



# AGILE ALD

**for companies driven by innovation**

## **A REVOLUTION IN ALD MASS PRODUCTION FOR 300 MM WAFER MARKETS**

The PICOSUN® Sprinter ALD system is designed to disrupt batch ALD production on 300 mm manufacturing lines in the semiconductor, display, and IoT component industries. The SEMI S2/S8-certified PICOSUN® Sprinter combines the leading single-wafer film quality and uniformity with fast processing, high throughput, and uncompromising reliability. Thanks to the fast process times, Sprinter's thermal budget is lower than typical vertical furnace reactors commonly used in batch ALD manufacturing. This makes Sprinter also ideal for sensitive substrate materials and devices. Barrier, high-*k* oxide, and metal films are deposited with perfect ALD in mass production volumes.

## SINGLE-WAFER FILM QUALITY SCALED TO HIGH VOLUME, WITH PERFECT ALD

The PICOSUN® Sprinter ALD system revolutionizes high-volume ALD mass production, with superior film quality, short cycle times, and full automation with Picosun's own, proprietary, SEMI-compliant PicoOS™ operating system and process control software. The short process times ensure a low thermal budget, while fully laminar precursor flows guarantee perfect ALD deposition without unwanted CVD growth, minimizing the need for system maintenance. Precursor delivery is optimized, so there is no waste of precursor materials. PICOSUN® Sprinter means single-wafer film quality scaled to batch level.

The PICOSUN® Sprinter can be purchased as a standalone ALD module ready to be integrated into an existing manufacturing line or cluster, or as a full cluster including two Sprinter ALD modules, a central vacuum wafer handling module, and an EFEM with three FOUP stations (the full cluster will be available on sale later in spring 2021). Our PicoOS™ operating system allows control of the Sprinter tool – either single module or the whole cluster – via one intuitive, user-friendly HMI (human-machine interface) and ensures smooth connection between the system and the customer's factory automation via SECS-II/GEM protocol. SEMI S2/S8 certification guarantees that the system is compatible with the strictest standards of the industry.

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 the lowest cost of ownership on the market.

PICOSUN® Sprinter is made in Finland with European vacuum robotics and process modules.

## TECHNICAL FEATURES AND PERFORMANCE DATA

The PICOSUN® Sprinter ALD system is designed for fast, high-volume batch manufacturing of semiconductor (e.g. emerging memory, transistor, capacitor), display, and IoT components on 300 mm wafers in fully automated production.

### Substrate size and type

- 300 mm wafers in batch for high throughput ALD
- Double-side coating possible
- High aspect ratio samples (up to 1:2500)

### Processing temperature

- Up to 400 °C

### Precursors

- Liquid, solid, gas, ozone
- Level sensors available for precursor containers
- Continuous dispenser for pyrophoric precursors available as option (delivering up to 4 tools)

### Film thickness 1σ non-uniformity, Al<sub>2</sub>O<sub>3</sub> on 300 mm Si wafers (81 pp, 5 mm EE)

- Within-wafer @ 200 °C: < 0.5 %
- Wafer-to-wafer @ 200 °C: < 0.5 %
- Batch-to-batch @ 275 °C: < 0.3 %
- Chip-to-chip @ 275 °C: < 1.0 %


### Cr, Fe, Ni contamination, Al<sub>2</sub>O<sub>3</sub> on 300 mm Si wafers

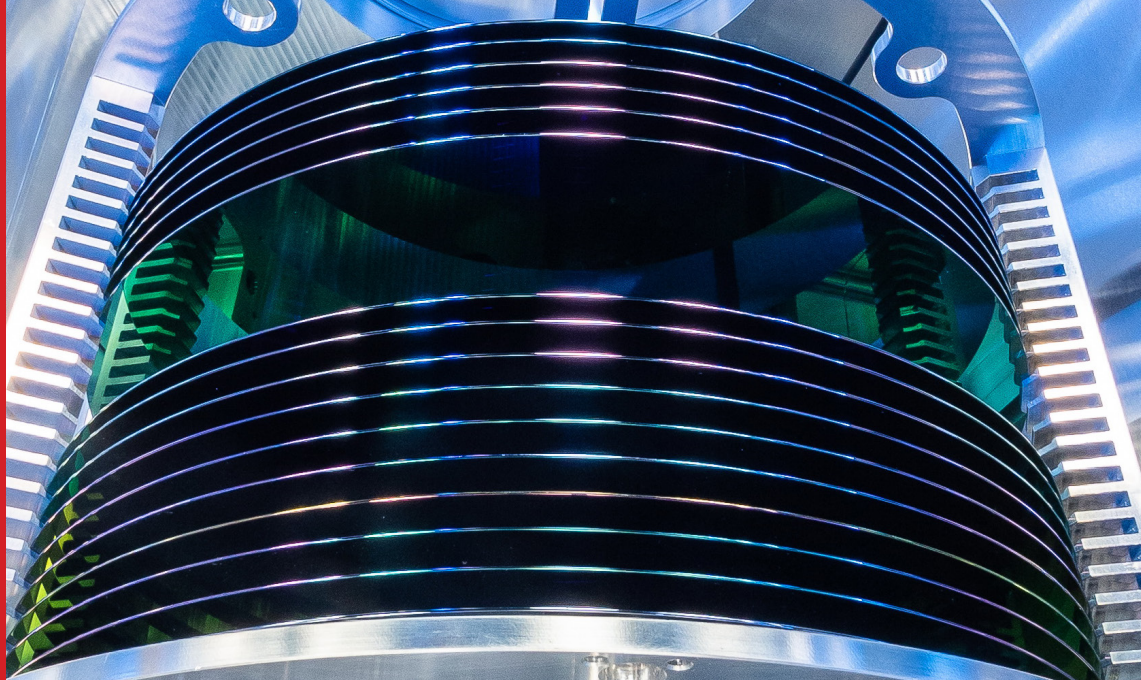
- < 1 \* 10<sup>10</sup> at/cm<sup>2</sup>

### Wet etch rate in Al-etch type A solution @ 50 °C, Al<sub>2</sub>O<sub>3</sub> on 300 mm Si wafers

- ~ 2 nm/min @ T<sub>dep</sub> ≥ 300 °C

## PicoOS™ key features

- Picosun's own, proprietary, SEMI-compliant scheduler
  - Windows 10 LTSB interface
  - One common interface to control the whole cluster
  - Data logged every 20 ms
  - Trend data can be exported
  - Access rights for different user levels
  - EtherCAT-based communication for MFCs and MFMs
  - Enhanced recovery features
  - One common event log for the whole cluster
  - Freely configurable and scalable recipe editor (no fixed number of steps and loops)
  - Recipes can be edited / created any time during system operation
- 



## **WE OFFER OUR CUSTOMERS**

### **STRATEGIC PARTNERSHIP**

For our customers, we provide a genuine strategic partnership that guarantees operational stability, reliability, and scalability for the future in a demanding, fast-paced business environment. As the thought leader in ALD, we are in a unique position to help you achieve your long-term vision. When the stakes are high, you need a partner that instinctively understands your systems, your goals, and your pressures. PICOSUN® Sprinter means perfect ALD – not only the hardware, but solid partnership and comprehensive, proactive consultancy and support throughout your ALD journey.

### **QUALITY AND PRODUCTIVITY AT ANY SCALE**

We are a value-driven company, with a relentless focus on quality in everything we do. We have an extensive portfolio of long-term relationships with partners in manufacturing at every level, including the world's leading companies in their own markets. We have over forty years of experience in the field, and now we are bringing that to provide the world's most elegant, large-scale ALD batch production systems. Nobody else can offer the same film quality, throughput, and reliability. PICOSUN® Sprinter means ALD done the right way, at any scale.

### **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 always ready to serve you. Our superior expertise in ALD processes will enable material combinations and film structure tailoring to optimize the properties of your ALD coating. This guarantees that your products will have exactly the performance you need to satisfy and exceed your customers' expectations. PICOSUN® Sprinter means the film quality of single-wafer reactors scaled to mass production volumes.





**RELIABLE**

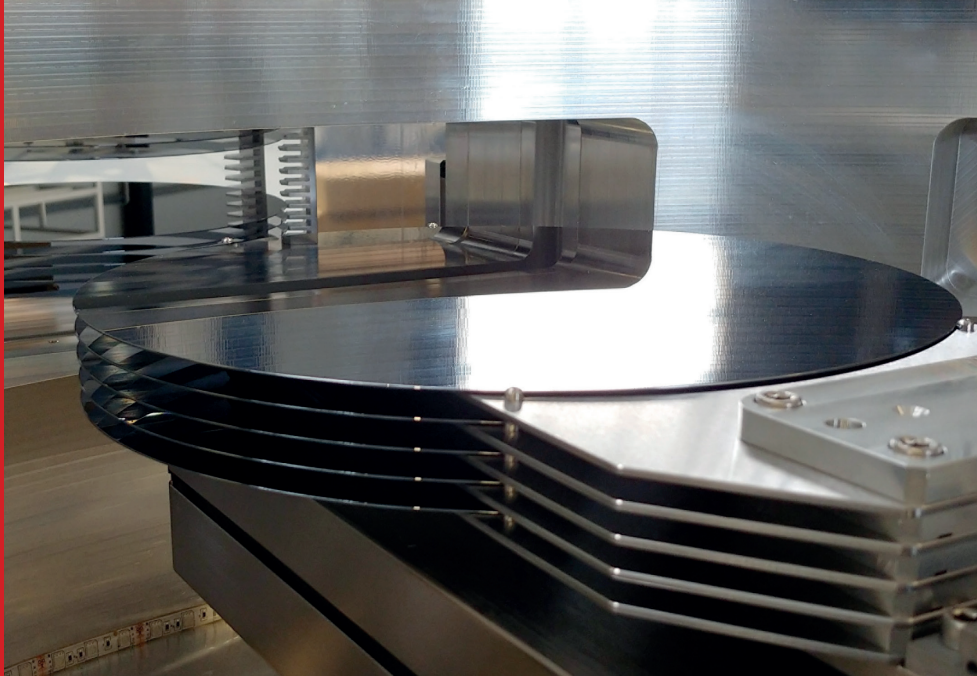
## CONSULTANCY

Our journey with our customers begins with comprehensive consultancy services. We delve into the details with you to map how our ALD technology can help you achieve your goals, no matter the scale.

We invented ALD, and it's all we do. We've remained in the vanguard of the technology for over 40 years, with over 15 generations of cutting-edge equipment and systems. 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 the most demanding, fast-paced and rapidly changing business ecosystems. We have worked with customers from all branches of manufacturing, and now we are bringing our expertise into play at the largest scale. PICOSUN® Sprinter is an elegant, 300 mm batch production tool for semiconductor manufacturing. It is the ideal choice when you need high-quality, consistent thin film coatings and throughput and reliability are your key drivers.

This is ALD as it's never been done before – perfect ALD. Contact us to find out how we can work with you to create exactly the systems you need, at whatever scale your organization needs. Our consultancy service doesn't stop after we deliver your ALD equipment. We commit fully to long-term strategic partnerships with our customers. We invest in multi-year commitment to your precise needs, no matter how demanding. We will work with you to plan the exact specifications for your application, and our systems are copy-exact, with no changes or deviations from the specifications – ever.

Nobody else can offer the same degree of tailored precision, reliability and commitment. Let Picosun provide you with a truly all-inclusive, strategic partnership built on close, long-term relationships where safety, trust and reliability combine with operational conformity to supply the ultimate in throughput and yield, with maximum uptime.



**EFFICIENT**



## DELIVERY & INSTALLATION

PICOSUN® Sprinter is designed to integrate with minimum effort with your other systems. To achieve this, we offer installation and integration services that cover materials, design – and even software. We don't try to impose our systems on you; we integrate with your systems. In other words, Picosun doesn't call the shots – you do. We want our ALD systems to be an integral part of your entire production line. We can provide Sprinter modules to be attached to OEM clusters, or we can supply entire clusters designed to take full advantage of the capabilities of PICOSUN® Sprinter and featuring our unique wafer-transfer robots.

We guarantee on-time delivery and smooth installation. We work with you to plan the delivery, installation and integration, and we keep the promises we make. To get your ALD system into full-speed production as quickly as possible, we provide precise preinstallation 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 and maintenance, safety, and utilities, either in electronic format or printed (on cleanroom paper, if needed).

While the system is being produced, our automation engineers will initiate discussions with your ICT department for the SECS/GEM factory integration. By listing the functionalities and metrics your factory automation wants to communicate with your PICOSUN® ALD system, we can reduce the time needed to establish the factory connection after the system installation.

We take a comprehensive, holistic approach to our partnerships with our customers. The functionality of every element of the system is thoroughly and comprehensively tested at our factories in Finland before delivery, and again on-site after installation. These acceptance runs can be tailored according to your precise needs. We focus on flexibility and meeting your needs, so every aspect of delivery, installation and testing can be agreed during the negotiations.

**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 repairs and scheduled maintenance.

Especially in a demanding business environment such as semiconductor manufacturing, where the strictest quality requirements apply for processes and products, 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 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.

Picosun provides scalable, modular and highly customizable training that can easily adapt to the needs of your business. We have training programs for production staff, focusing on the technical features and practical, hands-on use of your ALD system. 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, D.Sc. or Ph.D. level ALD experts.



## 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 ideal for the needs of full-scale production environments, adding value to your operations every day.

In mass production, PICOSUN® Sprinter provides maximum uptime and impeccable process quality with the highest yields and added value. The scheduled maintenance of PICOSUN® ALD tools is based on easy-to-swap kits, and the actual maintenance work can be concluded within hours (excluding cooling, heating, and qualification runs). Picosun's 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 and fulfil your customers' requirements. Our services cover everything from preventive maintenance to more advanced beta support for new processes, upgrades, and the like.

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 ("man-in-the-box"), 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 capacity. In addition to Picosun's own global service team, we have a network of local distributors and representatives with trained and certified service engineers ready to help you.

Contacting Picosun's service department is easy. Our technical support is always available via email or phone, and we serve you in all major languages.

For our products, we offer a one-year warranty as a standard for non-consumable items and certified engineer work.



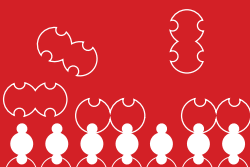
## THE PRINCIPLE OF ALD



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

### PICOSUN HQ

Email: [info@picosun.com](mailto:info@picosun.com)

Tel. +358 50 321 1955

### Picosun Oy

Tietotie 3

FI-02150 Espoo, Finland

### Picosun Oy (factories)

Masalantie 365

FI-02430 Masala, Finland

### PICOSUN BRANCH OFFICES

Email: [sales@picosun.com](mailto:sales@picosun.com)

### Picosun Europe

Tel. +49 1522 449 49 11 (Germany)

Tel. +33 60 785 1176 (France)

### Picosun USA

Tel. +1 214 790 0844

Mobile +1 972 482 1433

### Picosun Asia, Singapore

Tel. +65 9830 1709

### Picosun Taiwan

Tel. +886 90 515 2985

### Picosun China

Tel. +86 139 2640 6106

### Picosun Japan

Tel. +81 3 6431 9500

Mobile +81 70 1070 5116

### Picosun Korea

Tel. +358 40 825 1703

### Picosun India

Tel. +91 96000 28593

This technology is protected via  
granted patents or is the subject of  
pending patent applications.

PICOSUN® Sprinter · Version 1\_2021