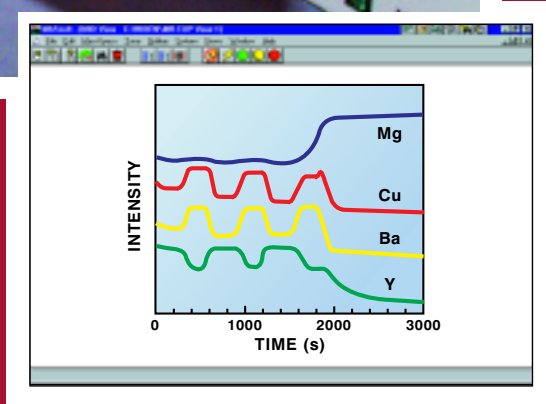
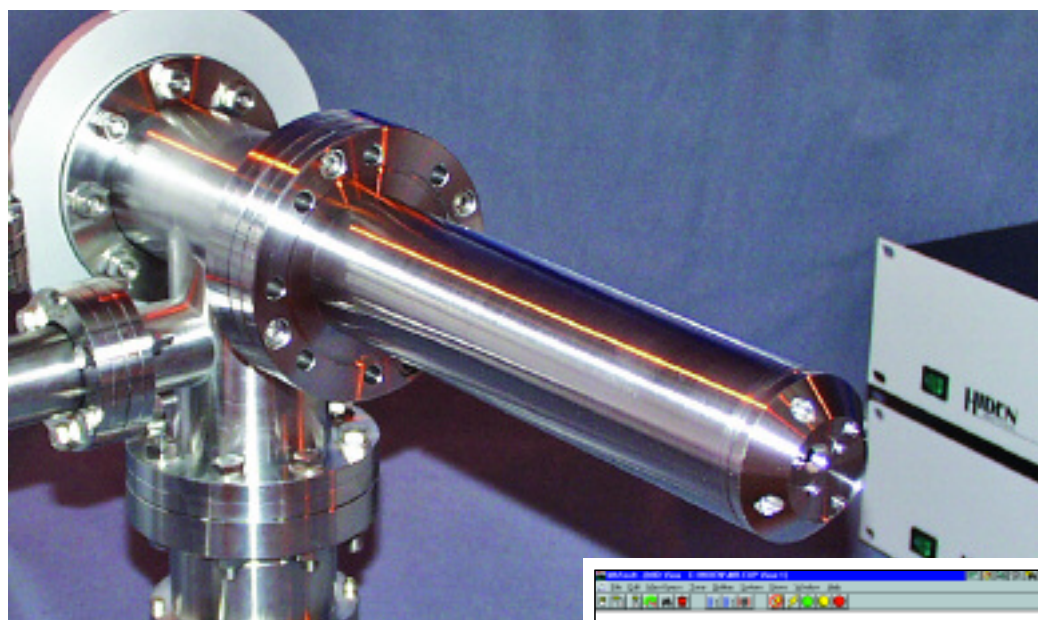


Hidden IMP Series End Point Detectors

Ion Milling Probes for Precise Control in Thin Film Etching Applications



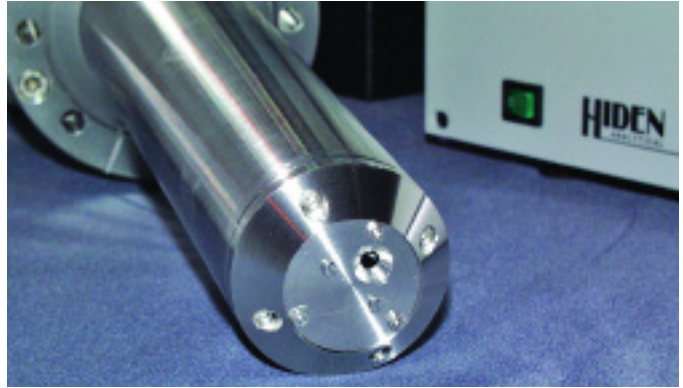
HIDEN

ANALYTICAL

HIDEN IMP SERIES END POINT DETECTORS

Production Control In Ion Beam Etching

Hidden IMP Probes are designed for precise control in Ion Beam Etching applications. Bringing together a high performance quadrupole mass filter, integral electron impact ioniser, compact energy analyser and ion optics for direct analysis of etch process secondary ions; the system provides for routine, user friendly monitoring and control of etch processes.



In-Situ Process Characterisation

The Hidden IMP Probe features Windows™ MASsoft PC software for automatic selection of the etch products from an internal library of device structures. During the milling process ions with a mass which is characteristic of the material to be etched are monitored. The rapid response to step changes in signal intensity of these ions provides for precise determination of end points and material interfaces. Integration with the production tool then ensures reduced undercutting and overetching, maximised feature control and selectivity, and no incomplete etching. Additionally the probe operates as a residual gas analyser for base pressure analysis, process gas monitoring and leak detection.

The Hidden IMP Probe Provides:

- Fast identification of device interfaces
- Enhanced sensitivity for complex multilayer structures
- Auto-Select and recognition of end point species
- Contamination resistant design for increased uptime
- Process control through machine tool integration
- Base pressure residual gas analysis and leak detection

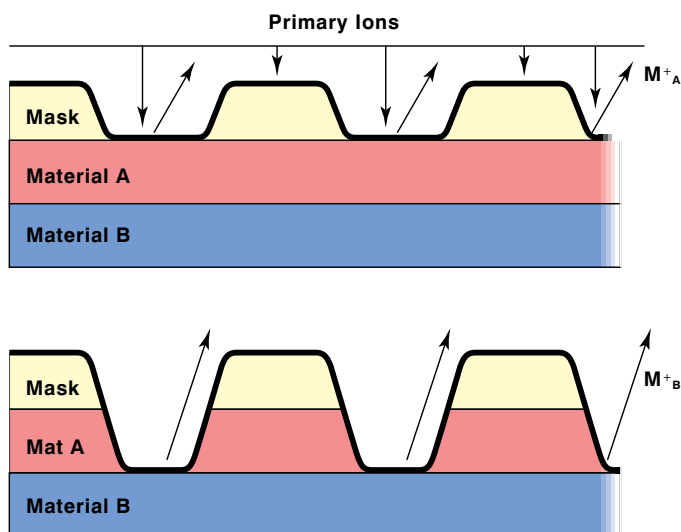
Process Control By Application Specific Outputs

The Hidden IMP Probe features a range of output facilities allowing termination of etching processes to be accurately and precisely controlled.

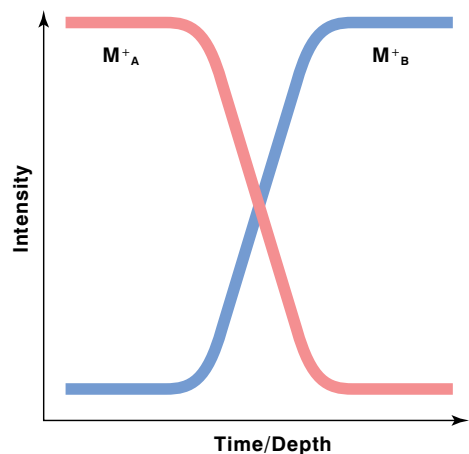
These include:

- Potential free relay contacts
- TTL output channels
- Serial communication ASCII string
- Analog , +/-10 Volt, 12 bit outputs

Multilayered Device Process Monitoring



The intensity of the most significant peaks from the mass spectra are plotted against time in Trend analysis giving real time etch depth information



User-Friendly Software

Hidden's IMP Series operates under the control of Windows™ MASsoft PC software - a powerful, user-friendly package offering extensive data handling and storage capabilities, on-board process statistics, networking and communications options, together with a wide range of intelligent trip controls and I/O facilities.

HIDEN IMP PROBE - TOTAL CONTROL IN DEVICE FABRICATION

Optimised Response For Etch Rate Monitoring

The Ion Milling Probe is used in a wide range of production applications where precise identification of interfaces in multilayer devices is important to maintain, and improve, yields. In new product development, where etch rate and depth profiling are critical to a complete understanding of device performance, system versatility provides for a wide range of complex materials and devices to be evaluated.

On-Board Library Of Etch Products

The control interface and software enable the preferred ion to be automatically selected from our built-in library of interface materials. With the etch products identified the system monitors, and displays, intensity data over time to give a real-time read out of the process status. All information is automatically stored to allow data review, manipulation, statistical analysis and export to other programs.

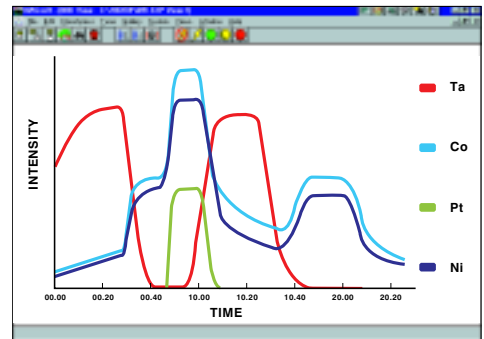
Process Integration For Hands Free Operation

Logic I/O is provided to enable automated operation of the process tool with minimal operator intervention. Data acquisition can be initiated by the process tool and, with the end point reached, etching terminated by the Ion Milling Probe - the whole process completed without the need for manual start/stop.

PERFORMANCE BENEFITS

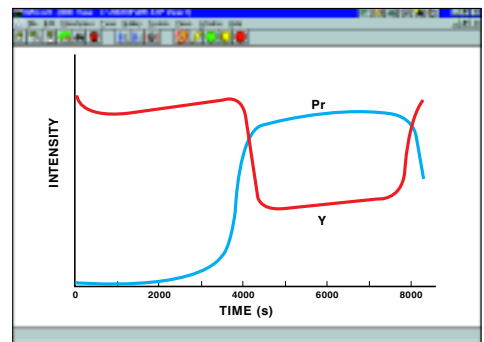
• MR Sensors

In MR and GMR head fabrication Hiden's IMP Probe, specifically designed for cluster tool integration, provides rapid, point-of-use end point detection. Data obtained during the milling of a Ta/NiFe/Pt multilayer structure is illustrated. Each interface is clearly identified and allows milling to be accurately terminated at the desired depth.



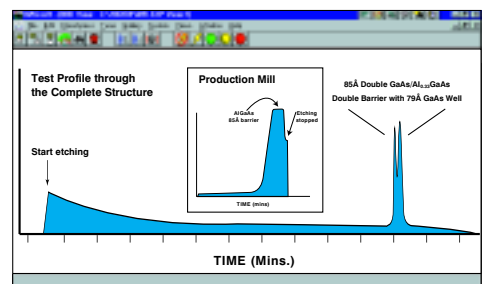
• High Temperature Superconductors

Hiden's IMP Probe provides a reliable method for determining milling depths in the processing of high temperature superconductors. The system is designed to allow differentiation between materials with similar structure and chemical properties (for example $\text{YBa}_2\text{Cu}_3\text{O}_7$ and $\text{PrBa}_2\text{Cu}_3\text{O}_7$). The data illustrates the results of ion beam milling through a $\text{YBa}_2\text{Cu}_3\text{O}_7$ - $\text{PrBa}_2\text{Cu}_3\text{O}_7$ bilayer. Profiles from ionic Pr and Y intensities clearly display the device interfaces.



• III-V Semiconductors

The system is ideally suited to the study of the rapidly expanding range of III-V materials. Providing for precise analysis of multi-quantum well structures, the IMP probe delivers real time device characterisation in a compact, user-friendly, bolt-on package. Data acquired during the milling of AlGaAs/GaAs is displayed. Etching is terminated at the centre of the 79 Å GaAs well, to within ± 5 Å.



Performance Assured

Hiden's IMP Probe provides exceptional etch depth resolution - a resolution limited only by film growth/deposition uniformity. In multi-wafer processing the fast response time of the system also provides for individual wafer monitoring during platen/product tilt and rotation. The data shown was obtained from devices with greater than 99% masking - illustrating the sensitivity of the technique.

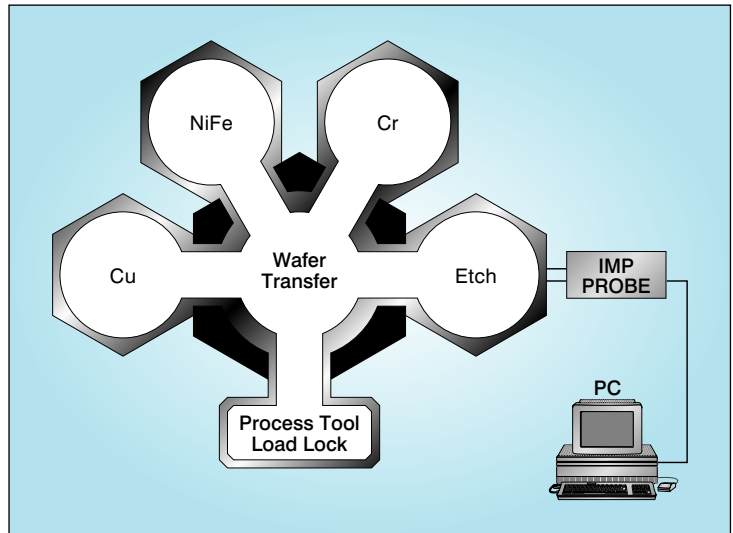
References: Data courtesy of DRA, Malvern, UK.

HIDEN IMP PROBE - COMPACT DESIGN FOR EASE OF INSTALLATION

System Configuration and Chamber Mounting

The Hiden IMP Probe is designed for integration on commercial and development ion beam etching systems. Benefiting from a small footprint, the IMP Series is ideally suited to installation on processing equipment where space is at a premium.

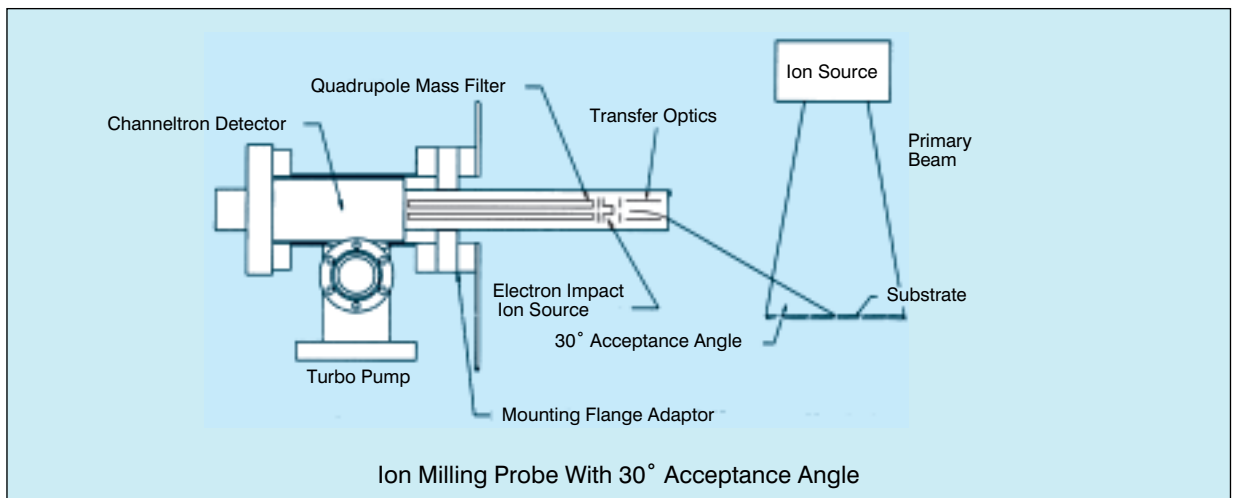
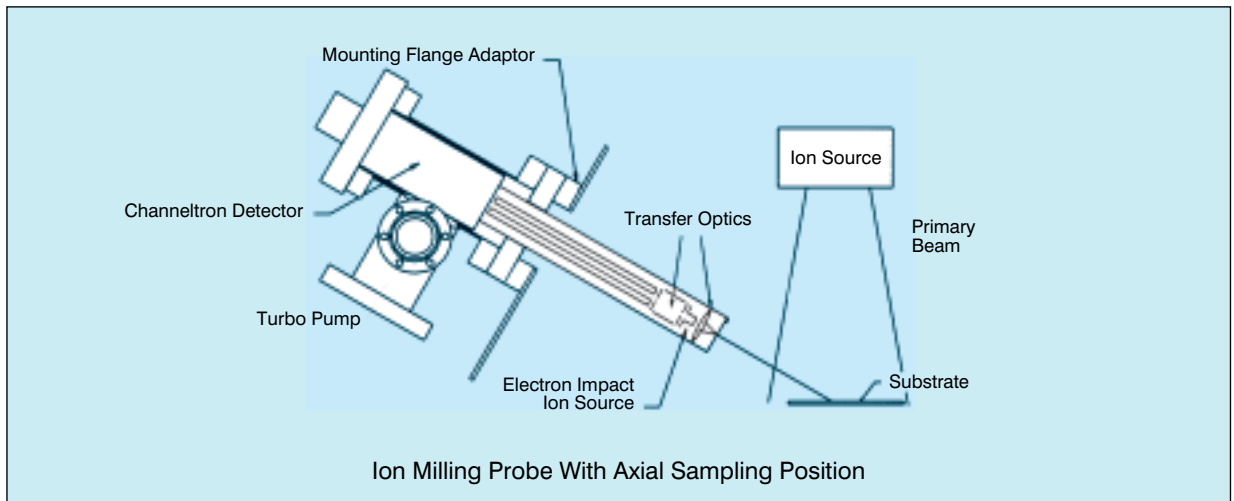
Each instrument is offered with axial and 30° acceptance options, along with linear motion capability, for optimal sampling and positioning in all equipment configurations. With extensive experience in both research and production applications, Hiden provides assured performance in even the most complex multi-layer device fabrications.



Hidden IMP Probe - Precise End Point Detection In Device Fabrication

System Flexibility For Performance Benefits

Two primary mounting configurations provide optimised sampling:



Hidden IMP Probe - Technical Specification and Materials Guide

Materials Guide

The interfaces listed below are examples of those that can be clearly identified using the Hidden IMP end point detector.

INTERFACE	APPLICATION EXAMPLE
Ga/Ni	GaAs etching with Ni mask. Signal identifies Ni mask exhaustion.
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 multilayer Mo/Ge structures.
Al/In	Identification of the interface between two semiconductors AlInAs/InP.
Ga/In	Identification between Ternary (GaInAs), Binary (InP) and Quaternary (GaInAsP) structure by magnitude of the Ga signal.
Ga/In	Detection of individual wells from multiquaternary well structure in InP/30 x (GaInAs/InP) InP.
Al/Ga	Definition of the interface between two layers of AlGaAs separated by a 79 Å GaAs well.
Y/Pr	Identification of the interface between two high temperature superconductor materials YBa ₂ Cu ₃ O ₇ and PrBa ₂ Cu ₃ O ₇ .
Y/Ba/Cu/Mg	Identification of separate layers in multilayer high temperature superconductor materials.
NiCr/Cu/NiFe/SiO ₂	Magnetic disc sensor head manufacture.

Elements identified in the above applications include:

Gallium, Titanium, Silicon, Gold, Chromium, Aluminium, Indium, Molybdenum, Germanium, Yttrium, Praseodymium, Barium, Copper, Nickel, Iron, Platinum.

Technical Specification

Ion Milling Probe

Mass Range :	300.
Mass Filter :	Triple filter assembly.
Energy Filter:	0 to 100 eV.
Ion Source:	Twin filament, radially symmetric, electron impact.
Detector:	Pulse Ion Counting Channeltron.
Dynamic Range:	7 decades.
Sensitivity:	A primary argon ion beam of 2.5 kV, 0.5mA/cm ² onto an aluminium target will yield current at m/e 27 of >10 ⁶ counts/sec. with probe to target distance of 75 mm.
Bake-out Temperature:	250 °C.
Maximum Operating Pressure:	5 x 10 ⁻⁶ Torr without differential pumping. 10 ⁻³ Torr with differential pumping.
Mounting Flange:	DN-63-CF.
Minimum Port Size:	60 mm.

Vacuum System

Pumping:	UHV vacuum manifold with 60 l/s turbomolecular pump set.
Gauges:	UHV Penning with controller including pressure sensing set-point and relay output for fail-safe operation.

System Control

Operating System:	Windows 3.x / Windows 95 / Windows NT.
Communication:	RS232, RS422, RS485, Ethernet LAN.
Inputs/Outputs:	Two 16 bit analog inputs as standard, eight channel input module optional. One 0 to ±10 Volt analogue output as standard, up to sixteen 12 bit outputs optional. Five logic level I/O channels plus two relay outputs included as standard.
Alarms:	Extensive alarm options including high-to-low/low-to-high status indication with message send capability.
Vacuum Protection:	Overpressure monitor for filament protection in RGA mode. External trip input from external pressure gauge for End Point Monitoring.

HIDEN IMP SERIES PRODUCT RANGE

Instrument	Mass Range	Detector	Ion Acceptance Angle	Product Code
HAL IMP/301/3F/PIC/A	300	Pulse Counting	Axial	413020
HAL IMP/301/3F/PIC/B	300	Pulse Counting	30°	413021

Extended ion optics configurations for large process chambers.

VACUUM SYSTEM SPARES AND ACCESSORIES

Component	Product Code
UHV vacuum manifold for differential pumping and probe positioning.	202400
60 l/s UHV turbomolecular pump set for routine processes.	303702
240 l/s UHV turbomolecular pump set for high pressure processes.	303712
Reactive gas pumping set.	303721
Penning gauge with relay output for interlock protection of the IMP Probe.	303805
Pneumatically actuated gate valve for automatic isolation of IMP Probe pumping system during process chamber venting.	3050110
Spare twin thoriated iridium filament pair.	201400

OTHER HIDEN PRODUCTS FOR PROCESS CONTROL IN SEMICONDUCTOR AND THIN FILM APPLICATIONS

Complementing the Hiden IMP Series of end point detectors, Hiden manufacture a complete range of dedicated residual gas analysers and in-situ process gas monitors for total control in PVD, CVD and MBE applications.

- **HAL RC-RGA Series**

Residual Gas Analysers for Precision Analysis in Vacuum Diagnostics

Fast, precise and easy to use quadrupole mass spectrometers for vacuum diagnostics, base pressure fingerprinting and leak detection.



- **HPR-30 Series**

High Performance Process Control Gas Analysers

Direct analysis of production processes in wafer fabrication for real time quality control. Featuring on-line statistics and control chart graphing.



HIDEN PRODUCTS FOR PLASMA MONITORING

- **Hiden EQP**

Plasma Sampling System

High sensitivity mass and energy analyser for precise monitoring of ions, neutrals and radicals in plasma processes.



- **Hiden ESP**

State-Of-The-Art Electrostatic Langmuir Probe

Routine analysis of the primary plasma electrical properties including plasma potential, floating potential, electron temperature, electron density, ion density, electron energy distribution and Debye length.



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It is Hiden Analytical's policy to continually improve product performance and therefore specifications are subject to change.

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