

Atomic Layer Deposition Tool SI ALD

Conformal, pinhole- and particle-free,
nanoscale controlled deposition

Combined thermal
and plasma enhanced ALD

True remote plasma source

ALD



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durch Leistung

Atomic Layer Deposition layer-by-layer deposition method

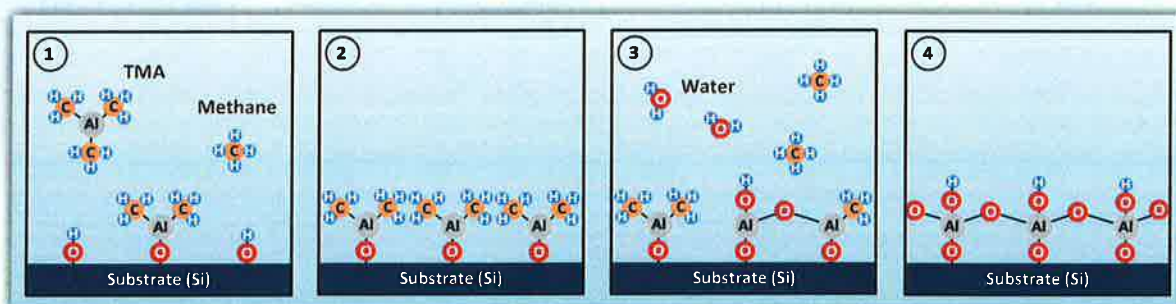
The Atomic Layer Deposition (ALD) method facilitates precise control of layer thickness by adding precursors in separate steps into the vacuum chamber during process cycle. As a result, in contrast to common CVD or PECVD methods, ALD allows the deposition of ultra-thin pinhole- and particle-free films of a few nanometers with excellent uniformity and very good conformity on 3D structures.

Highly reliable magneto-pneumatic loadlock for precise and repeatable positioning of wafers up to 200mm



Atomic Layer Deposition system SI ALD LL with true remote plasma source and loadlock

The SENTECH ALD system is especially suited for nanotechnology and micro-system applications, inorganic and organic semiconductor engineering as well as device passivation.



ALD cycle using trimethylaluminium (TMA) and water:

1. TMA chemisorption
2. Purging cycle
3. Water chemisorption
4. Purging cycle

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PEALD system for thermal and plasma based processes

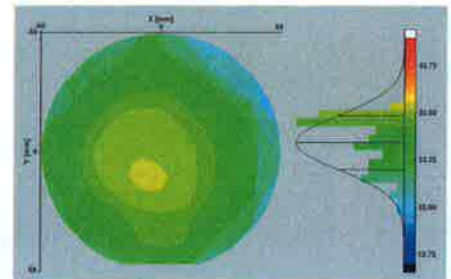
Applications:

- Passivation layers for electronic devices
- Diffusion barriers for organic materials
- Passivation of silicon solar cells
- Adhesion layers
- Highly conformal coating on 3D structures
- High k materials
- Optical coatings
- Diffusion layers
- Anti-corrosion layers
- Functional layers for nanotechnology
- Biomedical applications

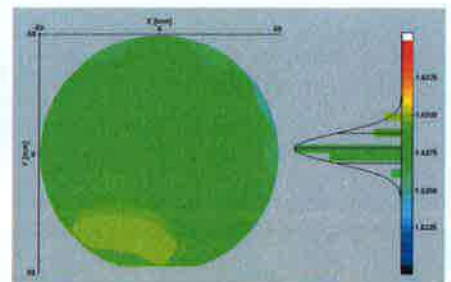
The ALD system is designed for a wide range of deposition modes and processes using flexible system architecture. It can be upgraded with more precursor and gas lines, high vacuum pumping unit, in-situ monitoring by SENTECH ellipsometer, and further options. SENTECH atomic layer deposition system SI ALD enables the deposition of several oxides (e.g. Al_2O_3 , ZnO , ZrO_2) on wafers of up to 200mm diameter. Outstanding features are the compact design, the loadlock, the flexibility of software and hardware, the inline monitoring by SENTECH ellipsometer, and the compatibility to the SENTECH plasma cluster tool.

In addition to thermal ALD processing, the system can be extended with a plasma source to enable low temperature processes. The Plasma Enhanced Atomic Layer Deposition (PEALD) system uses radical gas species rather than water as oxidizer during the deposition process. A Capacitive Coupled Plasma (CCP) source is attached as true remote source to the upper flange of the reactor with no direct line of sight to the sample.

PEALD Al_2O_3 deposition with trimethylaluminum (TMA: $\text{C}_3\text{H}_7\text{Al}$) and plasma generated atomic oxygen (O) at 200°C substrate temp. on 4" silicon wafer:

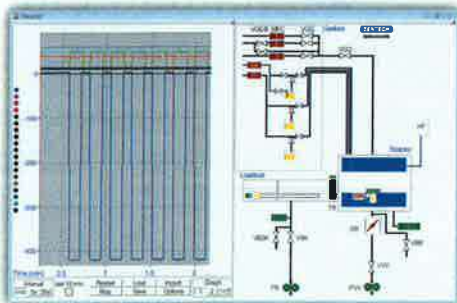


Thickness homogeneity of $33.3\text{ nm} \pm 0.25\text{ nm}$



Refractive index variation at 632.8 nm of 1.627 ± 0.0025

SENTECH plasma process system operation software – Mimik diagram of the reactor and data logging of the deposition process are shown.



SENTECH software for process control

The ALD system is controlled by an advanced hard- and software with client-server architecture. The user-friendly software interface enables quick and comfortable process development by optimized parameter setting, a powerful recipe editor, data logging, and extended user management.

Reactor chamber with substrate electrode (red), precursor cabinet (yellow), gas line (green), vacuum pump system (cyan), optional single wafer vacuum loadlock (blue), and CCP source (violet).



Atomic Layer Deposition System SI ALD

Configuration

ALD system for the deposition of ultra-thin films with direct load or vacuum loadlock, roughing pump, mains connection box, substrate electrode for 2"-8" wafers or pieces (on carrier), 300W RF power supply, one gas line, two precursor lines, substrate electrode and reactor wall temperature of up to 400°C/150°C, and SENTECH plasma process system operation software (Windows 7 based).

System Options

CCP source extension for PEALD
Additional precursor lines (heated, not heated)
Additional gas lines
Electrode temperature up to 500°C (above 500°C on request)
Turbo pump
Vacuum loadlock
In-situ monitoring
Cluster configuration



Utility requirements

Power	3 x 400 V \pm 5%, 32 A, 50 Hz
Compressed air	6 bar (oil and water free)
Nitrogen	3-4 bar, 25 litres per run (purge gas depending on pump)
Exhaust	DN 40 KF/DN 25 KF (processed gas) \varnothing_A 80 mm (gas box)

Ordering information

SI ALD	Atomic Layer Deposition system for direct load
SI ALD LL	Atomic Layer Deposition system with single wafer vacuum loadlock
SI PEALD LL	Plasma Enhanced ALD system with single wafer vacuum loadlock

Technical details and specifications are subject to change without notice.

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Distributors:

In situ monitoring ALD Real Time Monitor

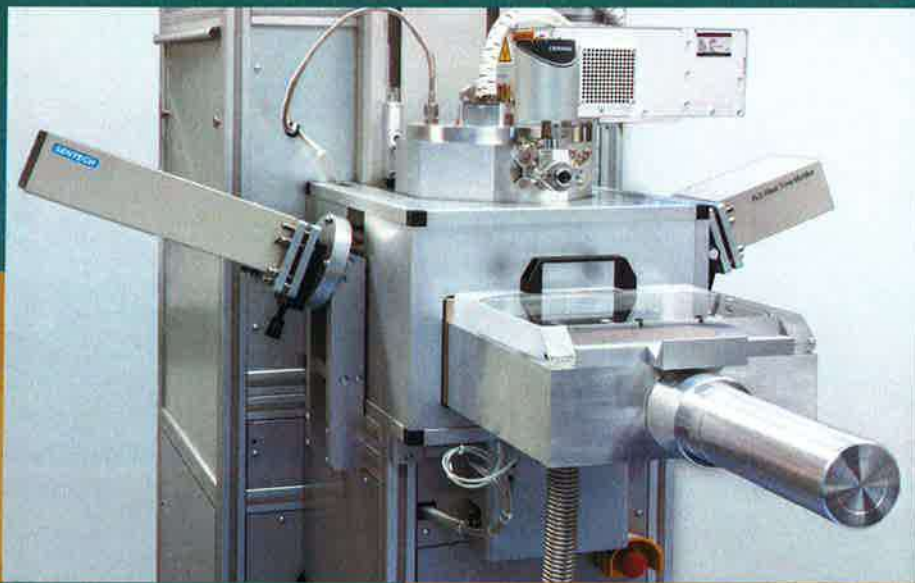
Real time monitoring of ALD process
directly on sample surface

Fast process optimization

Short development time

Easy operation

ALD



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ALD Real Time Monitor

In situ monitoring

- Real time monitoring of ALD process directly on sample surface
- Fast process optimization
- Short development time of new processes
- Easy operation

Product features

The SENTECH **ALD Real Time Monitor** is a novel optical diagnostic tool allowing ultra-high resolution of single ALD cycles. Analysing growth properties without breaking the vacuum, developing new processes in short time, and studying reaction mechanisms during ALD cycles in real time are main applications of SENTECH **ALD Real Time Monitor**.

The SENTECH **ALD Real Time Monitor** analyses the growth of the ALD film directly on the sample surface. The high measurement speed of 40 ms allows studying adsorption and desorption processes within single ALD cycles. The increase of film thickness between consecutive ALD cycles is directly measured. For the deposition of absorbing films computer controlled shutters are available on SENTECH ALD systems.

The innovative **ALD Real Time Monitor** is especially designed for fast and effective ALD process development and optimization. The **ALD Real Time Monitor** enables 10 times faster process developments than typically required. Development time, substrates and gases are saved.

The **ALD Real Time Monitor** is fully integrated in the SENTECH plasma equipment operating software. Recipe based easy operation and customized set-up of the measurement cycles allow the synchronization of real time monitoring and ALD process.

Configuration

- ALD chamber mount
- Wired connection to the ALD process controller
- Controlling through state of the art PC/ notebook
- Operation software package
- Remote interface

Technical Specifications

Optical setup:

Highly stabilized phase sensitive polarimeter for highest signal to noise ratio and self-calibrating capability

Measurement time:

Typ. 40 ms
Min. 25 ms

Precision of film thickness measurement:

0.1 Å

Measurement wavelength:

632.8 nm HeNe laser

Diameter of laser beam:

1 mm

Mounting flanges, shutters, and windows:

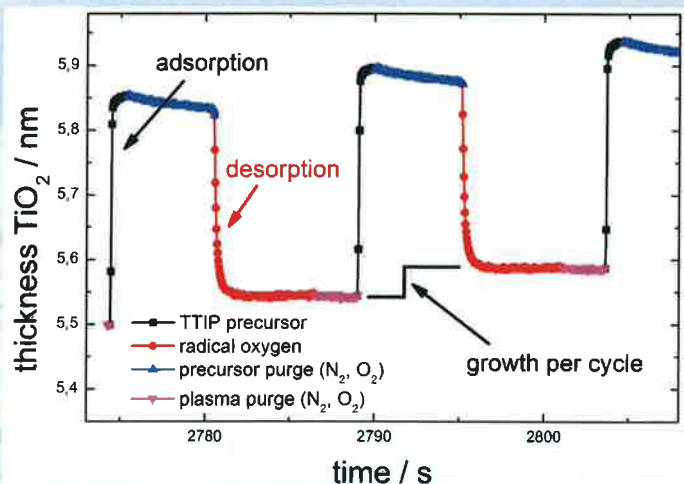
The operation of the **ALD Real Time Monitor** at SENTECH ALD tools requires the option "SI-ALD flange" which includes shutters and windows.

Setup:

Automatic calibration, including self-test

Software:

Windows 7 based SENTECH operation software



In situ monitoring of adsorption and desorption during ALD cycles with SENTECH **ALD Real Time Monitor**

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