

Market Share Analysis: Semiconductor Wafer Fab Equipment, Worldwide, 2021

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Initiatives: [Technology Market Essentials](#)

The semiconductor wafer fab equipment market grew by 42.3% to \$92.3 billion in 2021. This was driven by aggressive investments from leading-edge logic players and recovery by memory companies after two consecutive years of conservative spending.

Overview

Key Market Findings

- The rapid thermal processing (RTP) and oxidation/diffusion segment reported the strongest growth at 71.3%. This was driven by gate stack tools and plasma gate modification tools, which are required for building dielectric layers/gate material deposition and modifying the surface of the transistor, respectively.
- Lithography grew at 26.6%, below the market average, due to supply chain/logistic constraints that caused shipping/parts delays.
- Other wafer fab equipment (WFE) categories exhibited growth between 43% and 49%, similar to the overall market growth, due to strong demand across a wide range of applications and nodes.

Vendor Performance Highlights

- Tokyo Electron Ltd. (TEL) posted the strongest growth among the top five players at 62.2%, driven primarily by growth in the dielectric etch and chemical vapor deposition (CVD) segments.
- PSK and JUSUNG ENGINEERING registered strong growth at 113.8% and 237.9%, respectively, driven by market share gains in dry strip and atomic layer deposition (ALD)/plasma CVD, respectively, due to close relations with domestic memory players in South Korea.
- Nikon and Sumitomo Heavy Industries Ion Technology (SMIT) had the biggest revenue drops at 70.5% and 51.1%, respectively, driven by market share loss to other players in steppers and implant segments, respectively.

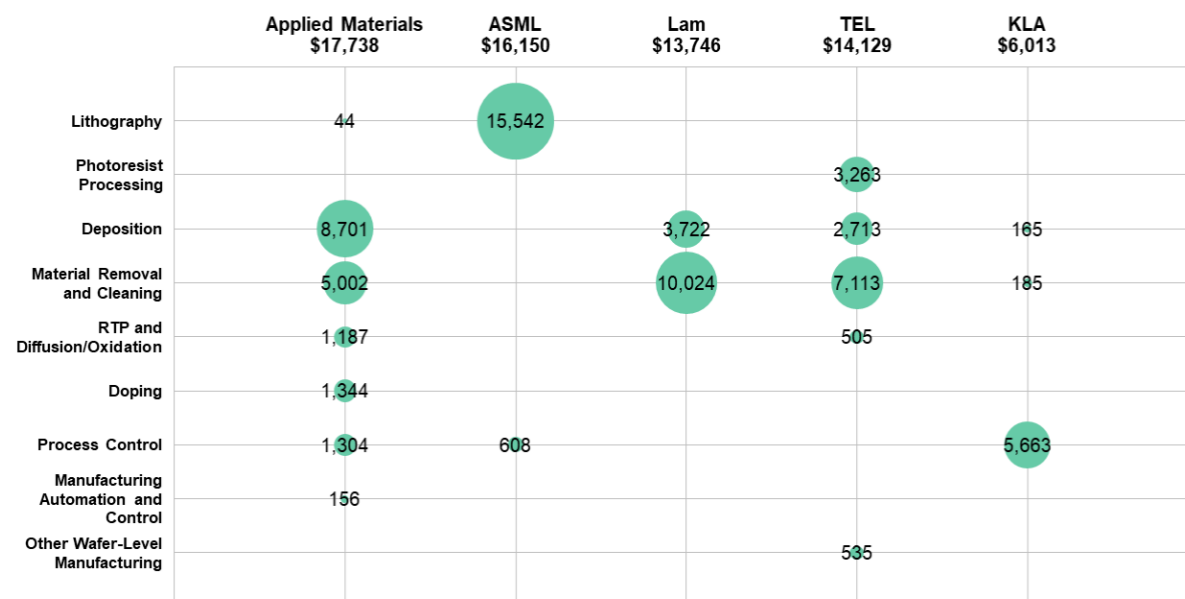
Market Share Data

This document was revised on 18 April 2022. The document you are viewing is the corrected version. For more information, see the [Corrections](#) page on gartner.com.

The worldwide semiconductor WFE market grew by 42.3% to \$92.3 billion in 2021. Figure 1 shows the top five semiconductor WFE vendors worldwide, ranked by their total shipment revenue in 2021, including the breakdown by equipment category. ASML and KLA continue to enjoy dominant positions in lithography and process control, respectively. Applied Materials, TEL and Lamalso posted growth across most segments. This was driven by a combination of memory players that are on a recovery path after two slow years of investments and aggressive spending by leading-edge logic players responding to strong demand for multiple applications. In addition, China continues to invest in building a domestic chip ecosystem. Further, chip players across the globe are trying to expand fab capacity by leveraging government subsidies and long-term agreements/prepayments from clients, who are responding to new ways of establishing their supply chain in response to chip shortages.

Figure 1: Top Five Companies' Revenue From Shipments of Total Semiconductor Wafer Fab Equipment, Worldwide

Top Five Semiconductor Wafer Fab Equipment Providers, Worldwide, 2021
Revenue (Millions of U.S. Dollars)



Source: Gartner (April 2022)

Note: The size of the bubble and value equal 2021 revenue (millions of U.S. dollars), and the color coding equals positive or negative year-over-year change. A green bubble represents positive change, and a red bubble represents negative change.

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Table 1 shows the top 10 semiconductor WFE vendors worldwide, ranked by their total shipment revenue in 2021. The top 10 ranking has few changes over 2020. The most prominent change was Murata Machinery moving back into the top 10 with a strong 2021 at 89.9% growth, driven by revenue of its automated material handling systems (AMHSs) as chip players invested in “greenfield” capacity, especially in China. KOKUSAI ELECTRIC moved up two places with strong performances in the tube CVD and plasma gate modification tool segments.

Table 1: Top 10 Companies' Revenue From Shipments of Total Semiconductor Wafer Fab Equipment, Including Wafer-Level Packaging, Worldwide (Millions of Dollars)

(Enlarged table in Appendix)

Rank 2020	Rank 2021	Company	Revenue 2020	Revenue 2021	Change (%)	Share (%) 2021
1	1	Applied Materials	12,078.9	17,738.1	46.9	19.2
2	2	ASML	11,758.2	16,149.9	37.4	17.5
4	3	TEL	8,711.2	14,128.8	62.2	15.3
3	4	Lam	9,722.5	13,746.4	41.4	14.9
5	5	KLA	4,186.3	6,012.8	43.6	6.5
7	6	SEMES	1,392.1	2,214.2	59.0	2.4
6	7	SCREEN Semiconductor Solutions	1,677.2	2,199.6	31.1	2.4
10	8	KOKUSAI ELECTRIC	1,046.4	1,783.1	70.4	1.9
9	9	ASM	1,198.4	1,665.6	39.0	1.8
14	10	Murata Machinery	641.9	1,218.8	89.9	1.3
		Other Companies	12,491.5	15,477.5	23.9	16.8
		All Companies	64,904.7	92,334.8	42.3	100.0
Note: Some columns may not add to totals shown because of rounding.						

Source: Gartner (April 2022)

Overall Market Segment Performance Analysis

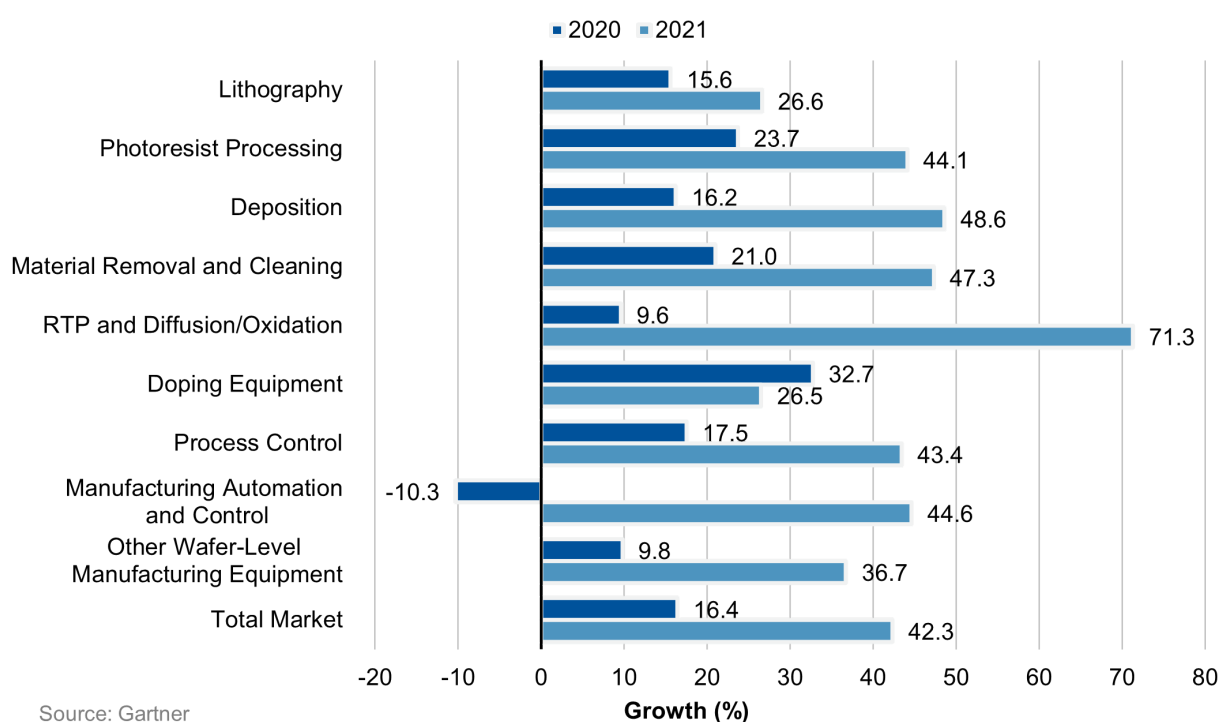
In 2021, the semiconductor manufacturing equipment market experienced another year of positive growth after a decent 2020 due to strong investment across the board, with key influencers being:

- Logic:
 - Strong demand for leading-edge devices in smartphones, servers, gaming and communication led leading-edge logic players to continue to invest in fab expansion. Additionally, a strong sentiment to improve domestic chip manufacturing in the EU and U.S. and diversification by Taiwanese foundries led to strong WFE growth.
 - Strong demand for automotive and industrial electronics led foundries/integrated device manufacturers (IDMs) that focus on legacy/mature nodes to spend on increasing fab capacity.
- Recovery in memory spending was driven by both DRAM and NAND after two consecutive years of conservative investments. DRAM players are increasing extreme ultraviolet (EUV) adoption, while 3D NAND continues to scale with a higher number of layers, requiring additional deposition and material removal steps.
- Advanced packaging continues to gain traction as leading chip makers invest in this capability. Integration of 2.5/3D with chiplets uses some similar equipment as a front-end wafer fab and will continue to drive WFE growth over the next few years.
- The U.S.-China trade war:
 - China continues to invest, as it maintains its resolve of achieving integrated circuit (IC) self-sufficiency amid trade issues with the U.S. China as a geography contributes significantly to the revenue of all major WFE companies.
 - While there are only four domestic Chinese WFE firms in Gartner's Market Share report, each with less than 1.7% of overall market share, they exhibited strong growth (see [Market Share: Semiconductor Wafer Fab Equipment, Worldwide, 2021](#)). Several other smaller WFE players in China are also expected to grow over the next five years.

The relative growth rates for the major equipment segments are shown in Figure 2. Among the market segments, RTP and oxidation/diffusion exhibited the strongest growth. Various other segments, like process control, deposition, manufacturing automation and control, photoresist processing, and material removal and cleaning, performed in the similar range as the market average. Only lithography and doping exhibited growth much lower than the average, while other wafer-level manufacturing equipment that also includes packaging was only slightly lower than the industry average. Lithography in particular faced issues with supply chain/logistic disruptions that delayed shipping and/or caused parts unavailability. Doping posted slower growth as the high-energy implanters posted negative growth, with a drop in sales for SMIT.

Figure 2: Revenue Growth of Major Equipment Segments, 2020 and 2021

Revenue Growth of Major Equipment Segments, 2020 and 2021



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Here are highlights of the various equipment segments, as well as the impacts of key influencers:

- The material removal and cleaning segment had 47.3% growth in revenue, driven by photomask cleans (classified under “other cleans” in our Market Share research) and dielectric etch for application in advanced 3D structures, like NAND.

- RTP and diffusion/oxidation registered 71.3% growth in revenue for 2021, driven by gate stack tools used for dielectric layer growth with atomic-level precision.
- The manufacturing automation and control segment, which includes equipment that is critical for fab shells, posted positive growth at 44.6%, as chipmakers continue to expand in greenfield fab capacity.
- The process control segment recorded growth of 43.4%, similar to the industry average. This growth was driven by optical patterned wafer inspection, wafer-level packaging inspection and overlay metrology.
- The deposition segment experienced growth of 48.6%, better than the industry average. This growth was primarily driven by strong demand in the tube CVD and nontube low-pressure chemical vapor deposition (LPCVD) segments.
- Lithography and track combined grew in 2021 at 29.4%, with lithography at 26.6% and photoresist processing at 44.1%. Lower-than-industry-average growth for lithography was due to supply chain/logistic disruptions and parts unavailability. Lithography systems typically have a much more complex supply chain and dependence in terms of number of parts and/or suppliers.
- The doping segment, which includes ion implants, was another segment with lower-than-industry-average growth at 26.5%, driven by a drop in revenue for high-energy implanters, which can vary in sales due to the cyclical nature of memory.

Top Vendors Analyzed

Applied Materials

Applied Materials (hereafter referred to as Applied) maintained the No. 1 position and market share in wafer-level manufacturing equipment in 2021, while posting a 46.9% growth rate, slightly above the industry average of 42.3%.

The main influential factors and background of Applied's market performance in 2021 are as follows:

- In the process control segment, the company posted a 52.2% growth rate, higher than the industry average of 43.4% for this segment. Applied continues to strengthen its e-beam wafer inspection/metrology for patterned wafers. In 2021, it introduced the PROVISION 3E EBEAM METROLOGY system, enabling detailed imaging at 1 nm resolution at a rate of 10 million accurate, actionable measurements per hour. The company also posted strong growth in the scanning electron microscope (SEM) defect review and classification segment. In addition, Applied introduced several solutions for process control based on AI and big data: the Enlight Optical Inspection optical wafer inspection system and ExtractAI technology.
- Applied posted 44.7% growth in the material removal segment, slightly lower than the industry average of 47.3% in this segment, as it still struggles to gain any significant market presence in dielectric etch. The company continues to have a stronger market share in the conductor etch segment, which grew slower than the industry average for material removal. Applied also introduced the new 200 mm chemical mechanical polishing (CMP) system to remove silicon carbide material from wafers.
- In the deposition segment, the company posted 43.9% growth, lower than the industry average of 48.6% for this segment. Applied is still not a major player in the ALD segment and posted slower growth in nontube LPCVD.
- In the doping segment, the company's revenue increased by 48%, significantly higher than the industry average of 26.5%, as it posted strong growth in high- and medium-current implanters. Applied's new "hot implant" technology for silicon carbide chips injects ions with minimum damage to crystalline structures, thereby maximizing power generation and device yield.
- In the RTP and diffusion/oxidation segment, its revenue increased by 86.7%, which was better than the industry average of 71.3%, with strong growth in gate stack tools at 141.3%.

Applied continues to make technology improvements in key segments. Examples include the following:

- In 2021, Applied and A*STAR'S Institute of Microelectronics expanded their research partnership to accelerate advanced packaging integration with hybrid bonding technology. Applied also entered into a joint development agreement with EV Group (EVG) for co-optimized wafer-to-wafer hybrid bonding solutions.

- Applied continues to leverage its expertise in materials engineering for scaling leading-edge devices. It introduced the Draco hard mask for capacitor scaling and brought Black Diamond low-k dielectric to the DRAM Market.

ASML

In 2021, ASML maintained its No. 2 position and posted a 37.4% revenue increase, slightly lower than the industry average of 42.3%. This was driven by supply chain/logistic disruptions that caused the delay and/or unavailability of critical parts. ASML and its supply chain partners are actively adding and improving capacity to meet current and future customer demand.

ASML continues to maintain its leadership in lithography, driven primarily by shipping 42 EUV units in 2021. EUV business accounted for almost 46% of ASML's system sales in 2021, up from 43% in 2020. ASML also had strong sales growth in KrF and ArFi units in 2021, as it continues to improve its capabilities and as demand for legacy node devices stays high for applications in automotive, industrial and communications.

ASML's high numerical aperture (high-NA) program is in R&D, and manufacturing is progressing well, with one EUV 0.55 NA (EXE:5000) order received. Additionally, the company has made serious R&D progress in areas such as:

- Modular wafer clamps, ready for qualification in an EUV scanner
- An effective coating solution for wafer tables to ensure stability and longer lifetimes
- Water-cooled EUV mirrors to remove heat generated from EUV light

ASML continues to extend market leadership in voltage contrast inspection and physical defect inspection with the single-beam platform. The HMI eScan 430 delivers throughput improvement across various applications in logic, DRAM and 3D NAND. In 2021, ASML added the next-generation HMI eScan 1100 to its product portfolio. With a 5x5 image, it demonstrates multibeam operation, simultaneously scanning with 25 beams. The 5x5 system has higher sensitivity for detecting voltage contrast defects and physical defects, while substantially increasing inspection throughput. ASML's computational lithography solutions are used in the development of new chips to optimize reticle patterns and the setup of the lithography system to ensure robust, manufacturable designs that deliver high yields.

Lam

Lam dropped a spot in 2021 to move to the No. 4 position after being at No. 3 in 2020, while posting 41.4% growth, close to the industry average of 42.3%.

The highlights of Lam's market performance in 2021 are as follows:

- Lam posted 41.1% growth in the deposition segment, lower than the segment average of 48.6%, primarily due to weaker gains in the plasma CVD segment. It lost market share to Applied and Wonik IPS, both of which posted better growth than the segment average. Wonik IPS benefited from sales in the domestic market, while Applied bounced off from a low in 2020 when it had slow growth.
- Within material removal and cleaning, Lam's growth at 41.5% was less than the segment average of 47.3%, as the conductor etch segment where Lam has a strong presence posted weaker gains. Both NAURA Akzion and AMEC posted strong growth and market share gains in conductor etch with sales to domestic Chinese chip players.

In 2021, Lam continued to offer new products with innovative technologies:

- Lam introduced the next-generation high aspect ratio etch tool Vantex that combines equipment intelligence and new chamber design to enable the use of higher radio frequency (RF) power levels. This supports etch for high aspect ratio features at high throughput and achieves cost scaling.
- Lam also announced Syndion GP: a new product that provides deep silicon etch capabilities to develop next-generation power devices and power management ICs used in the automotive, electric power delivery and energy industries. Syndion GP is designed to support this precision manufacturing process and can be configured to manufacture devices at 200 mm and 300 mm wafer sizes. Currently, many power devices are manufactured on 200 mm diameter silicon wafers, but to support increased demand, production is migrating to 300 mm wafers.

TEL

TEL gained a position to move to the No. 3 spot in 2021, up from No. 4 in 2020, posting 62.2% growth, the highest among the top five players and much higher than the industry average of 42.3%. It retained leadership with 88.8% market share in photoresist processing, while gaining some market share at the expense of SCREEN Semiconductor Solutions. This segment might see some competition when Lam launches its dry resist solution into the market, which it has developed in collaboration with ASML.

TEL also gained low-single-digit market share in oxidation/diffusion by posting 72.3% growth, while the segment average was 61.0% growth. Both ASM and KOKUSAI ELECTRIC posted weaker gains in this segment.

In the material removal and cleaning segment, TEL posted 65.7% growth, better than the industry average of 47.3%. TEL gained market share in single wafer processors from Lam and SCREEN Semiconductor Solutions. This was driven by sales of its single wafer system launched in 2019, the CELLESTA series, which provides collapse-free drying and improved productivity at leading-edge nodes. TEL gained market traction with domestic Chinese chipmakers for memory as well as legacy node logic devices. TEL posted strong growth in the dielectric etch segment, driven by demand for both memory and foundry, supported by a ramp-up of its Vantex product family.

In the deposition segment, TEL had better performance by posting 78.4% growth as compared to the industry average of 48.6%. TEL posted strong results in the nontube LPCVD segment as the segment depicted increased demand for tungsten and tantalum nitride deposition in leading-edge devices. TEL continues to occupy a market leader position in batch ALD systems, with no competition as ASM International continues to focus on the single wafer ALD system. TEL also posted strong numbers in ECD, driven by logic.

In 2021, TEL announced an etch system for 300 mm power devices called Tactras-UDEMAE. The system is capable of applying the existing process library for 200 mm wafers to 300 mm processes. It also features a new function to suppress particle generation in the wafer bevel area, an ability critical to the manufacturing of discrete power devices. This is critical as with limited and constrained supply of 8-inch wafers and strong demand for automotive/industrial applications, chipmakers are migrating devices from the smaller wafer to the larger wafer size. TEL also introduced Prexa, a next-generation 300 mm wafer prober. 3D stacking is drawing the industry's attention as it enables leading-edge packaging that integrates multiple devices and/or heterogeneous devices. One of the constraints in advancing 2.5/3D packaging is testing of known good die in the package. Individual dies can be tested, but when packaged, it becomes even more essential that performance is retained. This system provides that capability.

KLA

In 2021, KLA's overall growth at 43.6% was close to the industry average of 42.3%. It maintained leadership in process control with 54.4% market share — slightly better than that in 2020. KLA continues its dominant market position in patterned and unpatterned wafer inspection, and optical/overlay metrology. KLA has strong relationships and presence with the top chipmakers and collaborates closely with them on process development, which helps it maintain this leading position. Unless there is a strong competing offering, there is no motivation for chip players to switch tool suppliers. Additionally, KLA has a strong AI/ML modeling group that provides expert analysis on data collected by its process control tools that helps chipmakers in making process/yield improvement decisions. This has helped KLA strengthen its position in process control.

In 2021, KLA announced the launch of four new products for automotive chip manufacturing: the 8935 high-productivity patterned wafer inspection system, the C205 broadband plasma patterned wafer inspection system, the Surfscan SP A2/A3 unpatterned wafer inspection system and the I-PAT in-line defect part average testing screening solution. These products are tailored for fabs making automotive chips and focus on detecting reliability issues. The automotive industry is going through major transformation with megatrends such as electrification, connectivity, advanced driver assistance and autonomous driving. This implies that vehicles require more chips, driving demand. With chips at the core of vehicle operations and safety applications, reliability is critical and automotive chips must meet strict quality standards. Automotive chips have a very stringent qualification criteria, and KLA's products are targeted toward this high-growth application segment.

Other Notable Vendors

Murata Machinery — The company posted strong gains in 2021 at 89.9% growth, after a lackluster 2020 with a market leadership position in AMHS. For manufacturing control equipment, Murata Machinery provides a variety of tools, such as overhead hoist transport, overhead shuttle, automated guided vehicles, carrier stockers and tool stations.

Eugene Technology — The company posted strong performance in the deposition segment with 79.7% growth, driven by the nontube LPCVD segment, critical for 3D NAND oxide/nitride stack and channel silicon. The company also posted strong growth for ALD platforms. In addition, Eugene Technology benefited from domestic purchases, similar to those purchases made from PSK and JUSUNG ENGINEERING.

Mergers and Acquisitions

In March 2021, Applied terminated the earlier proposed deal to acquire KOKUSAI ELECTRIC as it didn't get the required approvals by Chinese regulators in time.

Document Revision History

[Market Share Analysis: Semiconductor Wafer Fab Equipment, Worldwide, 2020 - 8 April 2021](#)

[Market Share Analysis: Semiconductor Wafer Fab Equipment, Worldwide, 2019 - 13 April 2020](#)

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[Market Share: Semiconductor Wafer Fab Equipment, Worldwide, 2020](#)

[Market Definitions and Methodology: Semiconductor Wafer Fab Equipment](#)

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