Control your process.
In real time.

iTrap® by ZEISS

www.zeiss.com/iTrap
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 trouble shooting when integrated with a production chamber, but also for process analytics in an R&D environment.
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® provides key benefits for process control

**Speed**
Mass spectrum in ~ 0.5 sec

- Online process control of etch and deposition processes
- Real time contamination monitoring

**Sensitivity**
ppb concentration in ~ 0.5 sec

- Traces of reaction products and contaminants can be monitored where typically off-line analytics had been used so far

**Compactness**
3D ion trap at the size of an apple

- Sensor can be directly flanged to process tool via leak check port or exhaust line

**Robustness**
No fragile detectors, inert surfaces only

- Sensor is insensitive to H₂ and aggressive etch gases, resulting in low maintenance
iTrap® enables process analytics and advanced process control

Real time full mass spectral information from iTrap®

Process Analytics and Trouble Shooting
- Evaluate etch byproducts to optimize chemistry selection
- Watch real time evolution of etched species for process development
- Identify run-to-run and wafer-to-wafer variations
- Identify Memory effects from unefficient cleans
- Assess size of process window by response of mass spectra to parameter variation

Chamber Health
- Evaluate effectiveness of pre/post cleans in eliminating contaminant species e.g. metal halides
- Identify mismatched chambers and do root cause analysis faster
- Monitor byproducts to predict chamber lifetime ahead of inline signals
- Investigate atmospheric leaks and changes in incoming gas purity and composition

Process Control
- Call Change Point of Critical Etch Processes based on mass spectra changes
- Call End Point of cleans to guarantee efficient cleaning and minimize process time
- Proactively guard against leaks and changes in gas composition

Product configuration with max. flexibility for R&D and trouble shooting

Product configuration for direct integration with a process chamber
Versatile configurations matching to your needs

Three configurations are available based on one proven technology platform.

1. **PGA 1000 vacuum***
   - For \( p < 1 \times 10^{-6} \) mbar (< 1E-6 torr)
   - To be integrated in UHV process chamber
     (e.g. UHV processes or as add-on detector in analytics tools)

2. **PGA 1000 atmospheric**
   - For pressures from \( P \leq 10^{-3} \) mbar (standard) up to atmospheric pressure (optional, advanced gas inlet package)
   - To be coupled to your process chamber
     (e.g. CVD and etch processes)

3. **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

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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:

**Graphical User Interface**
- simple, intuitive, efficient
  - 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
- Export data for further data analysis
## 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 rack for transport and control Software</td>
</tr>
<tr>
<td>Mass Range</td>
<td>15–200 amu</td>
</tr>
<tr>
<td>Mass Resolution</td>
<td>&gt; 200 m/Δm</td>
</tr>
<tr>
<td>Ionization Method</td>
<td>EI (70 eV), W/Ta filament (Y coating optional)</td>
</tr>
<tr>
<td>Working pressure</td>
<td>1E-6 mbar or below (internal turbo pump)</td>
</tr>
<tr>
<td>inside gas analyzer</td>
<td></td>
</tr>
<tr>
<td>Max. Temperature</td>
<td>Up to 150°C–200°C (internal temperature)</td>
</tr>
<tr>
<td></td>
<td>Bakeout jacket optional</td>
</tr>
<tr>
<td>Software Config</td>
<td>V19.1</td>
</tr>
<tr>
<td>Material Exposed</td>
<td>304L Stainless Steel, 316L Stainless Steel, Alumina Ceramic Al₂O₃, 98% min., Nickel, Copper, Gold, Wolfram, Tantal</td>
</tr>
<tr>
<td>Cable length</td>
<td>Standard 5 m between analyzer and 19” electronics rack</td>
</tr>
<tr>
<td>Weight</td>
<td>Sensor head &lt; 50 kg, including turbo pump, excluding cables and separate electronics rack</td>
</tr>
<tr>
<td>Certification</td>
<td>CSA and CE</td>
</tr>
<tr>
<td>Cleanroom Compatibility</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### INPUT interfaces
- Analyte gas: 1E-3 mbar...1000 mbar input, CF or VCR ¼” fitting, closest possible to chamber
- Pressurized Air: 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 cfm/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 HDF5 format

### 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 – An internationally leading enterprise

ZEISS is an internationally leading technology enterprise operating in the fields of optics and optoelectronics. In the previous fiscal year, the ZEISS Group generated annual revenue totaling more than 5.8 billion euros in its four segments Industrial Quality & Research, Medical Technology, Consumer Markets and Semiconductor Manufacturing Technology (status: 30 September 2018).

For its customers, ZEISS develops, produces and distributes highly innovative solutions for industrial metrology and quality assurance, microscopy solutions for the life sciences and materials research, and medical technology solutions for diagnostics and treatment in ophthalmology and micro-surgery. The name ZEISS is also synonymous with the world’s leading lithography optics, which are used by the chip industry to manufacture semiconductor components.

With approximately 30,000 employees, ZEISS is active globally in almost 50 countries with around 60 of its own sales and service companies, more than 30 production sites and around 25 development sites.

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