ALD Solutions for Industrial Manufacturing

Picosun Brochure 2014

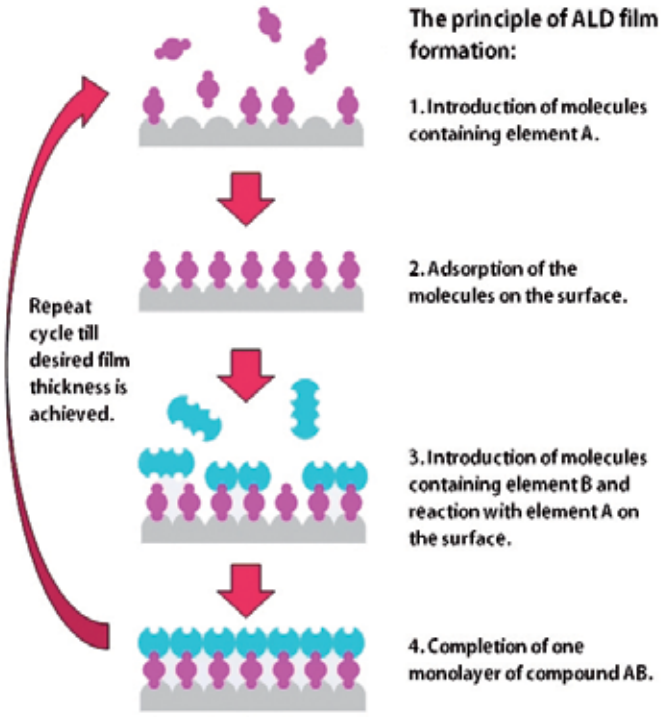
Picosun

Atomic Layer Deposition – Enabling the future

Atomic Layer Deposition (ALD), the most advanced thin film coating method, has been shaping future technologies since its invention.

Today, ALD is everywhere.

ALD enables the continuous miniaturization of electronic component size, realizing our modern everyday items such as smartphones and laptop computers. At the same time, ALD is rapidly breaking through in completely new industries at increasing speed – from future lighting devices and protective coatings on coins to spearheading medical technology and advanced energy storage solutions.



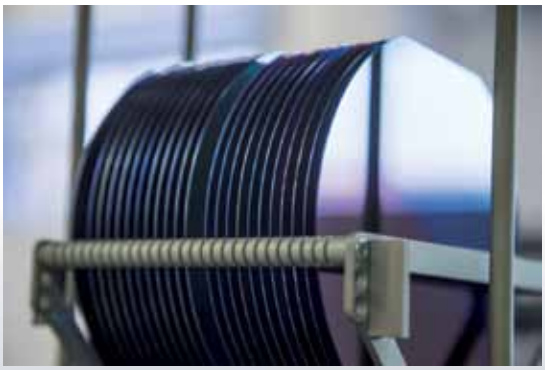
ALD films are a crucial element in semiconductor and integrated circuits (IC), MEMS (MicroElectroMechanical Systems), and sensor manufacturing. Other central applications are found in LED/OLED lighting, optics and optoelectronics, antitarnishing (e.g. coins), corrosion and wear protection, catalyst manufacturing, clean and renewable energy technologies, water purification, decorative coatings (e.g. watches), medical implants, and innovative packaging materials.

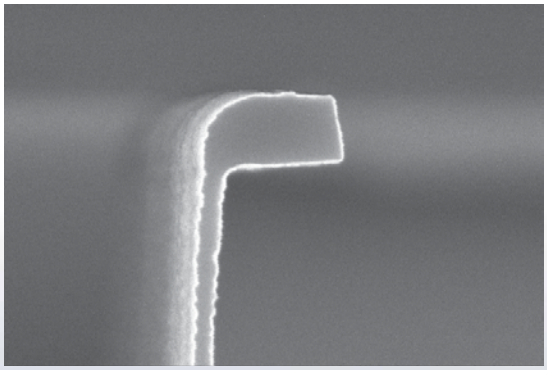
No matter what industry, ALD can realize completely new products or bring plenty of added value to existing ones.

Unlike any other thin film coating technology, ALD is based on chemical interactions between the substrate surface and the precursor vapor molecules. In ALD, the gaseous precursors only react at the surface – the film grows "up" from the surface by consecutive atomic layers, as illustrated in the figure on the left. Due to this surface controlled, self-limiting nature of the film growth, ALD ensures 100 % uniform, conformal, defect-, crack- and pinhole-free thin films with exact control over the film thickness and composition.

ALD coats everything from large substrates, such as planar or 3D objects, silicon wafers, and glass or metal sheets, to the very smallest of substrates, including tiny particles and powders. Regardless of feature size and shape, the film covers evenly every detail of the surface down to the nanometer level. ALD is also the only method by which high aspect ratio trenches such as through-silicon-via structures or through-porous samples such as microchannel plates can be successfully processed.

The selection of ALD materials widens constantly, covering an already large variety of thin film materials, e.g. metal oxide, nitride, sulfide, fluoride, and pure metal films – even noble metals such as platinum, gold, and silver are available. Because the film grows by one atomic layer at time, advanced structures such as nanolaminates, graded layers, mixed oxides, and doped thin films can also be manufactured.

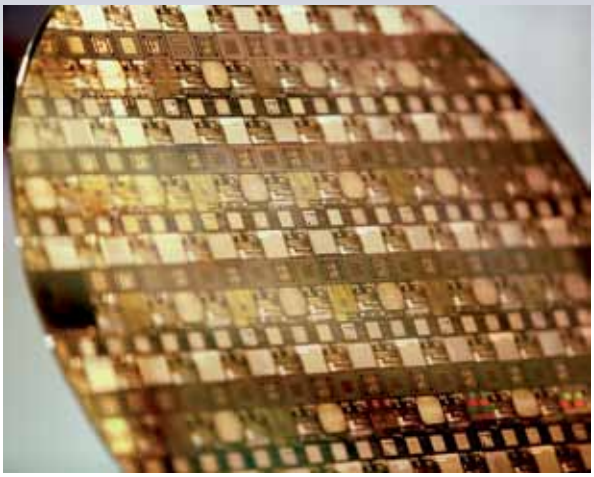




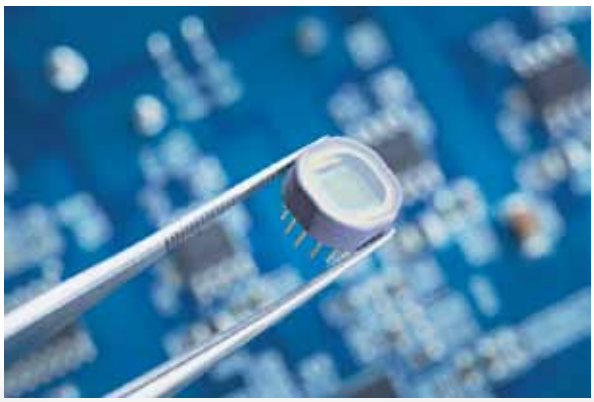
ALD is an essential manufacturing technique in wafer-based semiconductor industries. ALD coats details no other coating method does - on the right, a SEM image of an ALD film inside a curved microchannel (picture credit Fraunhofer IMS).

Examples of ALD applications

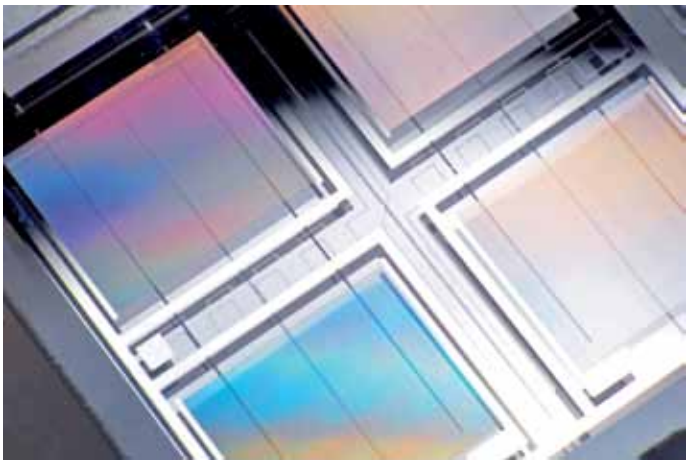
ALD application	Role of ALD
SEMI/IC	Spacer oxide films
	Inter poly dielectric oxide films
	Tunneling oxide films
	Blocking oxide films
	Passivation films
	Gap fill films
	Capping layer films
	Copper barrier and seed films
	High-k gate dielectrics
	Ferroelectric materials
	Paramagnetic materials
	Non-magnetic coupling
	Electrodes
Read heads for hard drives	Passivation layer
MEMS devices/processes	Etch stop layers
	Protective layers
	Anti-stiction layers
	Hydrophobic layers
	Adhesive layers
	Layers against friction and wear
	Electrical shorting prevention
	Charge dissipative layers
3D packaging (IC)	Through silicon vias
Medical applications	Biocompatible materials
Flat panel electroluminescent displays	Light emitting layer and passivation layers
Crystalline silicon solar cells	Surface passivation
CIGS thin film solar cells	Buffer layers
	Transparent conductive oxide (TCO) layers
Corrosion protection	Corrosion protection film on the surface

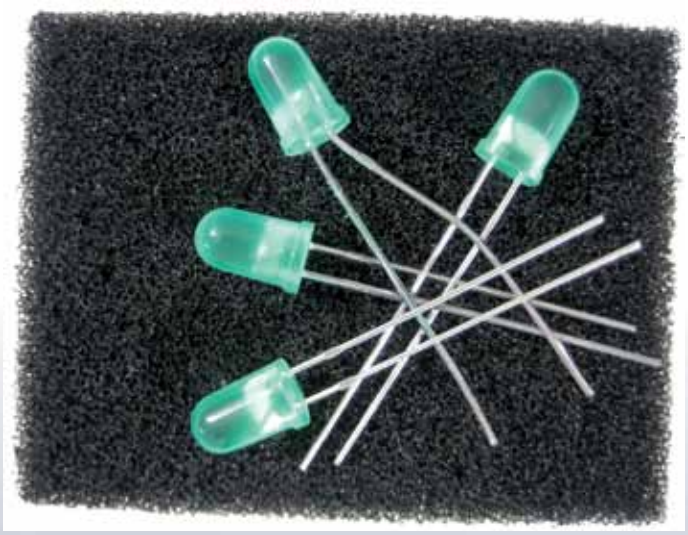


Picture credit He-Arc



ALD application	Role of ALD
Water purification membranes	Antibacterial layer
Recyclable, paper/cardboard-based packaging materials	Gas/moisture diffusion barrier
Fuel cells	Catalytes
Optical applications	Microchannel plates (e.g. X-ray optics) reflective coating Fresnel-zone lenses for X-ray optics
Decorative coatings	Colored, "metallic" films
Antitarnisning	Protection of metal items against darkening
Lighting	OLED (organic light-emitting diode) passivation
Low n layers on glass	
High n layers on glass	
Window layers on glass	
Glass strengthening	Anti-cracking layers on glass





Examples of ALD materials*

Oxides	Al_2O_3, $Al_xTi_yO_2$, Gd_2O_3, HfO_2, In_2O_3, MgO, Sb_2O_3, SiO_2, $SrTiO_x$, Ta_2O_5, TiO_2, Y_2O_3, ZnO, ZnO:Al, ZrO_2
Nitrides	AlN, TiAlCN, TiN, TaN_x
Carbides	TiC
Sulfides	Gd_2O_2S, In_2S_3, In_xZn_yS, ZnS
Fluorides	CaF_2, MgF_2
Metals	Ag, Au, Cu, Ir, Pd, Pt, Ru

Self-assembled monolayers (SAMs) for growth inhibition

Polymers and inorganic-organic hybrid materials

*The list is non-inclusive – for more detailed information please contact Picosun directly.

Picosun – The ALD company

"There is not a single ALD company in the world with credentials matching those of Picosun."

Four decades exclusively on ALD

Picosun's history dates back to the very beginning of Atomic Layer Deposition. ALD was invented in Finland in 1974 by Dr. Tuomo Suntola, who today serves as a Member of the Picosun Board of Directors. Picosun founder and Chief Technology Officer Mr. Sven Lindfors has created outstanding ALD systems since 1975 and is known as "world's most experienced ALD reactor designer".

We get it right

Picosun's unparalleled ALD experience comes from continuous, exclusive ALD system development with over 300 person years of first hand knowhow in the field. We get it right, where many just struggle. Picosun was established in 2004 and our core team consists of highly trained academic personnel, all experts in ALD. Picosun team, described by many "the best ALD team ever", has contributed to a vast number of patents on ALD. Today, our products represent the 15th generation of ALD systems for us. Our close collaboration with leading industries and top research organizations solidifies our frontline position in the global ALD network.

Leading thin film solutions for global industries and R&D alike

Picosun provides production-proven thin film coating solutions with world-leading process quality for global industries. We understand the customer's needs – our technology fulfills the most stringent productivity and reliability requirements. For research organizations, our tools offer unmatched versatility, flexibility, modularity, and unique scalability from research to production, filling the technological gap between. Reliable, efficient, compact, and user-friendly PICOSUN™ ALD tools have been chosen for daily use in all kinds of micro- and nanotechnology applications by frontline industries and top scientific organizations around the world.

Picosun headquarters are located in Espoo, Finland, our production facilities in Masala, Finland, our US headquarters in Detroit, Michigan, and our Asian headquarters in Singapore. Our worldwide network of distributors and representatives ensures top-level after sales and support services. Demo coating services and Ph.D. level process consulting are available directly from our headquarters.

Picosun Board of Directors. From left to right: Prof. Jorma Routti, Mr. Kustaa Poutiainen (Chairman of the Board), Dr. Tuomo Suntola, Mr. Jukka Jäämaa, and Mr. Hannu Turunen.

PICOSUN™ R-series ALD process tools

Manual or semi-automatic processing for research and development

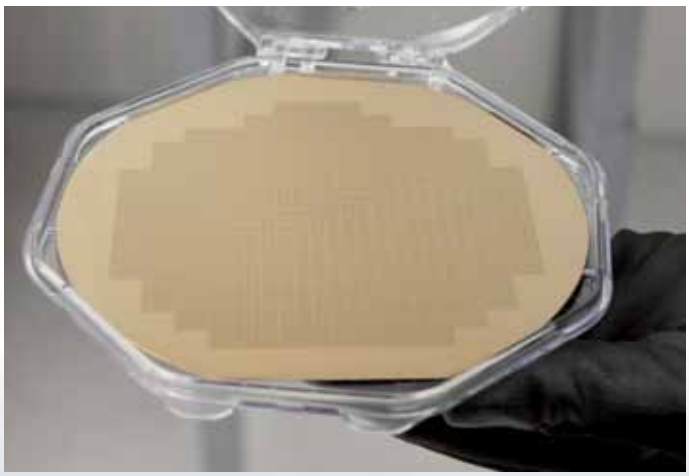
High standard R&D requires the best equipment. PICOSUN™ R-series ALD tools' unique hot-wall top-flow dual-chamber design guarantees the deposition of highest quality ALD films with excellent uniformity even on the most challenging structures such as through-porous samples, ultra-high aspect ratio trenches, or nanoparticle powders. Our highly functional and easily exchangeable precursor sources for liquid, gaseous, and solid chemicals enable particle-free processing of a wide range of materials on wafers, 3D objects, and all nanoscale features.

Although capable of serving even the most stringent overall requirements of thin film research of the highest caliber, PICOSUN™ R-series reactors are specifically designed for research that aims to bring its achievements out of the laboratory, into industrial manufacturing. Unmatched versatility, speed, and quality are combined with a compact, space-saving package. PICOSUN™ R-series ALD tools invite corporate funding – because of their unique scalability the results do not fall into the usual technology gap between research and production but can be directly transferred into production with PICOSUN™ P-series. PICOSUN™ R-series ALD tools are the systems of choice for the most productive research work.

PICOSUN™ R-200 Standard ALD tool.

Excellent film uniformities achieved in Picosun thermal ALD and plasma-enhanced ALD (PEALD) processes. Wafer size 150 mm, 49 point measurement.

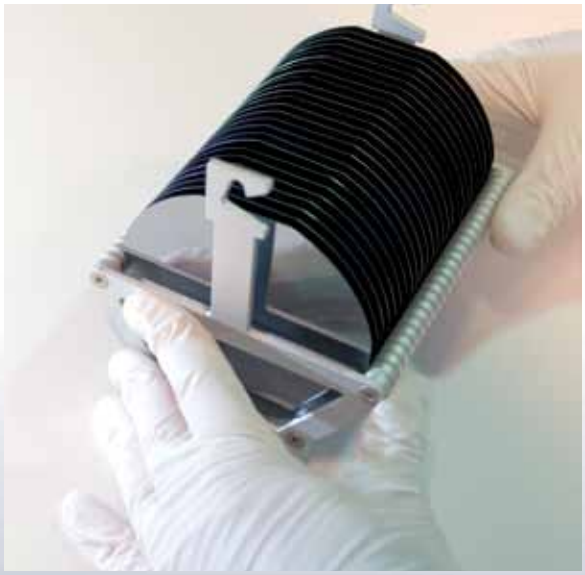
Material	Non-uniformity (1σ)	Single (S) / batch (B) process
Al_2O_3	0.13 %	B
SiO_2	0.77 %	B
TiO_2	0.28 %	S
ZnO	0.94 %	S
Ta_2O_5	1.0 %	S
HfO_2	1.77 %	S
Pt	3.41 %	S
TiN	1.10 %	S
PEALD Al_2O_3	0.50 %	S
PEALD AlN	0.62 %	S
PEALD SiO_2	1.10 %	S
PEALD TiN	2.16 %	S
PEALD TiAlN	2.87 %	S
PEALD In_2O_3	0.87 %	S
PEALD ZnO	2.64 %	S



ALD TiN coating on a device wafer.

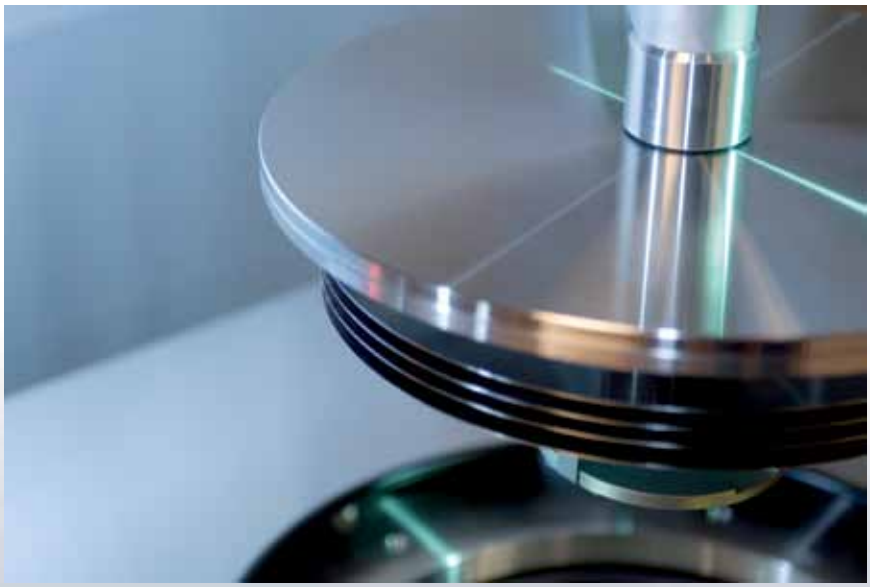
PICOSUN™ R-200 Standard ALD system technical features

Basic features	
Substrate size and type	50 – 200 mm single wafers Wafer minibatch up to 150 mm 156 mm x 156 mm solar Si wafers 3D objects Powders and particles Through-porous and HAR samples
Process temperature	50 – 500 °C, higher on request
Substrate loading options	Pneumatic lift (manual loading) Load lock with magnetic manipulator arm
Precursors	Liquid, solid, gas, ozone Up to 6 sources with 4 separate inlets
Measures	
Weight	350 kg
Dimensions (W x H x D)	Depending on options Minimum 146 cm x 146 cm x 84 cm Maximum 189 cm x 206 cm x 111 cm
Utilities	
Power supply	200-240 VAC, 1-phase, 50/60 Hz Fuse 1 x 16 Amps Power depending on options
Vacuum pump	Recommendation min. 100 – 420 m^3/h, mechanical particle trap and afterburner included
Carrier gas	99.999 % N_2 / Ar, min 2 slm
Compressed dry air	4 – 5.5 bar overpressure
Cooling water	Only required for dry vacuum pump, not for the reactor
Exhausts	Reactor frame, vacuum pump, source cabinets
Options	
PICOFLOW™ diffusion enhancer, QCM, RGA, N_2 generator, gas scrubber, customized designs, glove box compatibility for inert loading	



PICOSUN™ R-200 Advanced ALD system technical features

Basic features	
Substrate size and type	50 – 200 mm single wafers Wafer minibatch up to 150 mm 156 mm x 156 mm solar Si wafers 3D objects Powders and particles Through-porous and HAR samples
Process temperature	50 – 500 °C, higher on request
Substrate loading options	Pneumatic lift (manual loading) Load lock with magnetic manipulator arm Semi-automatic loading with handling robot Cassette-to-cassette loading with cluster tools
Precursors	Liquid, solid, gas, ozone, plasma Up to 12 sources with 6 separate inlets
Measures	
Weight	350 + 200 kg
Dimensions (W x H x D)	Depending on options Minimum 146 cm x 146 cm x 84 cm Maximum 189 cm x 206 cm x 111 cm
Utilities	
Power supply	400 VAC, 3 phase with N or 200-210 VAC 3-phase, 50/60 Hz Fuse 3 x 16 Amps Power depending on options
Vacuum pump	Recommendation min. 100 – 420 m^3/h, mechanical particle trap and afterburner included
Carrier gas	99.999 % N_2 / Ar, min 2 slm
Compressed dry air	4 – 5.5 bar overpressure
Cooling water	Only required for dry vacuum pump and plasma generator, not for the reactor
Exhausts	Reactor frame, vacuum pump, source cabinets
Options	
PICOFLOW™ diffusion enhancer, QCM, RGA, UHV compatibility, N_2 generator, gas scrubber, customized designs, glove box compatibility for inert loading	



PICOSUN™ R-200 Advanced ALD tool with a plasma generator integrated into a PICOPLATFORM™ 200 cassette-to-cassette loading cluster system.

PICOSUN™ R-200 Advanced ALD tool with a vacuum load lock and a plasma generator.

PICOSUN™ P-series ALD process tools

Fully automatic single wafer and batch processes for high volume manufacturing

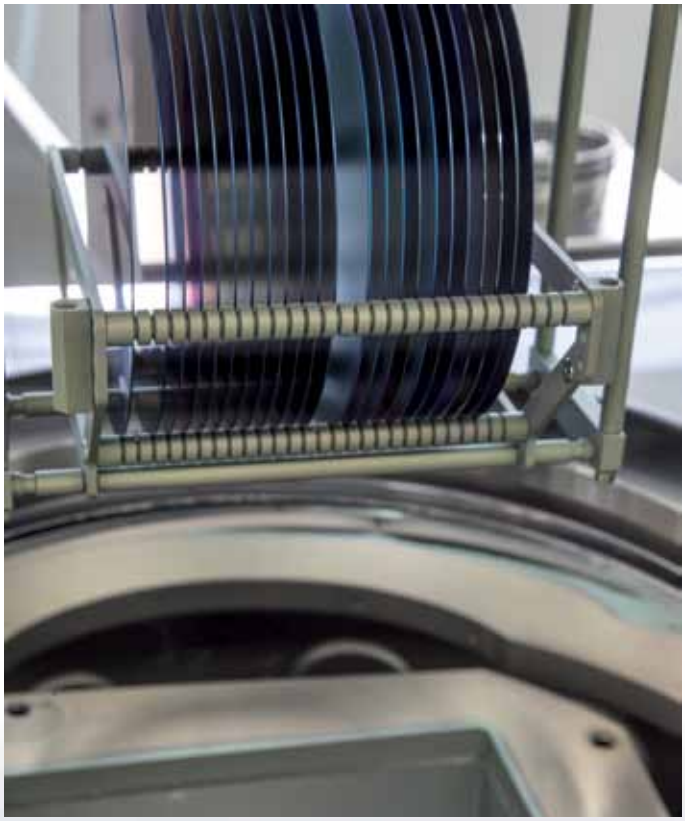
PICOSUN™ P-series and PICOBATCH™ define the new era of high volume ALD production. PICOSUN™ P-series ALD tools are fully automated and capable of coating hundreds or even thousands of wafers per hour in a cluster configuration. PICOSUN™ P-series is a prime example of the uniquely built-in scalability of PICOSUN™ ALD tools, offering Picosun's trademark fast, safe, reliable, and production-proven high throughput ALD manufacturing with low cost of ownership and without compromising even the strictest industrial quality and repeatability standards. Excellent film uniformities in batch (thickness STD < 1 % with Al_2O_3 on up to 300 mm silicon wafers), and world-leading particle level down to 1-2 added particles (>70 nm) per wafer have been achieved.

PICOSUN™ P-series ALD tools are production line and vacuum cluster compatible and ensure maximum, cost-efficient throughput under all conditions. Our compact, highly functional reactor design saves expensive facility space whereas quick and easy maintenance results in minimal system downtime. Our unmatched level of knowhow on ALD process mechanics ensures that production progresses smoothly with all precursor chemistries and substrate architectures.

Picosun's support organization is always ready to offer on- or off-site consulting from process chemistry to reactor maintenance procedures. Prior to purchase, our demo service ensures the reactor is optimized for 100 % fulfillment of your most demanding production requirements.

Customer data of Al_2O_3 batch process in a PICOSUN™ P-300B batch ALD tool.

	Target	Measured
Thickness non-uniformity in-wafer	< 1 % 1σ	0.51 % 1σ
Thickness non-uniformity in-batch	< 1 % 1σ	0.80 % 1σ
Deposition rate variation batch-to-batch	< 1 % 1σ	0.18 % 1σ
Added particles/ wafer (>70 nm)	< 8	1-2
Refractive index @ 190 nm	> 1.86	> 1.864
Film delamination or pinholes after HF etch	no	no
Film stress	< 200 Mpa	< 200 Mpa
Alkali contamination	< 10E10 at/cm^2	< 0.02E10 at/cm^2
MTTM < 4 h		
MTBM > 6 months		
Uptime > 90 %		



PICOSUN™ P-300S ALD system technical features

Basic features	
Substrate size and type	Single wafers up to 300 mm diameter 3D objects, e.g. steel, aluminum, plastic, silverware Powder and particle substrates Microchannel plates and through-porous substrates High-aspect ratio substrates (1000:1)
Process temperature	50 – 500 °C
Substrate loading options	Pneumatic loader, robotic loader
Precursors	Liquid, solid, gas, ozone Level sensors, cleaning and refill service Up to 12 sources with 6 separate inlets
Measures	
Weight	350 + 200 kg
Dimensions (W x H x D)	149 cm x 191 cm x 111 cm
Utilities	
Power supply	400 VAC, 3 phase with N or 200-210 VAC 3-phase, 50/60 Hz Fuse 3 x 16 Amps Power depending on options
Vacuum pump	Recommendation min. 420 m^3/h, mechanical particle trap and afterburner included
Carrier gas	99.999 % N_2 / Ar, min 2 slm
Compressed dry air	5 – 6 bar overpressure
Cooling water	Only required for the dry vacuum pump and ozone generator, not for the reactor
Exhausts	Reactor frame, vacuum pump, source cabinets
Options	
Cluster tools, UHV integration, automatic loading modules, gas scrubbers, chillers, nitrogen generators, factory host software connectivity, glove box compatibility for inert loading	

PICOSUN™ P-300S ALD tool integrated into a 300 mm vacuum cluster with a robot loader.

PICOSUN™ P-300B ALD system technical features

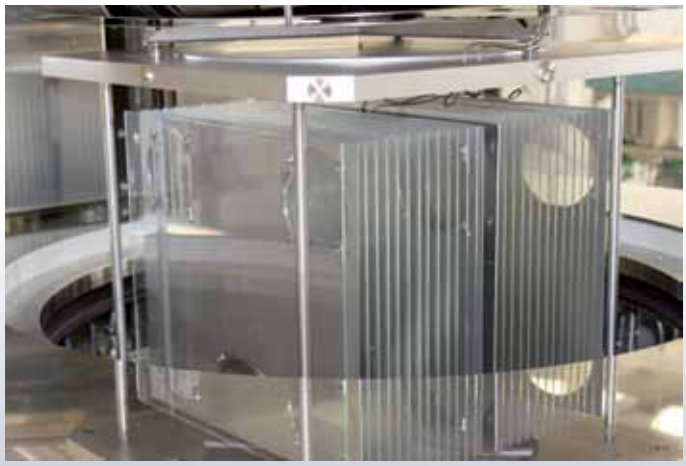
Basic features	
Substrate size and type	300 mm wafers in batches of 10 wafers/run (standard pitch) 200 mm wafers in batches of 50 wafers/run (standard pitch) 156 mm x 156 mm solar Si wafers in batches of 10/20 wafers/run (both sides/ back-to-back) Up to 300 x 300 mm glass wafers in batches of 100/200 wafers/run (both sides/ back-to-back) 3D objects, e.g. steel, aluminum, plastic, silverware Powder and particle substrates Microchannel plates and through-porous substrates High-aspect ratio substrates (1000:1)
Process temperature	50 – 500 °C
Substrate loading options	Pneumatic loader, robotic loader
Precursors	Liquid, solid, gas, ozone Level sensors, cleaning and refill service Up to 6 sources with 4 separate inlets
Measures	
Weight	400 + 300 kg
Dimensions (W x H x D)	149 cm x 191 cm x 111 cm
Utilities	
Power supply	400 VAC, 3-phase with N or 200-210 VAC 3-phase, 50/60 Hz Fuse 3 x 16 Amps Power depending on options
Vacuum pump	Recommendation min. 420 m^3/h, mechanical particle trap and afterburner included
Carrier gas	99.999 % N_2 / Ar, min 2 slm
Compressed dry air	5 – 6 bar overpressure
Cooling water	Only required for the dry vacuum pump and ozone generator, not for the reactor
Exhausts	Reactor frame, vacuum pump, source cabinets
Options	
Cluster tools, automatic loading modules, loading with an industrial robot, gas scrubbers, chillers, nitrogen generators, factory host software connectivity, glove box compatibility for inert loading	

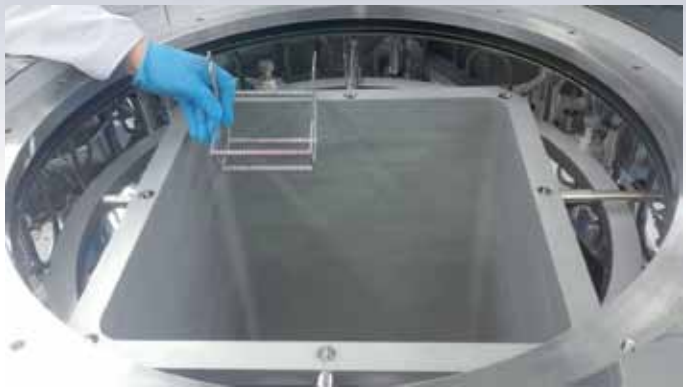
PICOSUN™ P-300B batch ALD tool.

PICOSUN™ P-300B batch ALD tool with an industrial robot.

PICOSUN™ P-1000 ALD system technical features

Basic features	
Substrate size and type	450 mm wafers in batch up to 40 pieces 300 mm wafers in batch up to 80 wafers 200 mm wafers in batch, 12 x 25 pieces 156 mm x 156 mm solar Si wafers in batches of 800/1000 wafers/run (both sides/ back-to-back) Up to 400 x 600 mm glass wafers in batches of 30/50 wafers/run (both sides/ back-to-back) 3D objects (450 x 450 x 650 mm), e.g. steel, aluminum, plastic, silverware Powder and particle substrates Microchannel plates and through-porous substrates High-aspect ratio substrates (1000:1)
Process temperature	50 – 500 °C
Substrate loading options	Pneumatic loader, robotic loader
Precursors	Liquid, solid, gas, ozone Level sensors, cleaning and refill service Up to 12 sources with 8 separate inlets
Measures	
Weight	2000 kg
Dimensions (W x H x D)	230 cm x 270 cm x 125 cm
Utilities	
Power supply	400 VAC, 3-phase with N or 200-210 VAC 3-phase, 50/60 Hz Fuse 3 x 32 Amps Power depending on options
Vacuum pump	Recommendation min. 420 m^3/h, mechanical particle trap and afterburner included
Carrier gas	99.999 % N_2 / Ar, min 2 slm
Compressed dry air	5 – 6 bar overpressure
Cooling water	Only required for the dry vacuum pump and ozone generator, not for the reactor
Exhausts	Reactor frame, vacuum pump, source cabinets
Options	
Cluster tools, automatic loading modules, gas scrubbers, chillers, nitrogen generators, factory host software connectivity	





PICOSUN™ P-1000 ultra-large scale batch ALD tool.

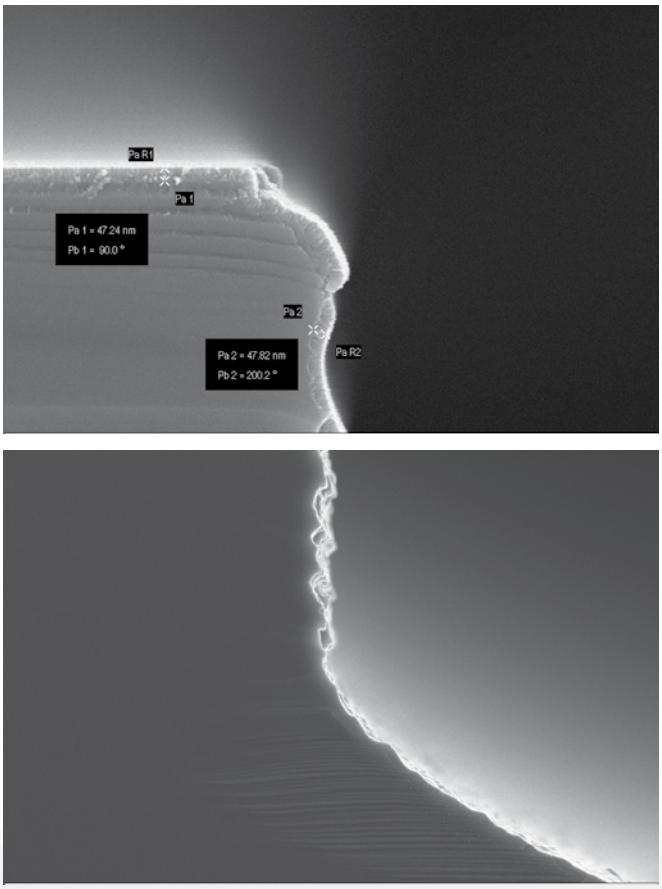
PICOPLASMA™ source system

Picosun's innovative PICOPLASMA™ plasma-enhanced ALD (PEALD) source system is based on a highly advanced, ion-free remote plasma source, proven by top research customers around the globe. Various excited species such as oxygen, nitrogen, and hydrogen radicals can be generated to broaden the range of ALD process chemistries – especially metal and metal nitride thin films can be deposited at low temperatures with activated species – and the remote source enables processing of the most sensitive substrates and delicate device structures without plasma damage due to very low ion count, while retaining high reactive species flux. With PICOPLASMA™, there are no short-circuiting problems even when depositing metals, the plasma can be ignited with normal flows with no pressure oscillation, and no separate valve is needed to prevent back-diffusion of the plasma species into the generator. The optimized design of PICOSUN™ ALD tools enables combining plasma and thermal process steps in the same deposition without mechanical changes to the tool construction.

PICOPLASMA™ source system can be mounted on existing PICOSUN™ ALD reactors or the whole PEALD system can be installed as one compact, small footprint deposition unit of capable of easy implementation, quick maintenance, and low cost of ownership. The system can also be fully automated by integrating it into the PICOPLATFORM™ cluster tool.

The stable power delivery of the plasma unit enables high yields with fast process speed and excellent film uniformity (thickness STD 0.7 % with Al_2O_3 and AlN on silicon, deposited from TMA and oxygen radicals) and good conformality in deep trenches up to AR of 1:48 for oxygen plasma processes and 1:25 for nitrogen/hydrogen plasma processes. In short, the PICOPLASMA™ system increases the already top-notch flexibility, versatility, and scalability of Picosun's existing ALD products.

PICOPLASMA™ source system installed on a PICOSUN™ R-series ALD reactor.

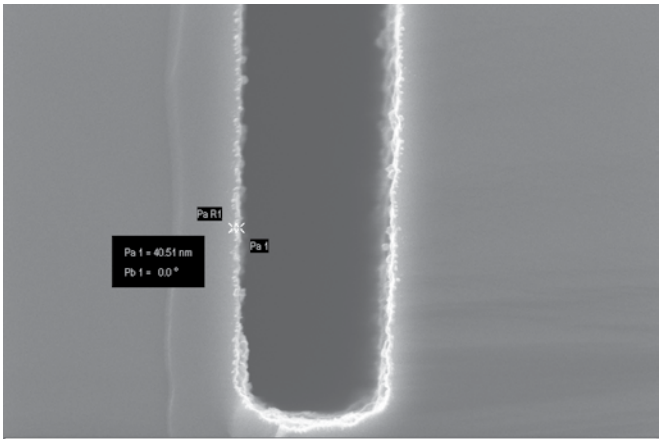


Highly conformal and uniform films of PEALD TiN on high aspect ratio trenches.

PICOPLASMA™ technical features

PICOPLASMA™ remote plasma source technical features

- Plasma generator and power supply integrated in one compact system, weight 22.2 kg
- Mounted to the transfer chamber with connection to the reaction chamber
- Commercial RF plasma generator with adjustable 100 – 3000 W power, 1.7 – 3 MHz RF frequency
- AC Power 208 VAC, 35 A, 3 phases, AC input current 16 A max
- Cooling water flow 5.71 lpm, T < 35 °C
- Analog (25 pin) and RS-232 (AE Bus) interfaces
- Chemraz® O-ring sealing
- Generator MTBF > 100 000 h
- Generator compliant with the following certifications: CE 73/23/EEC & 89/336/EEC, IEC/EN 61010-1, CSA C22.2 No. 1010.1, ANSI/ISA-82.02.01, NRTL/C, SEMI S2-0302, SEMI F47, EN 55011, EN61326 and 47 CFR



Highly conformal and uniform PEALD TiN + Cu films on high aspect ratio trenches.

PICOPLATFORM™ vacuum cluster tools

The PICOPLATFORM™ vacuum cluster tools from Picosun combine the unique scalability and modularity of all PICOSUN™ ALD systems with fully standardized automation solutions for high volume manufacturing with world leading process quality.

The PICOPLATFORM™ system consists of several ALD reactors clustered around a central vacuum robot loading and controlling unit for automatic wafer handling without vacuum break. The system can also be extended at any time by clustering with other process modules such as pre/post-treatment and deposition units. Depending on your application and production needs, the PICOPLATFORM™ cluster system product family now offers two alternatives: PICOPLATFORM™ 200 which is ideal for R&D and smaller scale production, and PICOPLATFORM™ 300, which is optimized for fully automated high throughput industrial manufacturing.

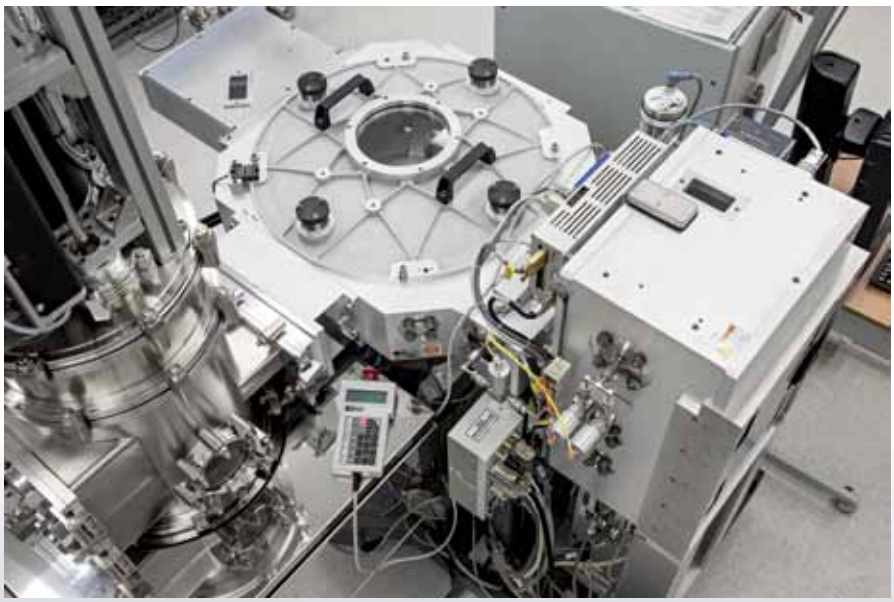
The substrate handling system of the PICOPLATFORM™ 200 tool is based on the Brooks MX400™ vacuum robot clustering unit. The PICOPLATFORM™ 200 cluster system is compatible with PICOSUN™ R-200 Advanced ALD tools, it can be used as 100/200 mm bridge tool, and it can be equipped with a single wafer load lock or an automatic cassette-to-cassette loader.

The substrate handling system of the PICOPLATFORM™ 300 tool is based on the Brooks Marathon 2™ vacuum robot clustering unit and a FOUP loading station to enable automatic wafer transfer between the wafer carrier FOUPs and clustered process modules without vacuum break. The PICOPLATFORM™ 300 cluster system is compatible with PICOSUN™ P-300S ALD tools and it can be used as 200/300 mm bridge tool. The PICOPLATFORM™ 300 cluster is SEMI S2 compatible.

Applications: Oxide, nitride, and metal film materials for integrated circuits.

- Spacer oxide films
- Inter poly dielectric oxide films
- Tunneling oxide films
- Blocking oxide films
- Passivation films
- Gap fill films
- Capping layer films
- Copper barrier and seed films

The large customer base of PICOSUN™ ALD tools and the fact that Picosun is working closely with the leading provider of vacuum automation solutions to the semiconductor industry, Brooks Automation, guarantees optimal performance, support, and maintainability of the automated PICOSUN™ ALD systems.



PICOPLATFORM™ 200 ALD cluster tool with an automatic cassette-to-cassette loader.

PICOPLATFORM™ 200 technical features

PICOPLATFORM™ 200 vacuum cluster technical features

- Wafer sizes: 100 mm, 150 mm, 200 mm
- Loader options
  - Single wafer load lock (semiautomatic)
  - Automatic cassette-to-cassette substrate loader for up to 25 wafers
- An additional port for integrating other process equipment to the vacuum robot central unit
- Transfer chamber with a wafer handling robot
- Thin film is deposited on one wafer at a time
- Wafer sensors
- Integrated wafer aligner
- The reaction chamber is isolated from room atmosphere during the loading and unloading of the substrate
- Leak rate: 1.0 x 10^{-8} Torr-l/sec He max
- Cleanroom compatible
- Operating atmosphere temperature: 10 °C to 30 °C
- Operating atmosphere humidity: 5 % to 80 % (relative, non-condensing)
- Electricity: Single phase 200-240 V, 10 A (usually supplied from the common cabinet of the clustered system)
- Dimensions: 868 mm x 1147 mm x 1392.5 mm (W x D x H)
- Weight: 708.5 kg
- Additional options
  - SMIF pod loader for controlled environment
  - Ports for additional options via tandem or Brooks MX700™ based cluster system
  - SECS/GEM communication

PICOPLATFORM™ 200 ALD cluster tool with four PICOSUN™ R-series ALD reactors.

PICOPLATFORM™ 300 technical features

PICOPLATFORM™ 300 vacuum cluster technical features.

- Vacuum system with a wafer handling robot in a transfer chamber and a load lock
- EFEM with three FOUP ports, wafer mapping with atmospheric robot
- Reliable MagnaTran technology by Brooks
  - > 10M MCBF
- An additional port for integrating other process equipment to the vacuum robot central unit
- Single wafer handling and optic wafer sensors on vacuum unit
- The reaction chamber is isolated from room atmosphere during the loading and unloading of the substrate
- Optional wafer aligner in the EFEM
- EFEM weight: 766 kg
- Marathon 2™ weight: 581 kg

PICOPLATFORM™ 300 vacuum cluster tool with a PICOSUN™ P-300S ALD reactor, vacuum robot loading unit and an EFEM with three FOUP ports.

Additional options

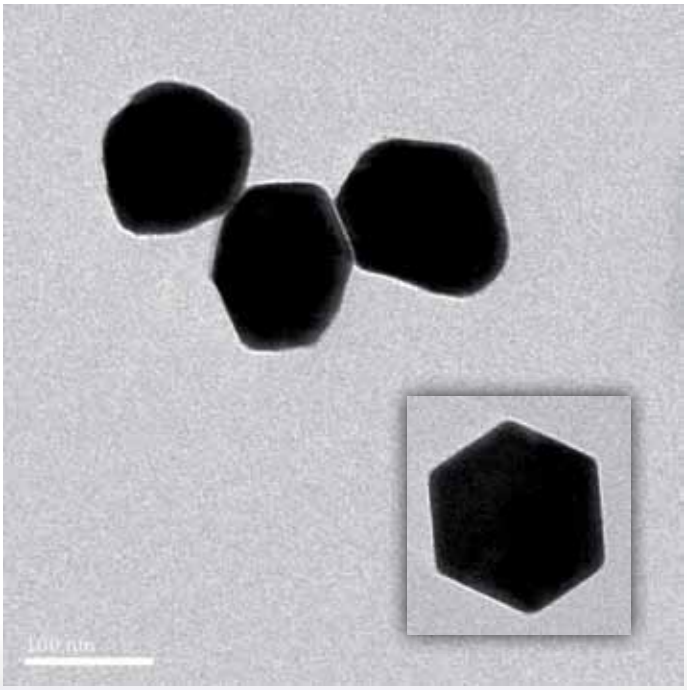
PICOFLOW™ diffusion enhancer

The PICOFLOW™ system is used for increasing the retention time of the precursors in the reaction chamber by slowing down the speed with which the reactant gases are pumped out from the reactor. This enables and improves the coating of challenging through-porous, highly tortuous, nanoporous, particulate, or otherwise nanoscale complicated structures by allowing the precursors more time to diffuse in and interact with the surfaces to be coated. The PICOFLOW™ diffusion enhancer system enables coating of extremely high aspect ratio samples without the risk of back-diffusion of the precursors into the inlet lines.

PICOFLOAT™ particle coating system

Powder materials form the basis of a huge number of industrial products – catalysts for chemistry and biochemistry, solid state batteries, pigments, additives for rubber, paper, plastic, cardboard, and food, and medical and cosmetic substances being just a few examples. With ALD coatings the surface of the particles can be tailored according to electrical, optical, physical, or chemical properties, or the particles can be functionalized for completely new activity. Catalyst manufacturing with ALD is also more environmentally-friendly than conventional, wet chemistry –based methods.

In Picosun's novel, innovative PICOFLOAT™ particle coating system the powder to be coated is in a constant motion which ensures uniform ALD film formation on every particle down to nanoscale dimensions. PICOFLOAT™ system is available for all, both old and new PICOSUN ™ ALD reactors, up from the PICOSUN™ R-200 series.



Roll-to-roll ALD chamber

Continuous ALD processing is needed for the fields of flexible, printed electronics, OLED lighting, third generation thin film photovoltaic devices, high energy density thin film batteries, smart textiles, organic sensors, organic/recyclable packaging materials, and flexible displays, to name a few. The key challenge in printed electronics is to find a flexible, reliable, and low-cost encapsulation material to protect the sensitive devices from ambient atmosphere (moisture, gases, impurities) to extend their lifetime. ALD oxides, namely aluminum and titanium oxides have shown excellent performance in this, making printed electronics definitely one of the most promising near future application areas for ALD.

Picosun's revolutionary roll-to-roll ALD technology is one of the most highly requested and welcomed additions to Picosun's capabilities as the leading provider of ALD solutions. The PICOSUN™ roll-to-roll ALD chamber is available for all, both old and new, PICOSUN™ R-series ALD reactors.

Glove box compatibility

All PICOSUN™ ALD tools can be integrated with various types of glove boxes to eliminate handling of moisture sensitive substrates in the air. Tools with separate load locks or the standard elevator can both be connected with a leak tight seal to the glove box wall or bottom plate.

A glove box is also ideal for using or storing toxic, very volatile, oxygen or moisture sensitive precursors.

UHV compatibility

All PICOSUN™ ALD systems can be made ultra-high vacuum (UHV) compatible either by integration with a pump-down chamber or by modifying the tool itself enabling pump-down down to UHV region. UHV ALD tools can be integrated with other deposition and measurement tools to make possible high-quality interface between ALD films and III-V semiconductors, for example.

All PICOSUN™ ALD reactors are integratable with different types of glove boxes. Glove box integration is ideal for e.g. OLED research and manufacturing.

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