Retarding Field Analyzer

Fig.2.6. shows the Retarding Field Analyzer. The housing has 54 mm diameter and 20 mm height. With the four M3-screws it can be simple mounted into a plasma electrode or a substrate holder. The RFA operates only at ground potential.

Fig. 2.6: Retarding Field Analyzer

The RFA operates up to 250 °C. The length of the internal cable is normally 2 m. Maximum operating pressure is 0.25 mbar. The RFA analyzes the Ion Energy distributions of positive or negative ions up to 1000 eV. Also the Electron Energy Distribution of electrons near the RFA can be analyzed.

2.6 Control Software

The control software for PlasmaMon 3 is nearly the same as for PlasmaMon 2. It contains four panels for the following functions:

a) "PlasmaProbe" for measuring of U-I curves of 16 probes simultaneously,
b) "Plasmaprofile (current)" for measuring the ion saturation currents of all 16 probes simultaneously,
c) "Plasmaprofile (float)" for measuring the floating potential of the 16 probes simultaneously,
d) "Retarding Field Analyzer" for measuring the ion energy distribution of the RFA,

Fig. 2.7. shows the software in operation with „Plasmaprobe").

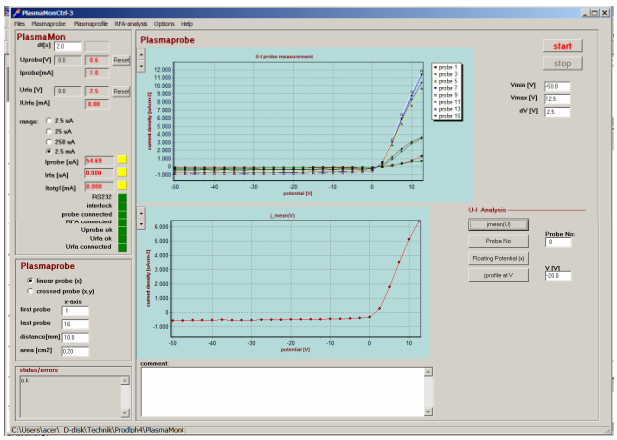

Fig. 2.7: Control software for PlasmaMon 3 in "Plasmaprobe" mode

Fig.2.8. shows the software in operation with the Retarding Field Analyzer (RFA) analyzing the ion energy distribution of an ion source.

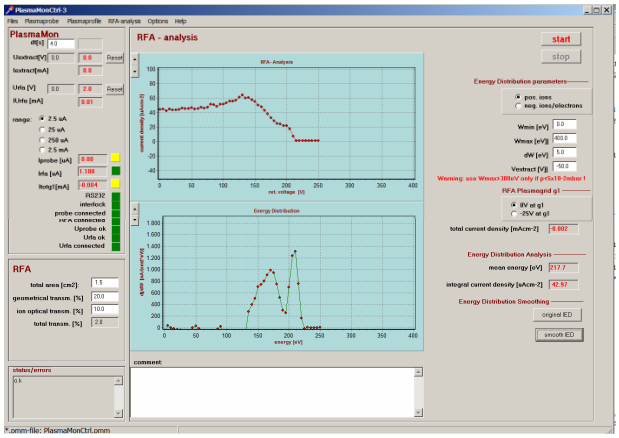

Fig. 2.8: Control software for PlasmaMon 3 in "Retarding Field Analyzer" mode

The dimensions of the used probes and the values of the analysis parameters can be controlled with the software. For each analysis problem they can be saved at a configuration file.

The results of each measuring mode can be saved as ASCII-file, so that further documentation is possible and more analysis (like for U-I curves) can be carried out.

3. Options

Customer specified probes can be delivered like:

- Integration of plasma probes or RFA into plasma electrodes or substrate holders,
- linear plasma probes with Langmuir probes at customer specified dimensions,
- probes, made from customer specified materials (like for plasma etching)