HIDEN ANALYTICAL

IMP – End Point Detector

An overview of Hiden Analytical's end point detector system for ion beam etch applications

HIDEN ANALYTICAL

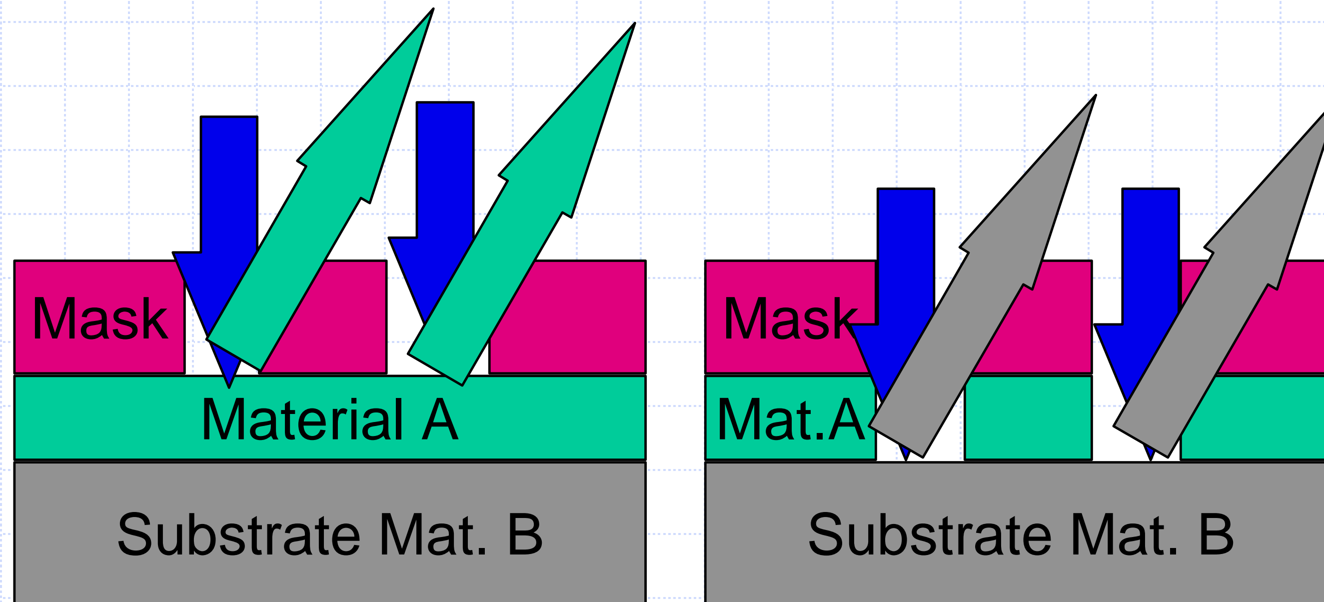
What is the Hiden IMP?

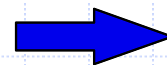
The Hiden IMP is a differentially pumped, ruggedized secondary ion mass spectrometer for the analysis of secondary ions and neutrals from the ion mill process.

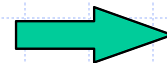
The IMP system comprises:

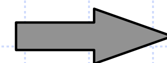
- Stainless Steel Shroud with Sampling Orifice
- Ion Optics with Energy Analyser and integral ioniser
- Triple filter Quadrupole mass analyser
- Pulse Ion Counting Detector
- Differentially Pumped Manifold With Mounting Flange to Process Chamber
- Data System with integration to the process tool

End Point Detection



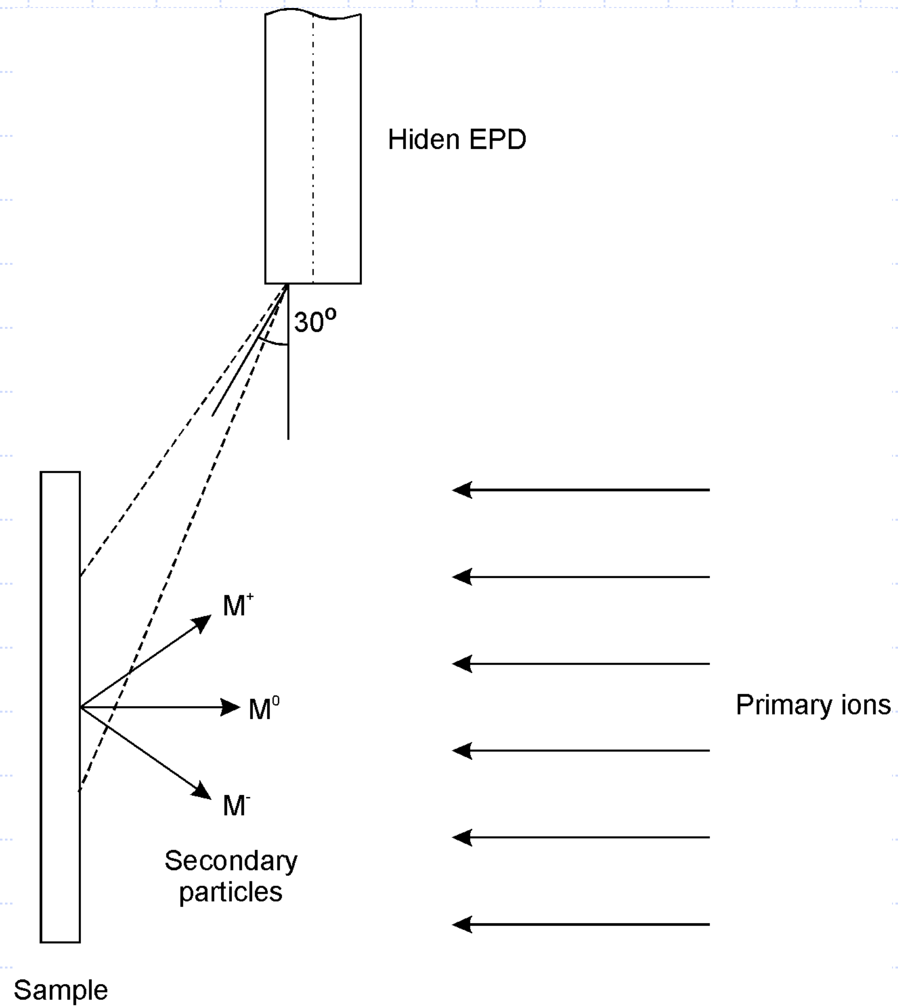
 Primary Ion Beam

 Secondary Ions Mat. A

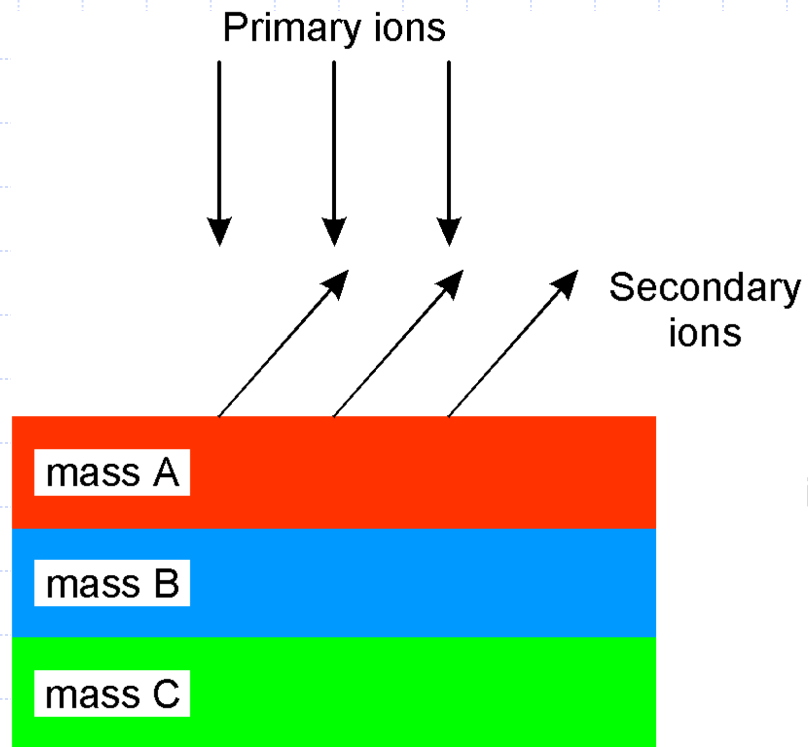
 Secondary Ions Mat B

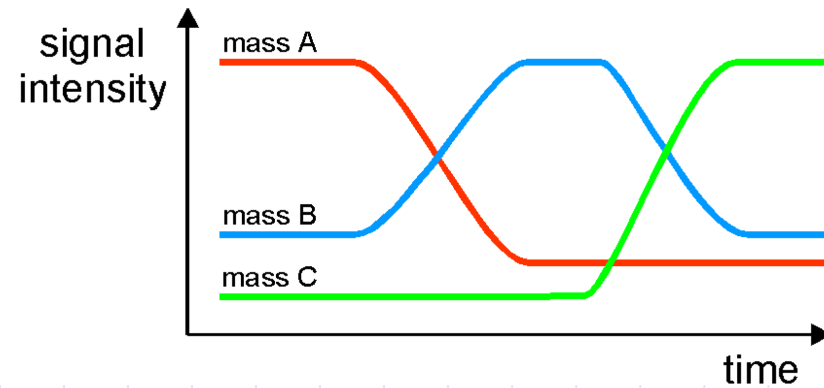
HIDEN ANALYTICAL

Signal Collection



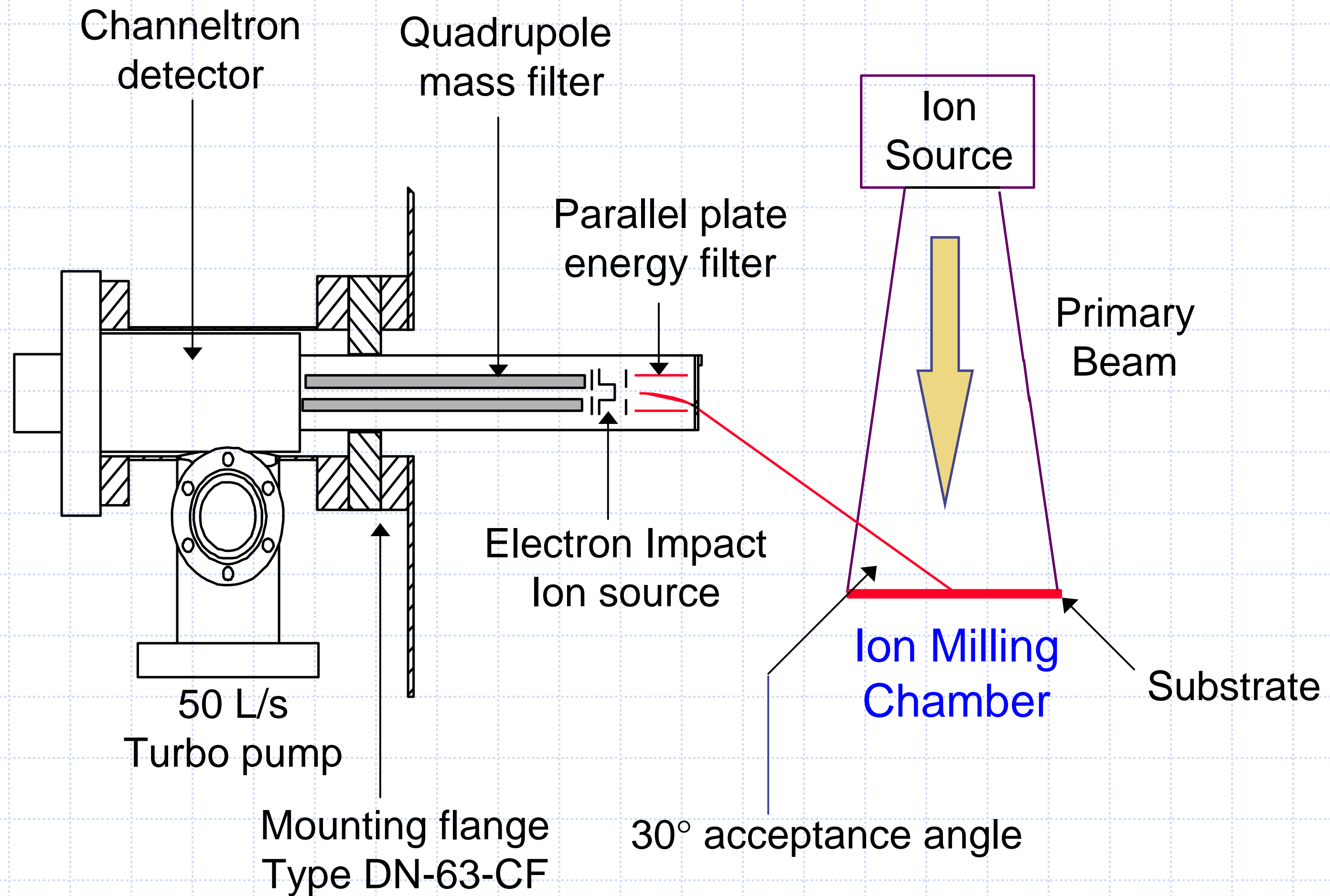
Data Output



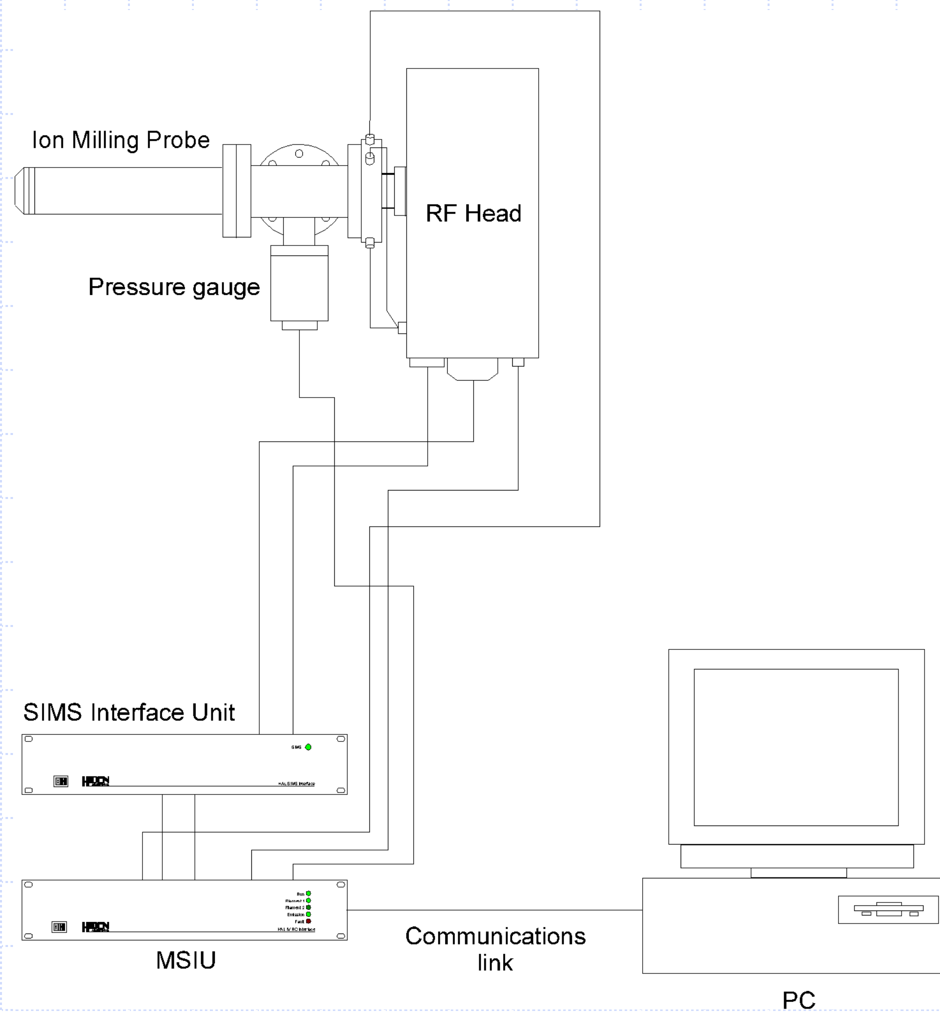


HIDEN ANALYTICAL

Ion Milling Probe 30°



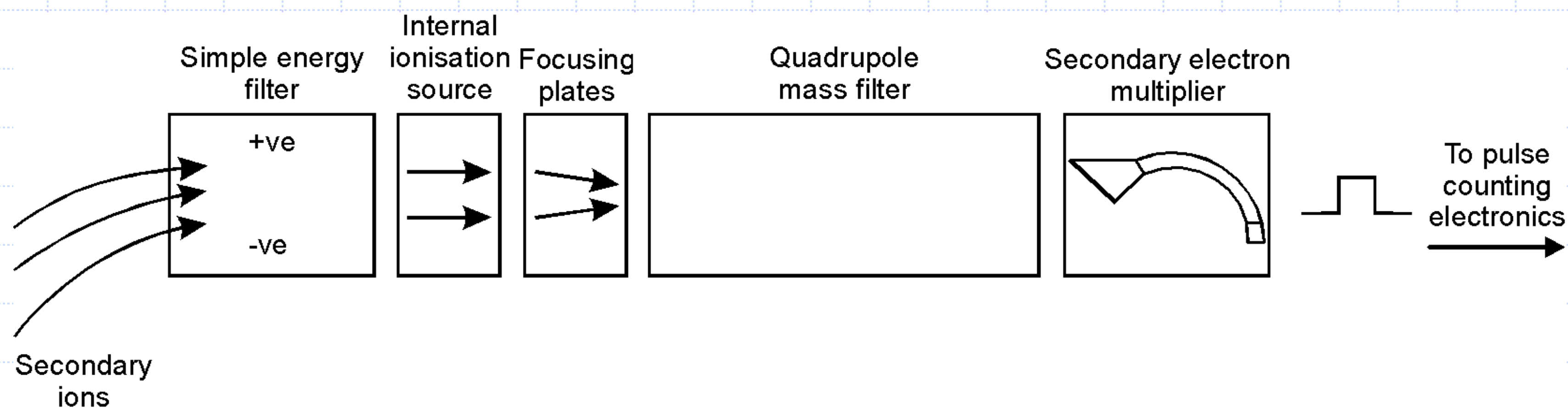
IMP Schematics

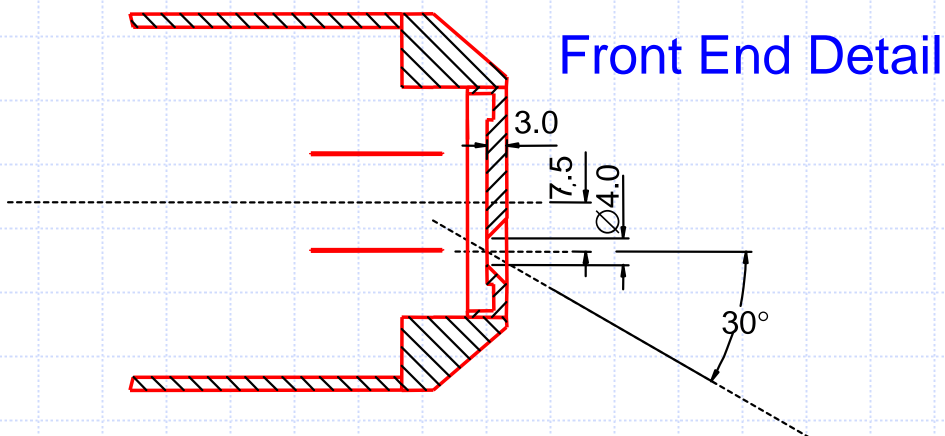


www.HidenAnalytical.com

HIDEN ANALYTICAL

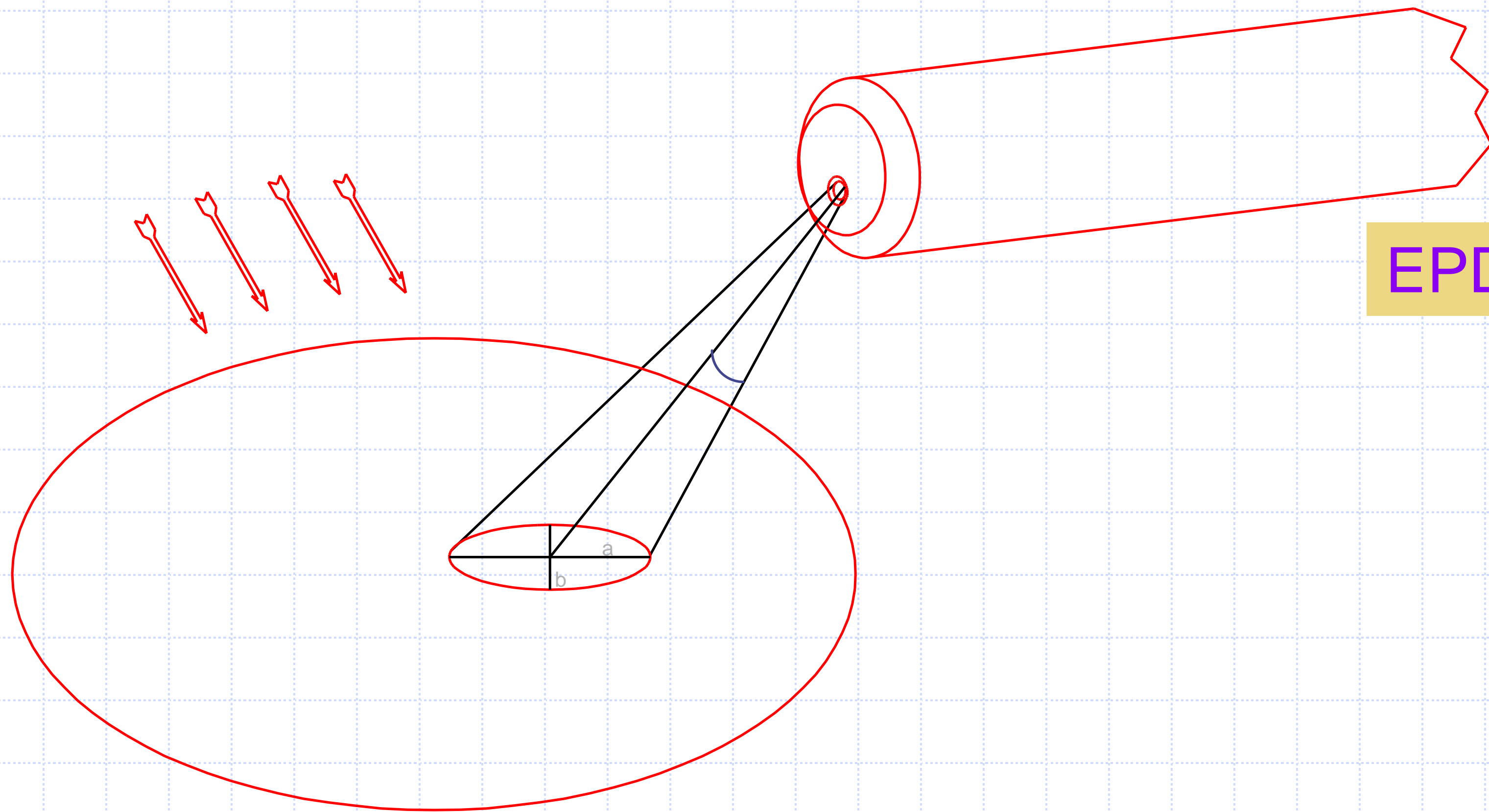
IMP – probe schematics





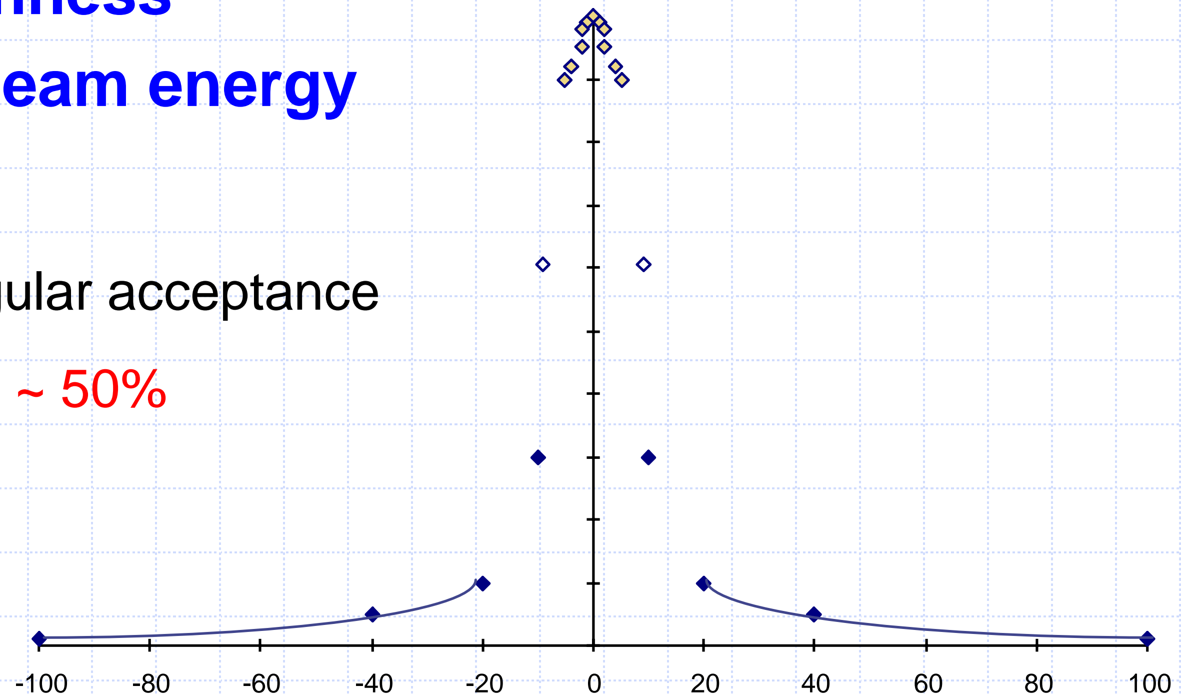
Front End Detail

Angle of Acceptance



Variables affecting angle of acceptance:

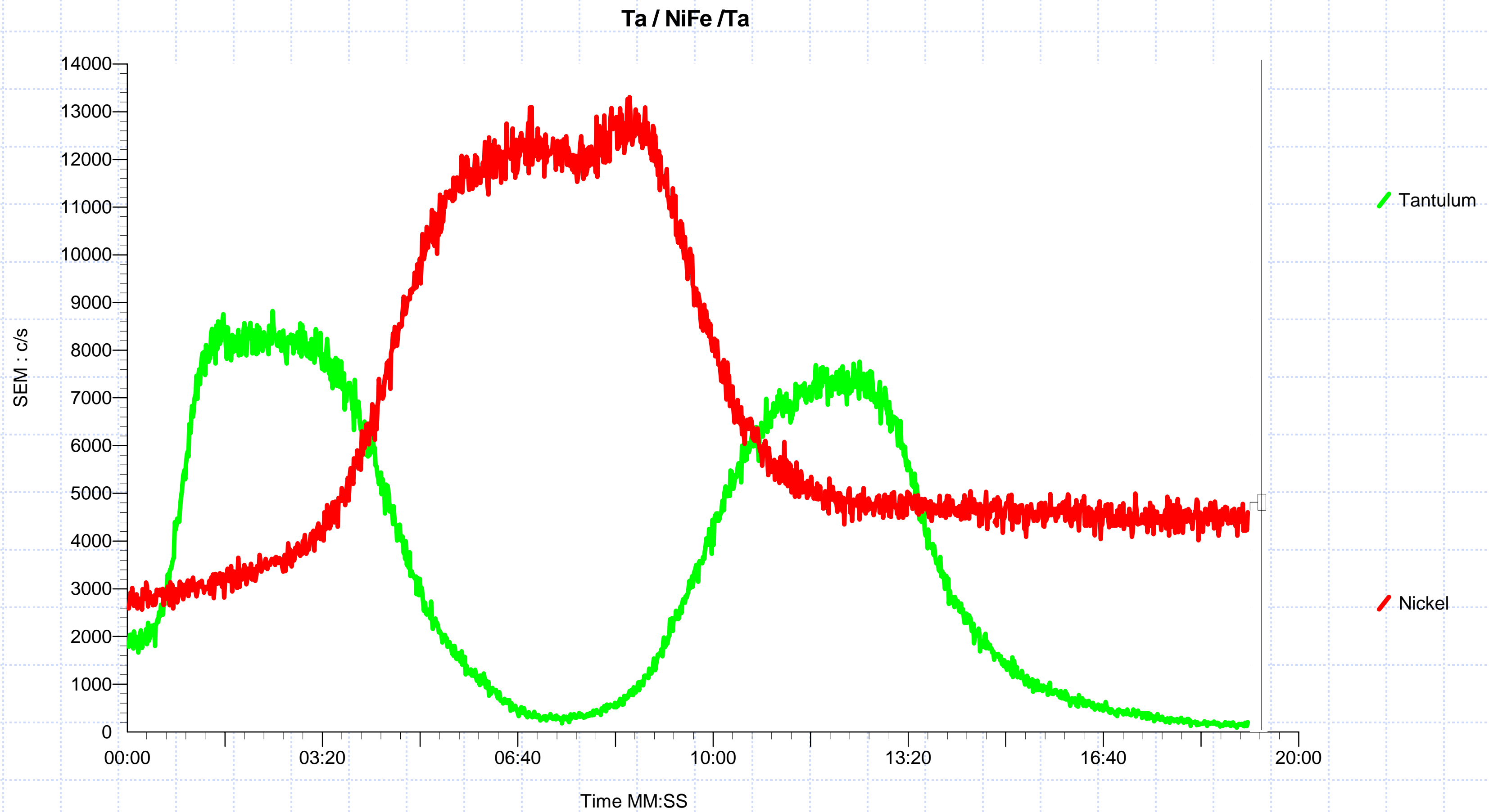
- Wafer tilt – The IMP end point detector probe operates over a wide range of wafer tilt angles
- Surface roughness
- Primary ion beam energy



Relative angular acceptance

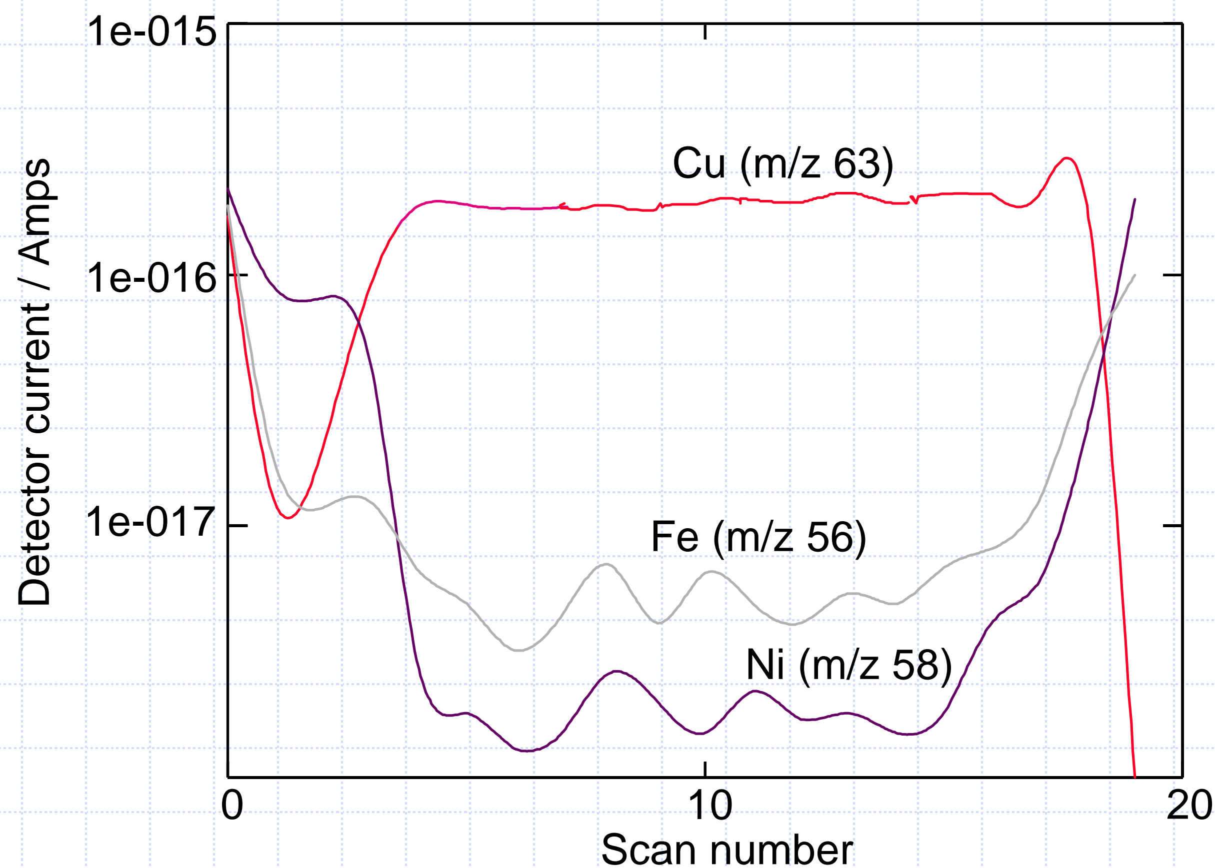
±5° ~ 50%

Example Data:



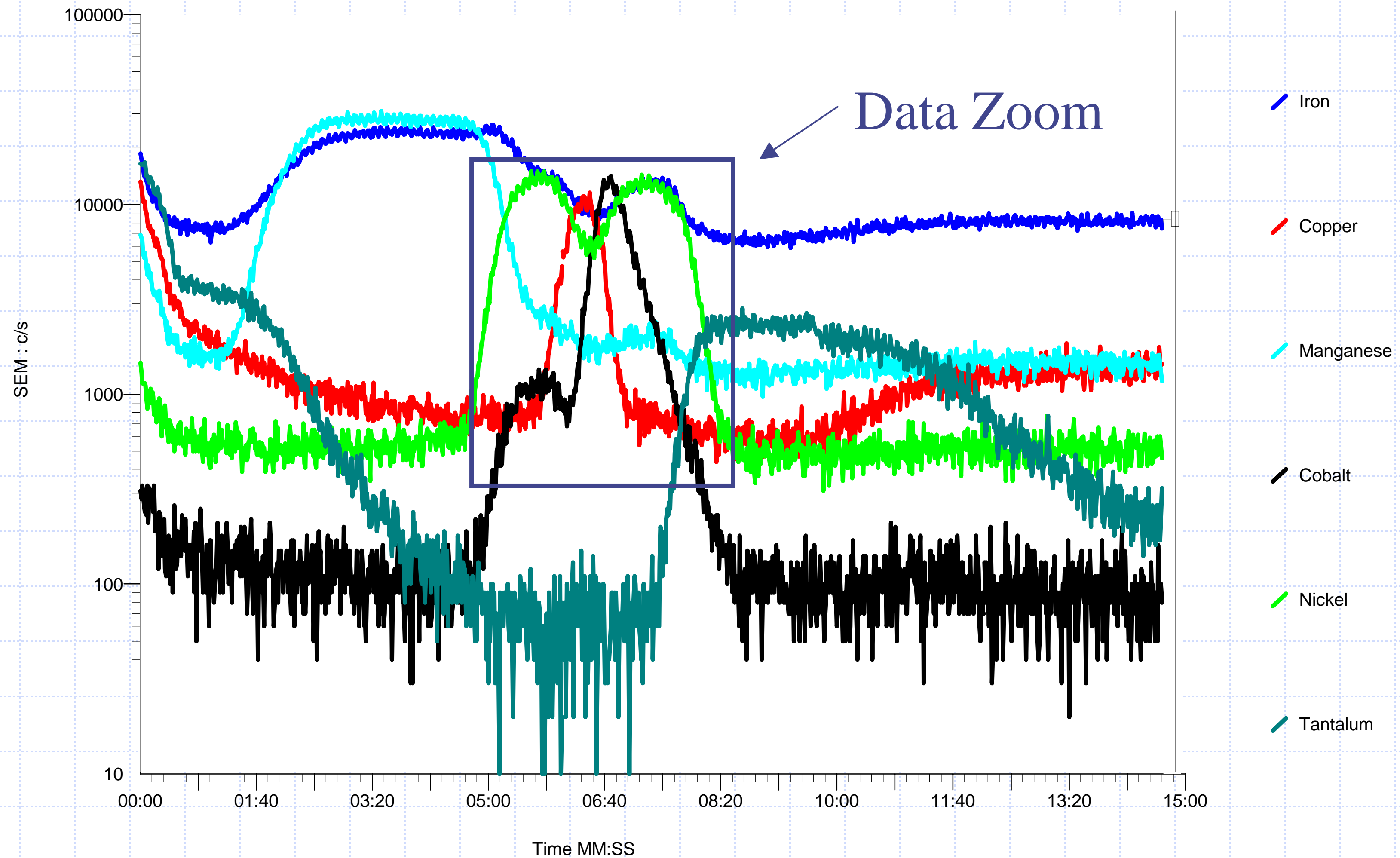
Example Data 2:

- **Etch profile for a Cu / NiFe layered material, with the objective to stop on the NiFe layer. Sample was 99% masked.**

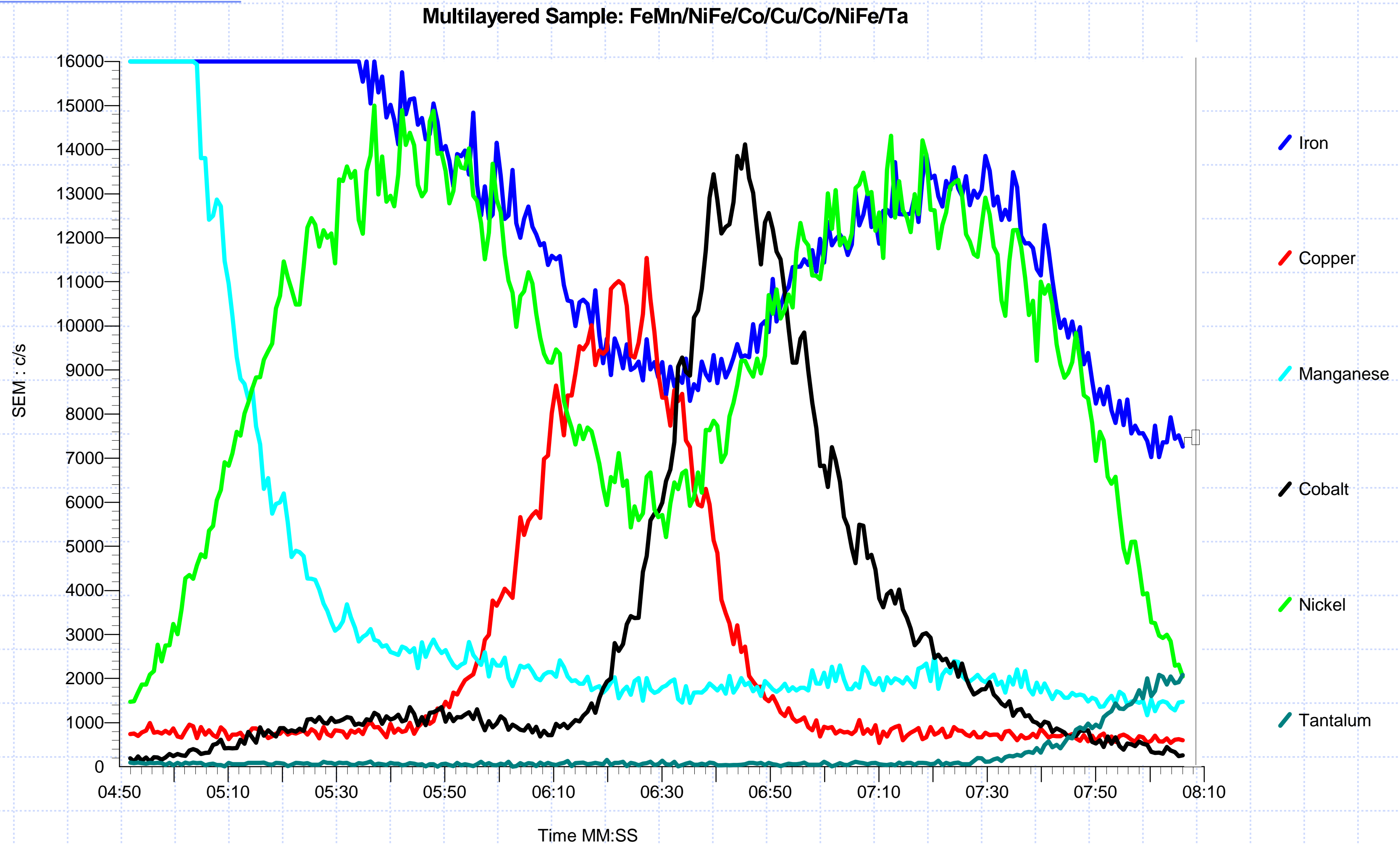


Example Data 3:

Multilayered Sample: FeMn/NiFe/Co/Cu/Co/NiFe/Ta



Data Zoom - variation due to sample rotation

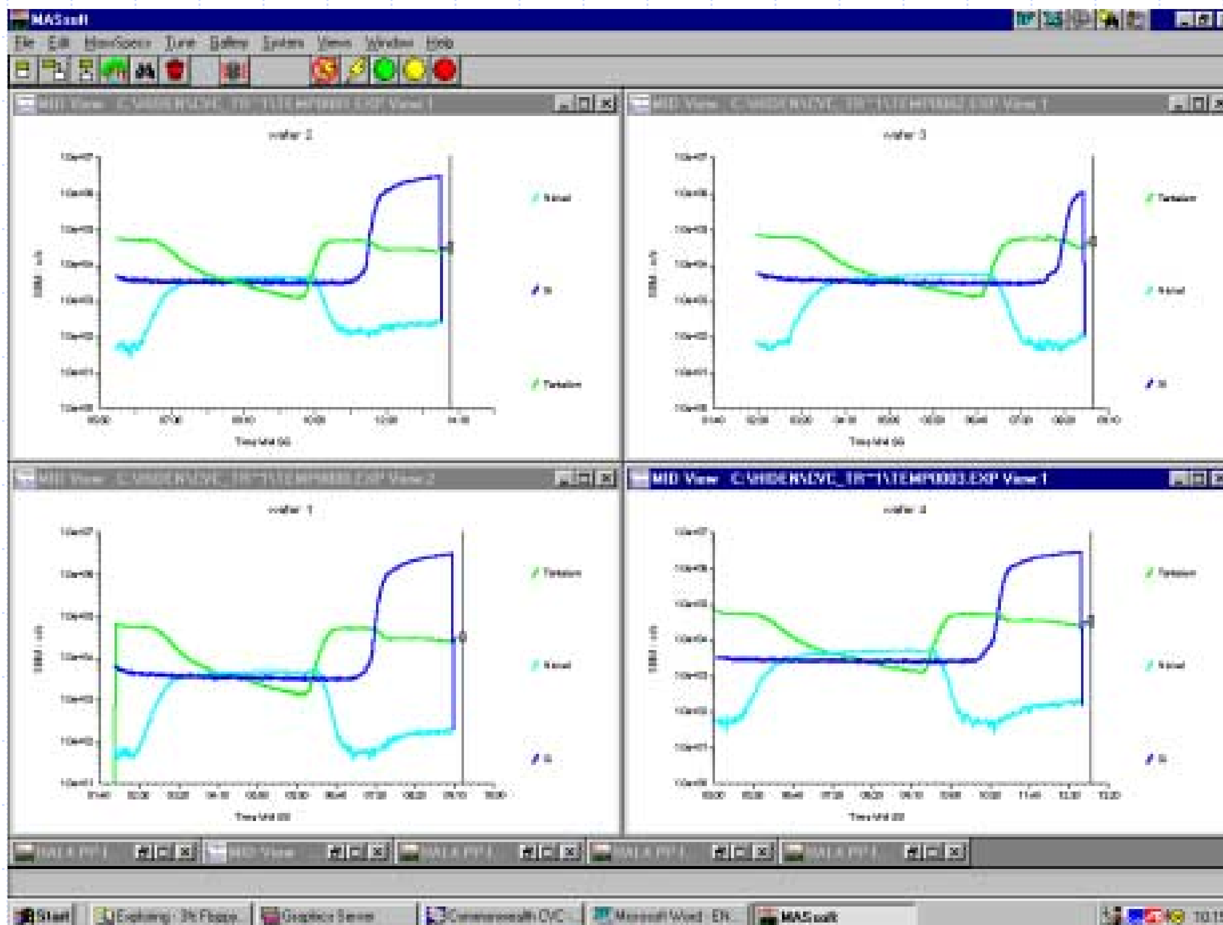


HIDEN ANALYTICAL

www.HidenAnalytical.com

Process Comparison / Evaluation:

- 4 wafers run sequentially – wafer 3 has an imperfection recorded



HIDEN ANALYTICAL

IMP Materials Guide

INTERFACE	APPLICATION EXAMPLE
Si/Ga	Identification of SiO_2 interface on III-V semiconductor.
Au/Cr/Al	Au/Cr track identification on aluminium substrates.
Au/Ti/Ga	Precise definition of Au/Ti electrical contacts in GaAs.
Mo/Ge	Precise definition of Mo/Ge interfaces in multifilm Mo/Ge structures.
Al/In	Identification of the interface between two semiconductors Al In As/InP.
Al/Ga	To etch down to the interface between two layers of AlGaAs separated by a 79 Å GaAs well. The Al signal clearly identified the sandwich.
Y/Ba/Cu/MgO	Identification of separate layers in multilayer superconductor materials.
NiCr/Cu/NiFe/SiO2	Magnetic disc sensor head manufacture.

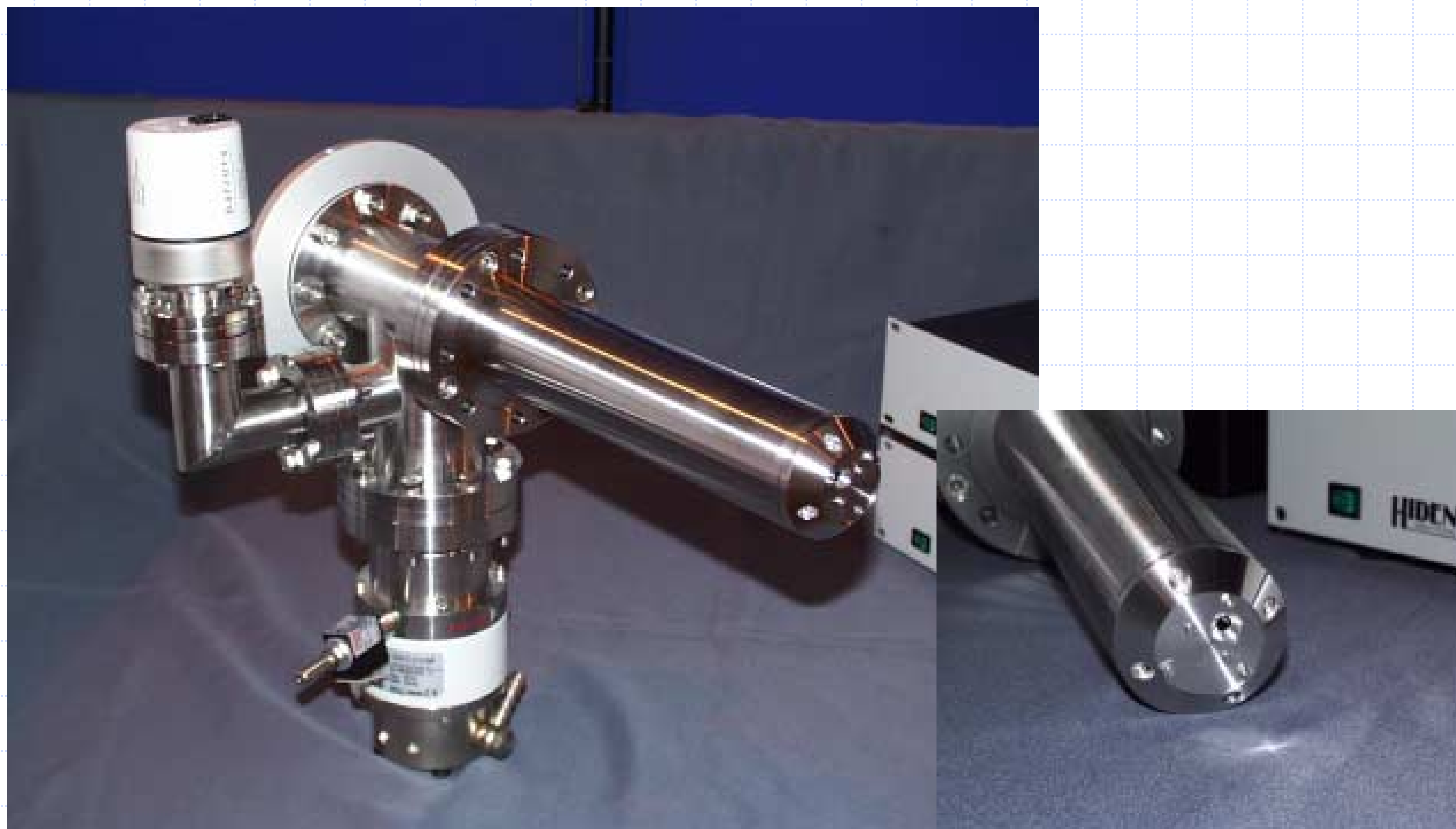
HIDEN ANALYTICAL

Mass Channels.

Layer	Mass to monitor	Mass number
AlTiC	Ti	48
CoFe	Co	59
Al_2O_3	Al / AlO	27 / 43
Ta	Ta	181
NiFe	Ni	58
Cu	Cu	63
FeMn	Mn	55
Co	Co	59
Ca	Ca	40
Ti	Ti	48
Cr	Cr	52
Ag	Ag	107
Au	Au	197
Pt	Pt	195
Si	Si / SiO	28 / 44

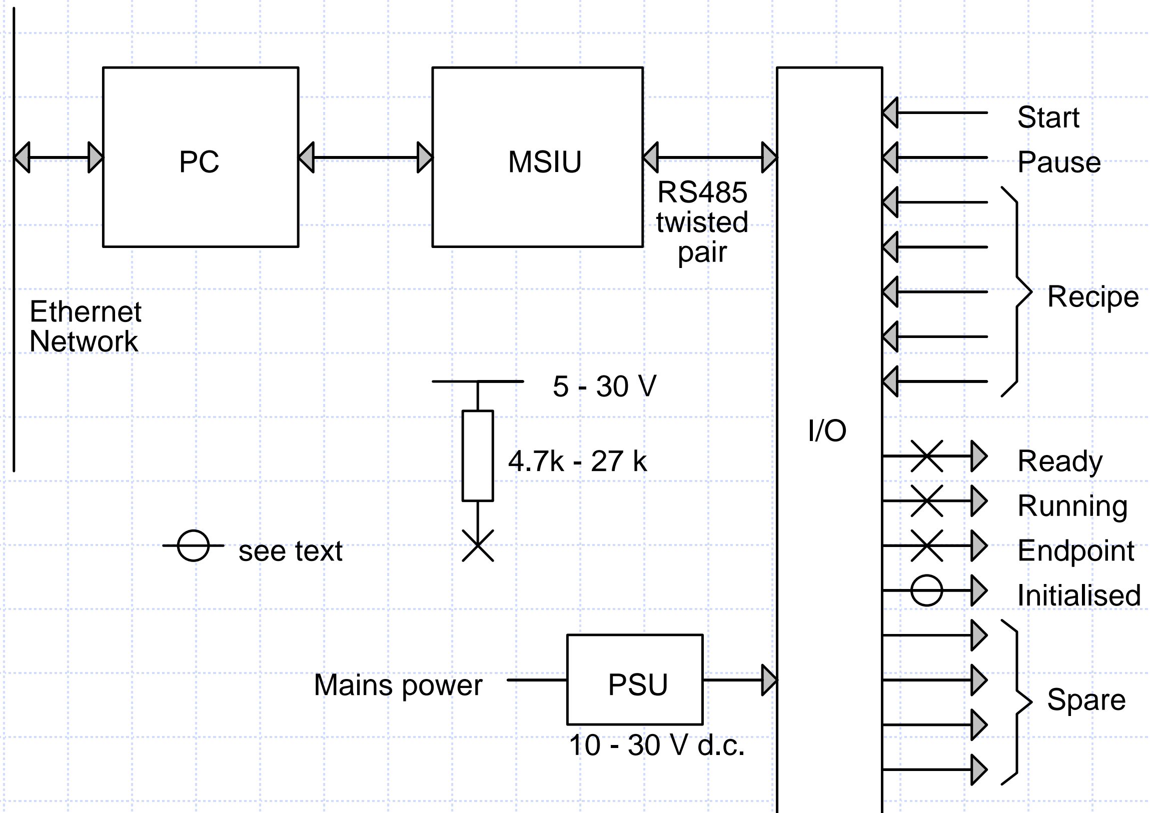
HIDEN ANALYTICAL

The IMP – Front End Detail.



Software Integration – Parallel digital I/O.

- Programmable DDE
- Parallel Digital I / O
- RS 232 Scripting communication



HIDEN ANALYTICAL

End point Control:

- The end point control signal is sent via digital I / O
- The end point is controlled with the following criteria:
- Rising edge or Falling edge with variables:
    - Mass channel
    - Percentage over etch
    - Timed over etch
    - Time out over etch

HIDEN ANALYTICAL

End point Control Parameters.

A_limit : The limit, in c/s, above which the signal intensity must be in order for the program to detect an endpoint. Can be useful to remove the effect of background signal.

Delay_A: The time after which the event sequence starts looking for an end point. During this time no endpoint indicated. Useful for setting to stop system end pointing on the signal burst caused by opening the shutter or to allow endpointing on a layer other than the first.

GetA- and GetANow: Set the comparison data points to see if the signal is rising / falling. GetA- registers the number of prevision cycles that the current data will be compared with and calculates the difference. These settings influence the determination of the slope and also the effect of S / N levels.

Is_A_50% : The events program is set to output the endpoint signal when the signal intensity is reduced to 50% of maximum. This can be changes by simply entering a different percentage value.

A_Rising: The rate at which the signal must be rising to be detected as a peak. Used to avoid noise generating a spurious endpoint in low S/N signals. Generated by the difference in GetA- / GetANow.

A_Falling: Similar to A_rising, but for a falling signal.

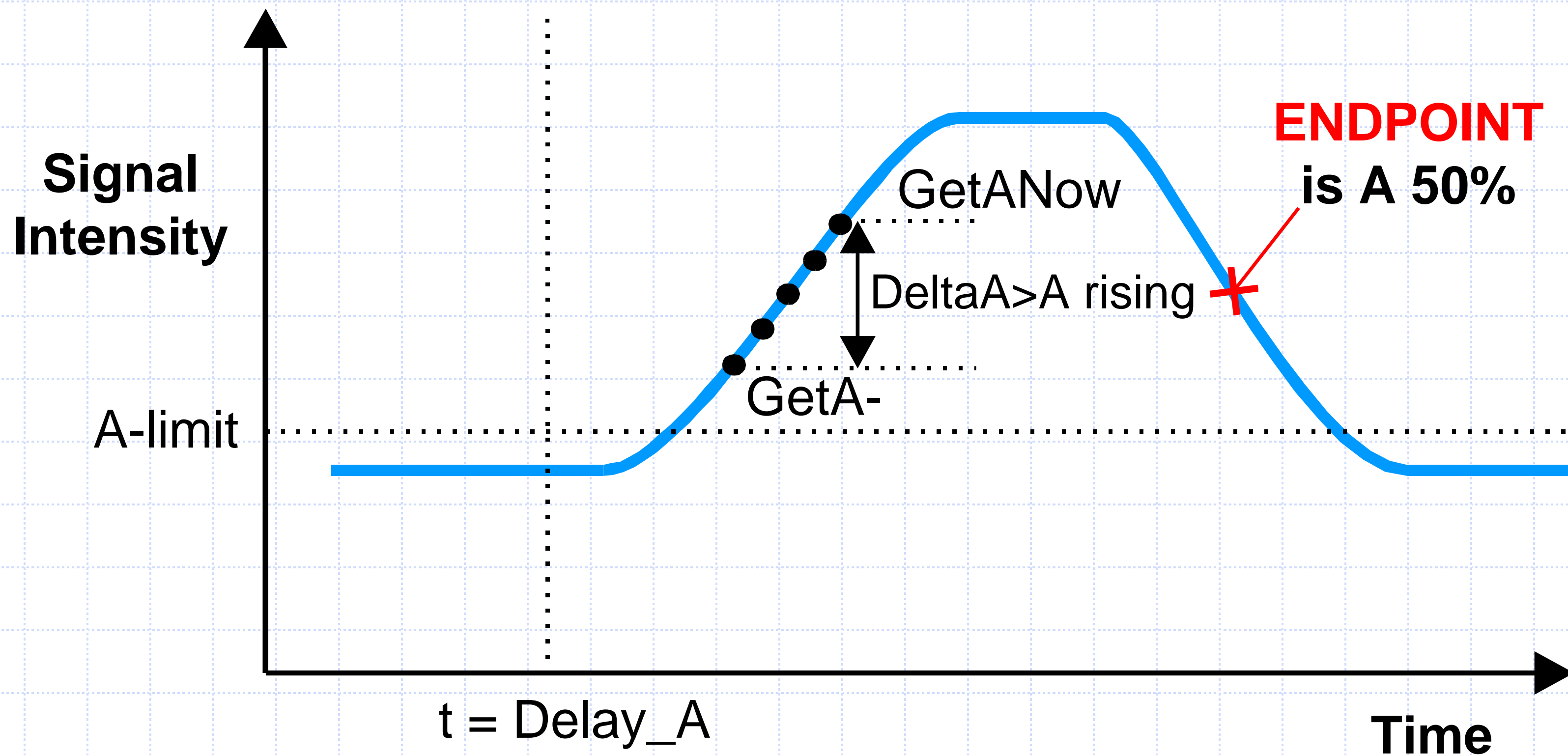
Percentage_OE: An over etch period can be added after endpoint detection as a % of the total milling time. Although the endpoint has been detected the no signal until over etch complete. If the % over etch is > maximum over etch the events log advises the maximum permitted time used instead.

Timed_OE: If the overetch period required is simply a know time, it should be entered here. There are basically three choices for the overetch - percentage, timed or none.

MaxOveretch:This is the maximum permitted over etch time.

HIDEN ANALYTICAL

End point Control:



HIDEN ANALYTICAL

Ion Milling Probe – Field Service.

The IMP replacement modules described below are available for immediate despatch by courier service world-wide.

For warranty repair, modules will be shipped free of charge with only shipping and clearance charges payable, if you have a courier service account number which is authorised for shipping the replacement module please forward to Hiden Analytical Inc. This will expedite the shipping procedure.

If you want Hiden to use its own courier service please send a purchase order to cover the freight and importation charges.

For out of warranty requirements a purchase order to the value of the new replacement module is required before shipment can occur. If the faulty module is returned in exchange Hiden will issue a credit note for you to ensure that you only pay the exchange module price.

Exchange is at Hiden's discretion, if the returned part is damaged beyond repair, exchange refund may be declined.

HIDEN ANALYTICAL

What else does the IMP do ?

- **Target Impurity Determination**

  At the start of the etch the ion milling probe provides high sensitivity SIMS spectra for the identification of impurities from surface and primary ion source contamination.

- **Residual Gas Analysis**

  The integral electron impact ioniser of the IMP allows for operation as a conventional differentially pumped RGA, with software control for leak detection and gas analysis included