

# AGILE ALD

for companies driven by innovation

## BEYOND MOORE AND MORE

The PICOSUN™ Morpher ALD system is designed to disrupt the up to 200 mm wafer industries in Beyond Moore technologies and more. It enables fast, high throughput production of MEMS, sensors, LEDs, lasers, power electronics, optics, and 5G components with the leading process quality, reliability, and operational agility. No matter what is your end product or business mode, Morpher adapts to the changing needs of your industry and the requirements of your customers. The leading versatility in substrate materials, substrate and batch size, and the wide process range make Morpher truly a transformable, all-inclusive manufacturing facility to keep you spearheading your industry.

## REVOLUTIONARY DESIGN

The PICOSUN™ Morpher is designed for fully automated handling of wafer batches in combination of industry standard single wafer vacuum cluster platforms. Revolutionary, patented wafer batch flipping mechanism enables integration of the system with semiconductor manufacturing lines where the most of the processing takes place in horizontal geometry, and the SEMI S2/S8 certification ensures that the system is compatible with the strictest standards of the industry.

The PICOSUN™ Morpher ALD system can be integrated to factory automation via SECS/GEM protocol and the state-of-the-art software offers easy, safe and fail-proof operation of the system through intuitive and streamlined graphical user interface. With our patented dual-chamber, hot-wall reactor design with fully separated precursor conduits and inlets, we create the highest quality ALD films with excellent yield, low particle levels, and superior electrical and optical performance. The compact, ergonomic design with easy and fast maintenance ensures minimum system downtime and lowest cost-of-ownership in the market.



## TECHNICAL FEATURES

The PICOSUN™ Morpher ALD system is ideal for high-volume batch manufacturing of MEMS, sensors, LEDs, lasers, power electronics, optics, and 5G components on wafers of up to 200 mm size in fully automated production.

### Typical substrate size and type

- 200 mm wafers in batches up to 50 pcs
- 150 mm wafers in batches up to 50 pcs
- 100 mm wafers in batches up to 50 pcs
- High aspect ratio samples (up to 1:2500)
- Substrate materials: Si, glass, quartz, SiC, GaN, GaAs, LiNbO<sub>3</sub>, LiTaO<sub>3</sub>, InP

### Processing temperature and capacity

- 50 – 300°C
- Up to 1000 wafers / 24 hours @ 15 nm Al<sub>2</sub>O<sub>3</sub> thickness

### Typical processes

- Batch processes available with cycle times down to single digit seconds
- Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, Ta<sub>2</sub>O<sub>5</sub>, HfO<sub>2</sub>, ZnO, TiO<sub>2</sub>, ZrO<sub>2</sub>, and metals
- Down to <1% 1σ non-uniformity in a batch (Al<sub>2</sub>O<sub>3</sub>, WIW, WTW, B2B, 49 pts, 5mm EE)

### Substrate loading

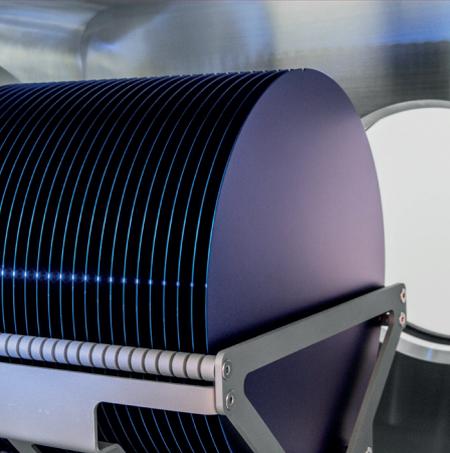
- Fully automatic loading with vacuum cluster tool combined with vertical flip function
- Cassette to cassette batch loading through Picoplatform™ 200 vacuum cluster system
- Optional SMIF station

### Key software features

- Independent recipe editor enabling recipe creation and modification during process runs, with dynamic structure (scalable format for each recipe)
- Unified interface to control the whole cluster with one communication protocol (Ethercat)
- Fixed loop control cycle with 1/20 millisecond data logging rate, capable of multi-tasking
- Datalogger accessible remotely, all data fully exportable
- SECS/GEM integration to factory host

### Precursors

- Liquid, solid, gas, ozone
- Level sensors, cleaning and refill service
- Up to 12 sources with 6 separate inlets



## **WE OFFER OUR CUSTOMERS**

### **STRATEGIC PARTNERSHIP**

For our customers, we provide a genuine strategic partnership that guarantees operational safety and scalability for the future in a changing business environment. As the thought leader in ALD, we are in unique position to help you to achieve an agile, long-term vision perfectly aligned with your customers' needs.

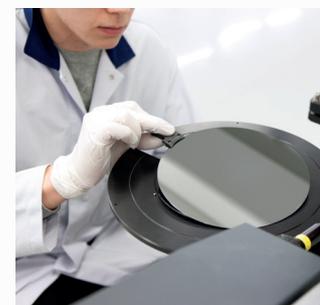
### **HIGH QUALITY IN EVERYTHING WE DO**

As a value-driven company, our focus on quality is evident in everything we do and the way we do it. We are a trusted partner, with a business based on long-term relationships. With over forty years of experience in the field, we take pride in designing optimized solutions for our customers tailored to their precise needs, and we offer our expertise throughout the entire lifecycle. Our scalable device and service ecosystem enables an exceptionally flexible cost structure that adapts to your changing business requirements.

### **SUPERIOR PROCESS KNOW-HOW**

We invented atomic layer deposition, and ALD is all we do. Our technical consultants are the best in the business, and they are ready to serve you. Our superior expertise in ALD processes guarantees that your product will meet the criteria that your users demand, supporting you every step of the way from R&D to production. We view our customers' ALD ecosystems as an entity, constantly striving to improve your processes, enhancing flexibility between production modes and daily usability, and ensuring operational safety at every stage of your products' journey.





**RELIABLE**

## CONSULTANCY

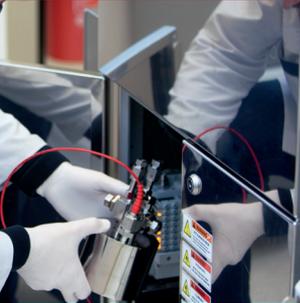
Our journey with our customers begins with comprehensive application consultancy. We delve into the details with you to map how our ALD technology can help you achieve your goals, as well as solving existing challenges and adding value to your products and processes. We can help you create completely new and disruptive product concepts to keep you at the forefront of your field. We have satisfied customers who had never heard about ALD, let alone realized that it was the solution they needed to take them to the next level in their operations – and now we are long-term partners collaborating to create ever-better ALD-enabled applications to shape the future of industry!

We invented ALD, and we've remained in the vanguard of the technology for over 40 years. The expertise we've accumulated over the years means that we have what it takes to truly comprehend and meet our customers' needs – even in rapidly changing business ecosystems. We also work with customers from all branches of manufacturing, from semiconductor and IC components, LEDs and sensors, through healthcare, space and other special electronics, and automotive and defense, all the way to luxury products such as watches, collectable coins and jewelry. This broad

approach is present in our slogan: Agile ALD. We want to be on the frontline, taking ALD where it has never been before. We will realize this goal thanks to our unmatched experience in the field: Twenty percent of our personnel have doctorates in ALD science. We only do ALD, and we own numerous patent families. Our products are already the 15<sup>th</sup> generation of ALD equipment designed and manufactured by the world's leading experts in the field. Our solutions have been proven in production day in, day out in the most demanding manufacturing and business environments.

Our consultancy service doesn't stop after we deliver your ALD equipment. We walk together with you along your ALD journey, from R&D to full-scale production, always ready to assist with new challenges, applications and needs.

All this combined lets us provide you a truly all-inclusive, strategic partnership built on close, long-term relationships where safety, trust and reliability combine with operational flexibility, and superior process and end product quality. Work with us, and you can become the pioneer in your industry, enabled by ALD!



**EFFICIENT**



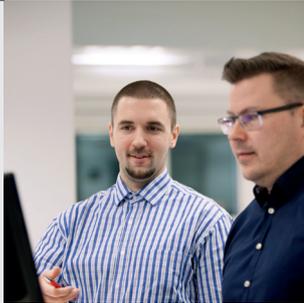
## DELIVERY & INSTALLATION

We guarantee you on-time delivery and smooth installation. To get your PICOSUN™ ALD system into full-speed production as quickly as possible, we provide precise pre-installation and preparation instructions well in advance of the actual equipment delivery. As soon as your system goes into production here at our factories, we create detailed electrical and installation drawings and documentation listing all the technical requirements for e.g. electricity and gas connections, gas delivery lines and regulators, process gas types and purity, and exhaust and pump lines and connections, as well as what chemicals, materials and equipment are needed for the post-installation acceptance runs. This documentation combined with consultancy from our customer support team allows your technical staff to prepare your facilities to integrate your PICOSUN™ system into your existing production ecosystem with no delays. We also supply detailed, system-specific manuals for operation, maintenance, safety and utilities, either on DVD or printed (on cleanroom paper, if needed).

We take a comprehensive, holistic approach to our partnerships with our customers. Installation, commissioning and acceptance tests are always included in the price of your PICOSUN™ ALD system. Installation is performed immediately after delivery (or at an agreed later time that is more suitable) by a trained, certified Picosun engineer or a certified engineer from one of our local partners. The functionality of the system is first tested before delivery, and again on-site after installation. These acceptance runs are identical and standardized, but we are also happy to perform acceptance tests that you specify according to your precise needs. All aspects of delivery, installation and testing can be agreed during the negotiations.

A brief system demonstration and basic operator training are included in the commissioning of your PICOSUN™ ALD system, but we recommend our more detailed, advanced training, which can be tailored according to your needs, whether they are related to operating the system and process development, or more concerned with technical and maintenance issues.

**ADAPTABLE**



## **TRAINING**

Safe and correct operation of equipment is a prerequisite for all professional production. When time and throughput are the key issues, having well-trained personnel is a necessity to ensure maximum system uptime and to minimize the time required for repair and maintenance.

Especially in quickly changing business environments where processes and requirements for products are constantly changing, a well-trained, in-house ALD team adds value for customers at every stage of the production process, as it ensures that your company possesses the high level of flexibility and expertise to rapidly respond to your customers' demands. Picosun offers a strategic partnership spanning your entire ALD journey. Our training is all about transferring expertise, and it's an integral part of our comprehensive care of our customers.

Responsible handover of your ALD equipment and continuous support play significant roles in our business. As a Picosun customer, you are a part of the global Picosun family, able to utilize all the vast ALD expertise accumulated not only at Picosun over the decades, but also at all the leading universities and research institutes spearheading the development of ALD science.

We provide scalable, modular and highly customizable training that can easily adapt to the needs of different business verticals. We have training programs for production staff, focusing on the technical features and practical, hands-on use of your PICOSUN™ ALD system. We can also produce training focused more on maintenance, service and troubleshooting. This training is ideal for your technical and maintenance staff, especially in R&D environments. Being able to resolve smaller issues yourselves is also cost-effective. At a more advanced level, we offer training courses that delve deeper into the very science and process development of ALD, led by our own highly qualified ALD experts. This is ideal both in product development and in the foundry environment, where ALD equipment must adapt to rapidly changing production requests from customers.





## LIFECYCLE MANAGEMENT

When your PICOSUN™ ALD equipment is installed and running at your facility, that's when our shared journey truly begins. As part of our strategic partnership with our customers, we offer uniquely scalable, modular and customizable service and support programs that adapt to the needs of both R&D and full-scale production environments, adding value to your operations every day.

In all business ecosystems, from corporate R&D to internal or foundry production, maximum uptime and impeccable process quality must combine with operational flexibility and the capability to switch quickly from one application to another. Our global service organization stands beside you in all the situations you might encounter on your ALD path, proactively ensuring that your ALD equipment is always in prime condition and that if issues arise, they are dealt with immediately.

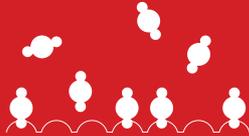
Our service programs cover all levels of support. Our highly experienced service department is happy to discuss with you in detail and construct the ideal support and maintenance plan to keep your everyday operations running smoothly, enabling you to always

stay at peak performance, even when your customers' requirements rapidly shift. We can arrange a fixed number of preventive maintenance visits per year, pre-paid service visits, local storage of spare parts, immediate dispatch of a service engineer or critical spares, and even 24/7 local support on-site, if needed. We can also provide a relocation service for your ALD equipment, as well as upgrades to your existing system configuration to increase your operational agility. In addition to our own service team, we have a global network of local distributors and representatives with trained and certified service engineers ready to help you.

Contacting our service department is easy. Our technical support is available 24/7 via email ([support@picosun.com](mailto:support@picosun.com)), or you can call our support phone service.

Naturally, we offer comprehensive warranties for all our products. During the warranty period, all repair visits and replacements of defective parts are free. Our standard warranty, included in every PICOSUN™ ALD system delivery, is one year, but extended warranties are also available at competitive prices.

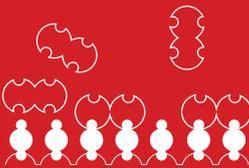
# THE PRINCIPLE OF ALD



Introduction of molecules  
containing element A.



Adsorption of the molecules  
on the surface.



Introduction of molecules  
containing element B and  
reaction with element A on the  
surface.



Completion of one monolayer  
of compound AB.

Repeat cycle till desired film  
thickness is reached.

**picosun**  
AGILE ALD

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Multiple patents granted and  
pending, including but not limited to  
US8211235, US8741062, US8753716,  
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