HPR-30 Vacuum Process Gas Analyser

A differentially pumped RGA system for vacuum process monitoring
**HPR-30 vacuum process gas analyser**

- To analyse processes with high dynamic range operating at pressures $>10^{-4}$ Torr it is necessary to pump the RGA with its own pumping group and sample the process through a sampling connection.

- The sampling connection to the process chamber is optimised to maintain fast response time and maximum sensitivity.

- The HPR-30 uses an orifice inserted into the process chamber with a high conductance path from orifice to RGA for monitoring gas composition and contaminants in sputtering, CVD, ALD, MOCVD, PECVD, PVD, evaporation, and optical coatings.
HPR-30 vacuum process gas analyser

• The re-entrant orifice provides for fast response, high sensitivity sampling

• A special high conductance sampling path provides for residual gas analysis when the chamber is at less than $10^{-3}$ mbar, or at base vacuum

• The re-entrant orifice is custom designed for special process monitoring requirements, for both process chamber configuration and process pressure

• Cart mounted system

The HPR 30 system includes a complete turbo molecular UHV pump set and Penning gauge with interlock protection in case of over pressure
The cart mounted design has a small footprint, adjustable height, and is easily moved from process tool to tool.
HPR 30 – Vacuum manifold detail

The leak valve option shown extends the sampling pressure range.
HPR 30 vacuum process gas analyser
The mass spectrometer:

- The Hiden HAL201 RC residual gas analyser is included as standard:
- Mass range: 200 AMU
- Detector: Dual Faraday cup and single channel electron multiplier
- Ion source matched to HPR 30 sampling system
- Data acquisition speed up to 500 measurements per second
- MASsoft PC software

Mass range options: 300 AMU, 510 AMU or 1000 AMU
Mass Spectrometer Interface Unit

- Ethernet TCP/IP, USB and RS232 communication links
- I/O subsystem with:
  - multi protocol RS485 links for external devices, mass flow controllers, CO analyser, total pressure gauges for example
  - 5 channel TTL for process control / automatic start - stop trigger
  - Analogue inputs and analogue signal output options
Mass Spectrometer software – easy start

Pre set modes of operation, templates and full control of mass spectrometers parameters.
Trend Analysis

- Unlimited number of mass channels
- Full mass spectrometer control on a per channel basis
- Automatic mass peak selection from on board user editable library
- Quantitative analysis with user editable algorithms
Mass Spectrometer - mass scanning -1

• Histogram scanning mode

• Extract trend analysis for any mass peak(s) within the scan
• New 4, 6 or 8 decade dynamic range scan
Mass Spectrometer – mass scanning-2

- Peak profile diagnostic mode

- Optimised multistage analysis - configure different analysis for different parts of the experiment
Pre set modes of operation, templates and full control of mass spectrometers parameters.
MS Control

Fully editable scan sequence with selectable:
scan mode, detector and mass spectrometer parameters
set individually for each scan in the sequence.

Events provides control of:
- Alarm set points.
- Data I/O.
- Multiple data functions
  - including:
    - real time display of derived values, ratio, end point, and calibration for example.
HPR 30 vacuum process gas analyser

Data examples

- Pump down Profiles
- Vacuum Diagnostics
- Base Pressure
- Residuals
- Backfill
- Sputter-On
- Bake-Out
- Leak Checking

Trend Analysis of: water, hydrogen, hydrocarbons, CO₂, Ar, N₂ in four titanium nitride deposition cycles.
TiN Deposition: A Wafer Cycle Profile

- TiN Process Endura PVD
- Reagent Gas Levels Monitored
- 8mTorr process pressure
- Ultrapure Ti Target
- 60:40 N$_2$ to Ar

Scan 9: mass 20.00
Scan 8: mass 14.00
Scan 7: mass 15.00
Scan 6: mass 18.00
Scan 5: mass 2.00
Scan 4: mass 40.00
Scan 3: mass 44.00
Scan 2: mass 32.00
Scan 1: mass 28.00

SEM: torr

Hydrocarbon mass 15, N$_2$ mass 14, Ar mass 20
Primary Contaminant Analysis

- Zoom in on the process run data to reveal the primary process contaminants

- Water at 0.1%

- Hydrogen at 0.05%
Low Level Process Contaminants

- Further zoom to examine ppm level contaminants
- In process hydrocarbon background at 100ppm
- CO$_2$ at 120ppm
## Installations the following sites use Hiden Gas Analysis Systems

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Quadrupole Mass Spectrometers for Advanced Science

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