Ultra High Precision Components
for semiconductor equipment

- Miniaturized Sensors
- 6-Axis Nanopositioning
- Stage Displacement Measurement
Semiconductor manufacturers face the challenge to produce ever more efficient and dense chips. All involved steps - from production to quality assurance - share one precondition: to ensure highest precision and reliability to maximize the quality output.

Involved devices need to be compatible with extreme conditions such as clean room environments, elevated operating temperatures, or vacuum conditions. attocube’s high precision components meet these demands and offer cutting-edge technology for semiconductor applications.

**Lithography Process**
- Ultraprecise Position Tracking
- Dynamic Motion Control
- Beam Aperture & Filter Positioning

**Metrology & Inspection**
- Laser Beam Adjustment
- Planarity Detection
- Beam Aperture & Filter Positioning
Motion & Sensing
ultra-precise devices for semiconductor applications

attocube offers ultra precise nanopositioning and interferometric measurement devices, which are compatible with extreme environmental conditions such as high vacuum, clean room environments or elevated operating temperatures.

Years of experience and a dedicated application team guarantees highest levels of consulting competence, a comprehensive on-site installation service and excellent after-sales support for standard products as well as customized OEM solutions.

Nanopositioners
- vacuum compatibility down to $5 \times 10^{-11}$ mbar
- max. operating temperature 100°C
- 0.01 ångstrom resolution
- working distance up to 5 m

Interferometer
- vacuum compatibility down to $1 \times 10^{-10}$ mbar
- max. operating temperature 150°C
- 0.01 ångstrom resolution
- working distance up to 5 m

Services & Certifications
your reliable OEM partner

Testing Facilities & Quality Assurance
For more than 15 years attocube designs components for extreme environments. Our quality assurance is equipped with test stations for low temperature, ultra-high vacuum and ambient conditions.

Application Development & Expert Support Team
attocube’s application team consists of experts with a vast engineering background who help our customers in selecting and integrating motion and sensing components into their systems.

Lean Production
Made in Germany
The complete supply chain is directed towards the lean production organization that enables short delivery times, flexibility and high quality for the production of customized systems as well as high quantities.

Traceability of Sensing & Motion Components
Thanks to our sensor technology that is traceable to the NIST and to the PTB, we offer systems for Motion & Sensing that are calibrated to international metrology standards.

Your reliable OEM partner
Application/Challenge:
attocube’s laser interferometer IDS3010 with vacuum and high temperature compatible sensor heads can be easily integrated into lithography machines, ensuring the best alignment among the key components with nanometer accuracy, delivering high speed data with up to 10 MHz bandwidth.

attocube’s Solution:
attocube’s laser interferometer IDS3010 with vacuum and high temperature compatible sensor heads can be easily integrated into lithography machines, ensuring the best alignment among the key components with nanometer accuracy, delivering high speed data with up to 10 MHz bandwidth.

Product:
Displacement Sensor IDS3010
• 10 MHz bandwidth
• 2 m/s target velocity
• real-time

Sensor Heads
• vacuum compatible
• pluggable
• compatible with different targets

Ultraprecise Position Tracking

During the photolithography process circuit patterns of few nanometers in size are transferred from the photomask (reticle) via various lenses onto the semiconductor wafer. After the photomask pattern is projected to one part of the wafer, the wafer stage is moved and the lithography process is repeated until the whole wafer is covered with the respective patterns. The ultraprecise position tracking and alignment of measurement frame, optics and wafer stage is key condition to ensure highest quality throughout the lithography process. All components used in this process need to meet the requirements of clean room conditions and - depending on the technology - be capable to perform under vacuum and high temperature environments.
Dynamic Motion Control

Challenge:
Reticle and wafer stages need to perform long stroke movements of up to several meters that are both fast and precise. Any measurement device for motion control has to be an order of magnitude more precise and fast than the process itself.

attocube’s Solution:
attocube’s laser interferometer IDS3010 enables metrology tools to achieve the required precision at nanometer range over long distances up to 5 meters with a target velocity of up to 2 m/s.

Product:
Displacement Sensor IDS3010
- long distance
- miniaturized sensor heads (1.2 mm)
- application specific design

Sensor Heads
- travel ranges up to 5 m
- 2 m/s target velocity
- low electric noise level

Lithography Process
- Dynamic Motion Control
attocube’s laser interferometer IDS3010 is capable of measuring directly on the wafer or on mirrors to capture deformations in nanometer range. The miniaturized design of the sensor heads allows to measure the deformation at several places on the same wafer to detect more-dimensional deformations. It can be used under extreme environmental conditions such as vacuum or other harsh environments.

**Challenge:**
During the lithography and metrology processes the wafer is exposed to extreme environments, fast motions and multi-dimensional forces. These could cause elastic or plastic deformation of the wafer which influences the wafer’s planarity. Uneven wafers reduce the accuracy of lithography processes and distract results of metrology analyses. For example the movement of wafer stages working with magnetic levitation deforms in direction perpendicular to the flat surface of the plate. The operating status of the wafer stage motor influences the level of deformation. To optimize the operation mode of wafer stages and therefore reduce the wafer deformation during lithography process, a nano-precise and contactless detection of wafer deformation is required.

**attocube’s Solution:**
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**Product:**
Displacement Sensor IDS3010

- **Certified accuracy in nanometer range**

**Sensor Heads**
- Vacuum compatible
- Pluggable
- Compatible to different surfaces (wafer, mirrors, polished metal...)
Challenge:
attocube’s nanopositioners are designed to operate with low particle generation at high temperatures and vacuum with nanometer precision. These features make them the perfect choice for reliable aperture control under extreme conditions.

In lithography and metrology processes, the precise alignment and filtering of the beam is directly related to the wafer’s quality. The laser beam produces photons that are collected via a gathering mirror and directed via different apertures to hit, e.g. the reflection mask.

attocube’s Solution:
Beam Aperture & Filter Positioning

Product:
Nanopositioners
- nanometer precision
- UHV compatibility up to \(5 \times 10^{-11}\) mbar
- coarse & fine movement

Metrology & Inspection
Lithography Process
- Accurate Beam Aperture & Filter Positioning

attocube’s nanopositioners are designed to operate with low particle generation at high temperatures and vacuum with nanometer precision. These features make them the perfect choice for reliable aperture control under extreme conditions.
Challenge:
attocube's nanopositioners are used in critical, ultra-precise motion applications due to the superior accuracy, repeatability and resolution. These unique features together with high reliability are providing a solution for a continuous and stable beam alignment within the metrology process.

Laser Beam Adjustment

During the metrology process in the wafers production the light or laser beam path have to be precisely and continuously adjusted to perform the relevant controls over the whole wafer surface in order to detect imperfections and provide certain results on the wafer’s quality. There are different kind of inspections: Un-patterned wafer inspection where the goal is to identify particles and pattern defects and link those to a specify position on the wafer. Patterned wafer inspection which identifies geometry imperfections via the comparison with a “golden” dye and lastly the reticle inspection which helps to identify single defects on a wafer reticle. This last inspection is usually performed by using UV illumination.

attocube’s Solution:
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Product:
Nanopositioners
- high stability
- goniometer resolution 1 u°
- rotator resolution 10 u°
The continuous increase of ultra precise motion control in the semiconductor equipment makes the IDS3010 (Interferometric Displacement Sensor) the perfect choice for industrial manufacturers in the industry. attocube’s laser interferometer provides miniaturized sensor heads, suitable for harsh environment with extreme accuracy and resolution down to pico-meter level. This is the outstanding combination for easy integration within semiconductor machines thanks to a broad spectrum of digital and analog real-time interfaces and protocols to deliver simple transmission of position data.

**Fast, precise & powerful**
- data capturing rate of 10 MHz
- measurements with target velocities of up to 2 m/s
- working distances up to 5 m
- 1 pm resolution

**Compact & robust sensor heads**
- smallest diameter 1.2 mm
- pluggable or clamped
- vacuum compatibility up to 5e-11 mbar
- temperatures up to 150°C

**Adaptable modules & components**

**Options for accessing the IDS via computer**
- Measurement
- Software WAVE
- Webserver
- DLLs (C, C#, Labview, Matlab)

**Realtime output-signals:**
- Sin/cos
- HSSL
- Linear analog
- AquadB
- BISS-C

**Mounting**
- cylinder or metric thread from 1.2 mm diameter to M15.5 x0.5 metric thread

**Fiber connection**
- clamped on fiber or pluggable FC/PC

**Optics type**
- focusing, divergent or collimating

**Customization**
- dedicated focal length
Ultraprecise Nanopositioners
piezo based nanopositioners for ultra clean environment

Due to the need of highest accuracy in the semiconductor market, attocube combines its superior precision positioning technology with unrivaled compact and low-particle generating design to fit in any high complex system. Moreover attocube’s nanopositioners offer flexible stacking for motion with multiple degrees of freedom suitable for a wide range of extreme environments.

Extreme Environments
attocube’s nano drives meet the challenge of precise positioning systems, reliably working under extreme environmental conditions. Suitable models are available for high temperature, high and ultra high vacuum.

Every positioner is tested in it’s mentioned environment to ensure reliable functionality in any critical situation.

Compact, precise, & powerful
attocube’s positioners employ a powerful and precise nano drive in a compact frame for easy integration into customer setups.

Footprint
• From 15 x 15 mm²

Dynamic Force
• up to 8 N

Resolution
• down to 1 nm

Flexible positioning
attocube’s positioners can be stacked to multi-axis devices with up to 6 degrees of freedom.

Rotation

Goniometer

Linear Positioner

UHV Pressure
• down to 5 x 10⁻¹¹ mbar

High Temperature
• up to 100°C