Pioneering ALD experience since 1974

Picosun
The ALD Powerhouse

Picosun SUNALE™

R-series ALD systems

Bridging the gap between research and production

THE FUTURE OF THIN FILM IS HERE

Experience the full potential of ALD with Picosun's new SUNALE™ reactors. Imagination is the limit – with our compact, versatile and uniquely scalable ALD system design the gap between research and production is no more.

SEMI organization President and CEO Stanley T. Myers presents the European SEMI 2004 award to Dr. Tuomo Suntola at Semicon Europa 2004 exhibition in Munich.

Picosun Board of Directors. Back row, from left to right: Prof. Lauri Niinistö, Mr. Kustaa Poutiainen (CEO), Prof. Jorma Routti, and Mr. Juhana Kostamo (Managing Director). Front row, from left to right: Dr. Tuomo Suntola and Mr. Sven Lindfors (CTO).

Picosun – Defining the future of ALD

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

Picosun's history and background date back to the very beginning of the field of atomic layer deposition. ALD was invented in Finland in 1974 by Dr. Tuomo Suntola, who today serves as Member of the Picosun Board of Directors. Picosun founder and Chief Technology Officer (CTO) Mr. Sven Lindfors has created outstanding ALD systems since 1975 and is known as the "world's most experienced ALD reactor designer".

30 years exclusively on ALD

Today Picosun combines over 30 years of continuous, exclusive ALD system development with over 200 person years of first hand know-how in the field. The company was established in 2003 and our core team consists of highly trained academic personnel, all experts in ALD. Picosun team, described by many as "the best ALD team ever", has contributed to over 100 patents on ALD and our close collaboration with top research organizations and major industries solidifies our frontline position in the global ALD network.

Unique scalability from research to production

Picosun is an international equipment manufacturer with a world-wide sales and service organization. We develop and manufacture ALD reactors for all kinds of micro- and nanotechnology applications. Picosun provides its customers with user-friendly, reliable and productive ALD process tools with top level after-sales, demo coating and process consulting services. The company is based in Espoo, Finland and has its US headquarters in Detroit. SUNALE™ ALD systems are used by leading scientific institutions and companies across four continents.

We get it right

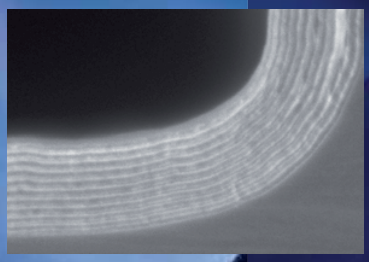
What makes us special in the field is our exclusive focus on ALD. We get it right, where many just struggle. We understand the customer's needs and can offer unmatched quality coating solutions that fulfill even the most stringent research and productivity requirements. With our uniquely compact, upscalable and versatile reactor design, there is no hindrance to the transition from research to industrial production.

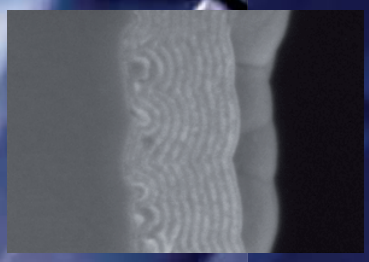
ALD – Winner technology for thin films

As a surface controlled, self-limiting chemical vapor processing method, ALD ensures 100 % uniform, conformal, defect and pinhole free thin film growth on even the most challenging nanoscale architectures such as ultra-high aspect ratio trenches and high tortuosity through-porous samples. Wide range of e.g. metal oxide, nitride, sulfide, fluoride and pure metal coatings as well as nanolaminates, mixed oxide and doped thin films can be used in numerous applications for example in micro- and optoelectronics, optics, catalyst manufacturing, clean and renewable energy technologies, water purification and innovative packaging materials.

Examples of ALD Applications

Material	**Applications**
Aluminum oxide, Al_2O_3	MEMS coatings, passivation coatings, insulator layers, diffusion barriers, etch stop layers
Tin dioxide, SnO_2	Optoelectronics, gas sensors, antistatic coatings, ARC
Titanium dioxide, TiO_2	Photocatalytic coatings, photovoltaics, antistatic coatings
Vanadium oxides, V_2O_5 and VO_2	Catalyst coatings, optical switching materials, energy storage
Zinc oxide, ZnO	Semiconductor materials, buffer layers in solar cells, UV blocking layers
Titanium nitride, TiN Tantalum nitride, Ta_3N_5	Metal electrodes, diffusion barriers
Hafnium dioxide, HfO_2 Zirconium dioxide, ZrO_2	High-k dielectrics
Iridium, Ir Platinum, Pt Ruthenium, Ru	Metal electrodes





SUNALE™ R-SERIES ALD process tools

Manual or semi-automatic processing for research and development

High standard R&D requires the best equipment. SUNALE™ 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 nanoparticulate 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 calibre, SUNALE™ 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 ready to be integrated e. g. to vacuum line, glove box etc. systems. 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 SUNALE™ P-series. R-series ALD tools are the systems of choice for the most productive research work.

Material	Thickness	Uniformity
Al_2O_3 (300 °C)	47.2 nm	0.21 % (1σ)
Plasma-Al_2O_3 (120 °C)	55.8 nm	1.78 % (1σ)
HfO_2 (250 °C)	30.6 nm	1.96 % (1σ)
TiO_2 (300 °C)	117.0 nm	0.6 % (1σ)
TiN (400 °C)	25.5 nm	1.57 % (1σ)
ZnO (300 °C)	28.1 nm	0.94 % (1σ)
Pt (300 °C)	39.3 nm	3.41 % (1σ)

Excellent film uniformities achieved by R&D customers in single wafer processes.

	Specification	Measured data
Within wafer	< 1 %	0.6 %
Within batch	< 2 %	1.0 %
Batch to batch	< 2 %	0.3 %

Al_2O_3 batch process for production. Uniformity: 1σ, STD, 9 points in each 4" Si wafer.

SUNALE™ R-SERIES 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 samples
Process temperature	50 – 500 °C, higher on request
Substrate loading options	Pneumatic lift (manual loading) Manual loadlock Robot for semi-automatic loading Cassette-to-cassette cluster tool
Precursors	Liquid, solid, gas, ozone, plasma Up to 12 sources with 6 separate inlets

Measures

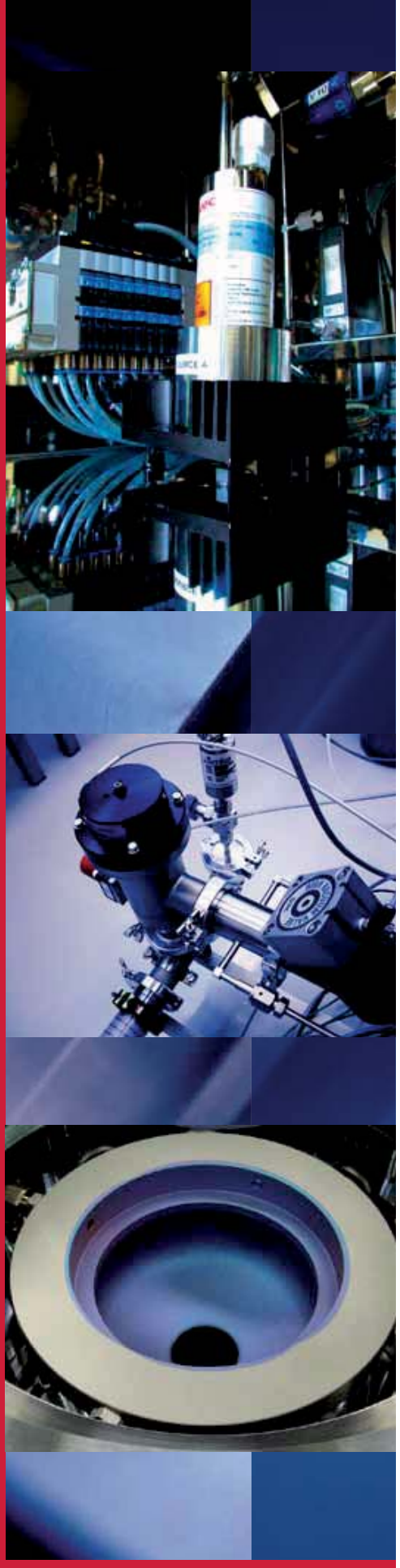
Weight	350 kg
Dimensions (W x H x D)	Depending on options Minimum 146 cm x 146 cm x 84 cm Maximum 189 cm x 206 cm x 111 cm

Utilities

Power supply	400 VAC, 3 phase, 50/60 Hz, Fuse 3 x 16 Amps. Power depending on options.
Vacuum pump	Recommendation min. 35 – 420 m^3/h, mechanical particle trap
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	Vacuum pump, source cabinets

Options

Stop-flow, QCM, RGA, UHV compatibility, N_2 generator, gas scrubber, customized designs



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