iTrap® by ZEISS
Real time process control for semiconductor processes
ZEISS iTrap
Highly sensitive, fast, robust and compact

The new ZEISS iTrap is a highly sensitive process analyzer based on a Fourier Transform mass spectrometer. It monitors reaction products and chamber health in real time.

ZEISS iTrap is an ideal tool for inline process control and contamination monitoring for process engineers in R&D and production.
Experience creates trust

ZEISS looks back on nearly 50 years of history in semiconductor manufacturing technology. Since 1968, ZEISS has been shaping and driving the era of microelectronics. With our diverse product portfolio, we cover a wide range of key processes in microchip manufacturing, including optical lithography and mask optimization. Our technologies continuously advance the miniaturization of structures on microchips, enabling chip manufacturers to produce microchips that are ever smaller, faster and more energy-efficient.

Our roadmap is drawn for the long term and focuses on the needs of our markets and customers around the globe. We have taken the first step into the future microchip production with EUV lithography. By further developing and optimizing EUV lithography systems we discovered the needs for detecting contaminants in vacuum chambers at extremely low concentration levels. As there were no commercial tools available on the market with adequate sensitivity, speed and robustness, we decided to develop a tool by ourselves: iTrap®.

iTrap® by ZEISS

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iTrap® provides key benefits for process control

**Speed**
Full mass spectrum in ~ 1 sec
- Online process control of etch and deposition processes
- Real time contamination monitoring

**Sensitivity**
Sub-ppb concentration in ~ 1 sec
- Traces of reaction products and contaminants can be monitored where typically off-line analytics had been used so far

**Compactness**
Sensor at the size of an apple
- Sensor can be directly flanged into process tool via leak check port or exhaust line

**Robustness**
No fragile detectors, inert surfaces only
- Sensor is insensitive to \( \text{H}_2 \) and aggressive etch gases, resulting in low maintenance
iTrap® adds value to critical Fab processes

**Chamber Health**
- Preprocess check for contaminants
  - Identify Memory Effects from last Process
    - (Resist depo, resist etch, Dielectric etch, metal depo, Epi, dopants)
  - Detect water from cleanings
  - Detect leakage into chamber
- Preprocess Go or No-Go signal to trigger Maintenance
  - Compare to golden fingerprint spectrum

**Process Control**
- Process check for proper process evolution, including contaminants
  - Correlate to standard process monitoring data such as optical emission signals
  - Process endpoint

**Wafer Health**
- Post-process check for outgassing of reactants

**Process Yield / Uptime / Tool Matching**
- Stop process when outside acceptance range or when endpoint reached
  - Compare to process evolution golden fingerprint
- Stop process when outside acceptance range
  - Compare to golden fingerprint
Versatile configurations matching to your needs

Three configurations are available based on one proven technology platform.

**PGA 1000 vacuum**
- For p < 1E-5 mbar (< 1E-5 torr)
- To be integrated in UHV process chamber (e.g. UHV processes or as add-on detector in analytics tools)

**PGA 1000 atmospheric**
- For pressures up to 1000 mbar (1000 torr)
- To be coupled to your process chamber (e.g. CVD and etch processes)

**PGA 1000 mobile**
- For R&D and process engineers
- Maximum flexibility
- Based on a cart

* PGA = Process Gas Analyzer
Configuration PGA 1000 mobile

iTrap® technology based on a flexible and cleanroom compatible cart for R&D and trouble shooting

Find all relevant information about the ZEISS iTrap in a short video: www.zeiss.com/iTrap/video
Working Principle

Ion Filtering & Detection

- Electron impact (70 eV) generates ions
- Ions are trapped in 3D quadrupole trap by an RF electric field
- Ion oscillation frequency directly relates to m/z ratio
- Metal electrodes detect superposition of electrical signals of all ions
- FFT of electrical signal yields full mass spectrum in a single shot

- Increased sensitivity and dynamics through accumulation of ions
- Ion species can be selectively accumulated and measured, resulting in superior dynamics for trace constituents
- The same ion population can be repeatedly measured to improve S/N ratio

Find all relevant information about the ZEISS iTrap in a short video: www.zeiss.com/iTrap/video
Software
Tailored to your needs

iTrap® features an embedded system, allowing for data processing in **Standalone Mode** without PC. Measurements are self-triggered or triggered remotely by process control systems.

iTrap® can also be controlled directly from a PC by an intuitive graphical user interface:

- All control parameters are accessible on a single screen.
- Both Ion Signal and Mass Spectrum are visible for online analysis.
- Measurements are stored in a session browser within the workspace for immediate access.
- All measurements can be automatically saved and exported.

Log in as a **Manufacturing Engineer:**
- Start / stop pre-defined jobs
- View output data

Log in as a **Process Development Engineer:**
- Modify job sequences
- Generate new jobs
- Analyze data in detail

The “iTrap® Office” package will allow you to do **Offline Analysis** right at your office desk.
Technical Data
Configuration: PGA 1000 atmospheric

<table>
<thead>
<tr>
<th>Type</th>
<th>Ion Trap based Fourier Trap Mass Spectrometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>PGA 1000 atmospheric</td>
</tr>
<tr>
<td></td>
<td>Portable Analyzer, with separate electronics</td>
</tr>
<tr>
<td></td>
<td>rack for transport and control Software</td>
</tr>
<tr>
<td>Mass Range</td>
<td>15..200 amu</td>
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<tr>
<td>Mass Resolution</td>
<td>&gt; 200 m/∆m</td>
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<tr>
<td>Ionization Method</td>
<td>EI (70 eV), W/Ta filament (Y coating optional)</td>
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<tr>
<td>Working pressure</td>
<td>1E-7 mbar or below (internal turbo pump)</td>
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<tr>
<td>inside gas analyzer</td>
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<tr>
<td>Max. Temperature</td>
<td>Up to 150°-200°C (internal temperature)</td>
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<td></td>
<td>Bakeout jacket optional</td>
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<td>Software Config</td>
<td>V16.1</td>
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<tr>
<td>Material Exposed</td>
<td>304L Stainless Steel, 316L Stainless Steel,</td>
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<tr>
<td></td>
<td>Alumina Ceramic Al₂O₃, 98% min., Nickel,</td>
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<td></td>
<td>Copper, Gold, Viton, Wolfram, Tantal</td>
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<tr>
<td>Cable length</td>
<td>Standard 2.5 m between analyzer and 19&quot;</td>
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<tr>
<td></td>
<td>electronics rack</td>
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<tr>
<td>Weight</td>
<td>Sensor head &lt; 50 kg, including turbo pump,</td>
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<tr>
<td></td>
<td>excluding cables and separate electronics</td>
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<tr>
<td></td>
<td>rack</td>
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<tr>
<td>Certification</td>
<td>CSA and CE</td>
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<td>Cleanroom Compatibility</td>
<td>Yes</td>
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</tbody>
</table>

**INPUT interfaces**
- Analyte gas: 1E-3 mbar...1000 mbar input, CF or VCR ¼” fitting, closest possible to chamber
- Pressurized Air: 7.2 bar abs
- Power Supply: 115 V / 220 V, 60 Hz, 250 W (max 2000 W during bakeout)
- Optional: calibration gas, purge gas

**OUTPUT interfaces**
- Forevacuum by dry pump (to be provided by customer)
- Data: Ethernet
- Heat: approx. 300 W to ambient

**Dry Pump**
- To be provided by customer, pumping speed ≥ 5 cbm/h, p ≤ 0.1 mbar, interface KF16

**Cooling**
- Air cooling of Turbo and electronics

**User interface**
- ZEISS Software GUI on customer’s PC (to be provided by customer)

**User Output**
- Mass spectrum in ASCII

**PC**
- To be provided by customer, 64 Bit Operating System Windows 7, RAM ≥ 16 GB, Hard disk ≥ 1 TB, CPU Intel i5 or better, Ethernet access recommended; remote access to PC recommended
ZEISS Semiconductor Mask Solutions
Competence Centers and Distributors

About ZEISS
ZEISS is an internationally leading technology enterprise operating in the optics and optoelectronics industries. ZEISS develops and distributes semiconductor manufacturing equipment, measuring technology, microscopes, medical technology, eyeglass lenses, camera and cine lenses, binoculars and planetarium technology. With its solutions, the company constantly advances the world of optics and helps shape technological progress. ZEISS is divided into the four segments Semiconductor Manufacturing Technology, Research & Quality Technology, Medical Technology and Vision Care/Consumer Optics. ZEISS is represented in over 40 countries – with around 30 production sites, over 50 sales and service locations and about 25 research and development facilities.

About Semiconductor Manufacturing Technology
With a broad product portfolio and globally leading know-how in the areas of lithography and optical modules, the business group covers key processes in microchip production. Semiconductor Manufacturing Technology includes three business units: the Semiconductor Manufacturing Optics, the Process Control Solutions and Semiconductor Mask Solutions. It is headquartered in Oberkochen. During fiscal year 2015/16 this segment generated revenue of €972 million and employed around 2,700 people.

For more information please visit us at www.zeiss.com/iTrap
Control your process.

ZEISS iTrap