

Chapter 6: Deposition and Etch

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CITE AS Sharma, Yashvardhan. "Deposition and Etch." *Chip Supply Chain: How AI Chips Are Made*. Edition of 20 October 2026. <https://chipsupplychain.org/deposition-and-etch/>

CHAPTER

06

STAGE 6 OF 15

Deposition and Etch

Deposition and etch tools build a chip layer by layer. They are among the chipmaking tools where Chinese toolmakers gained the most share from 2019 to 2024.

IN PLAIN TERMS

Deposition and etch build the chip itself, one layer at a time. Deposition lays down a thin film, sometimes only a few atoms thick. Lithography prints a pattern on it. Etch then eats away everything the pattern does not protect, and the next film goes down on top. Making one chip takes 1,000 to 1,500 steps, the Semiconductor Industry Association estimated in 2025¹³. Some of the holes the etch cuts in memory chips are more than 50 times deeper than they are wide, like a finger-wide shaft about a meter deep¹⁴. The film has to coat them right to the bottom. The etch has to eat one material and leave the one beside it untouched. Applied Materials and Lam Research in America, Tokyo Electron in Japan and ASM International in the Netherlands make most of these machines. Chinese toolmakers have gained share in both kinds of tool since 2019.

¹³ Testimony of David Isaacs, Semiconductor Industry Association, hearing on "Trade in Critical Supply Chains". U.S. Senate Committee on Finance · 14 May 2025 · p. 2 [A](https://www.finance.senate.gov/download/051425-isaacs-testimony&download=1#page=2) www.finance.senate.gov/download/051425-isaacs-testimony&download=1#page=2

¹⁴ Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 5 December 2024 · p. 17 [A](https://www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=17) www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=17

IN SHORT

American companies held 60.3 percent of the world market for deposition tools in 2025, Japanese companies 14.0 percent and China-based companies 9.8 percent, by CSET's count from TechInsights data ². In etch and cleaning tools that year, American companies held 52.6 percent, Japanese companies 32.6 percent and China-based companies 10.1 percent ³⁴.

Atomic layer deposition tools coat a hole's walls and floor as evenly as its rim ⁷. China-based companies held only 2.6 percent of the world market for them in 2025, by CSET's count from TechInsights data ⁶. The December 2024 US export rule targets tools for advanced atomic layer deposition and for coating holes more than 200 times deeper than they are wide ⁴⁵.

² Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [A](https://chipexplorer.eto.tech/?parentNode=N35&selectedNode=N36)
chipexplorer.eto.tech/?parentNode=N35&selectedNode=N36

³⁴ Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [A](https://chipexplorer.eto.tech/?parentNode=N46&selectedNode=N55)
chipexplorer.eto.tech/?parentNode=N46&selectedNode=N55

⁷ Export Controls on Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 25 October 2023 · p. 16 [A](https://www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=16)
www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=16

⁶ Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [A](https://chipexplorer.eto.tech/?parentNode=N35&selectedNode=N41)
chipexplorer.eto.tech/?parentNode=N35&selectedNode=N41

⁴⁵ Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 5 December 2024 · p. 33 [A](https://www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=33)
www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=33

CHOKEPOINT CARD		HIGH CONCENTRATION
		MODERATELY HARD TO SUBSTITUTE
CONCENTRATION	SUBSTITUTABILITY	PRICE OR MARKET SIZE
High	Moderate In 2025 Lam Research held 41.1 percent of dry etch tools, Tokyo Electron 23.4 percent and Applied Materials 17.4 percent, by CSET's count from TechInsights data¹.	\$26.2B deposition tool market in 2025, by CSET's count from TechInsights data². Dry etch tools were a \$21.9B market in 2025¹
WHO LEADS	US Applied Materials 82.4% of physical vapor deposition tools in 2025, by CSET's count from TechInsights data³ US Lam Research 51.2% of conductor etch tools in 2025⁴ JP Tokyo Electron 55.9% of dielectric etch tools in 2025⁵ NL ASM International 54.5% of atomic layer deposition tools in 2025⁶ CN Naura 14.7% of physical vapor deposition tools in 2025³	
WHERE IT IS MADE	US United States Applied Materials, Lam Research JP Japan Tokyo Electron, Kokusai Electric NL Netherlands ASM International, atomic layer deposition KR South Korea Large equipment buyer CN China Naura, AMEC and Piotech, in the largest equipment market (\$49.3B in 2025)	
WHY SUBSTITUTION IS POSSIBLE	Atomic layer deposition lays down a film a fraction of a layer of atoms at a time ⁷ . At least five makers sell it ⁶ .	
WHERE CHINA STANDS Chinese toolmakers held 12.4 percent of dry etch in 2025, according to CSET's analysis of TechInsights data¹. CSET's earlier analysis of TechInsights data had them under 1 percent of atomic layer deposition in 2024⁸.		WHERE THE US STANDS A December 2024 US rule lists some dry etch, atomic layer deposition and deep-hole deposition tools as controlled exports⁹. Its foreign direct product rule reaches some tools built outside the United States¹⁰.

1 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026

chipexplorer.eto.tech/?parentNode=N46&selectedNode=N103

2 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026

chipexplorer.eto.tech/?parentNode=N35&selectedNode=N36

3 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026

chipexplorer.eto.tech/?parentNode=N35&selectedNode=N42

4 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026

chipexplorer.eto.tech/?parentNode=N46&selectedNode=N50

5 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026

chipexplorer.eto.tech/?parentNode=N46&selectedNode=N51

6 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026

chipexplorer.eto.tech/?parentNode=N35&selectedNode=N41

Applied Materials and Lam Research are the two largest deposition and etch suppliers. Applied Materials booked \$28.368 billion of revenue in fiscal 2025 ¹¹. Lam Research booked \$23.233 billion in fiscal 2026 ¹².

How it works

Most etch steps, and many deposition steps, happen in a vacuum chamber that holds one wafer at a time. A pump empties the chamber of air, and a measured flow of gas comes in. A radio-frequency field, an electric field that reverses millions of times a second, turns the gas into a plasma. The field splits the gas into charged ions and into neutral fragments called radicals, which are more reactive than whole molecules ¹⁵. Batch furnaces such as Tokyo Electron's TELINDY PLUS instead heat as many as 125 wafers at once, usually without plasma, for oxidation, low-pressure chemical vapor deposition and some atomic layer deposition ¹⁶.

In most deposition steps, the gas carries the material the film will be made of. The molecules, or the radicals a plasma splits from them, land on the wafer and stick. The film builds up a few atoms at a time.

To coat the floor of a deep hole as thickly as its rim, the machine can work in cycles, a method called atomic layer deposition. First one gas settles in a single layer on every surface, and the pump removes the rest. Then a second gas reacts with that layer and nothing else, and the pump empties the chamber again. Each cycle adds a fraction of a layer of atoms wherever the gas reached, so the film grows as evenly on a hole's walls and floor as on its rim ⁷.

For etch, the gas attacks one material and leaves the one beside it. Wherever the photoresist covers the wafer, it shields the film beneath. Wherever it does not, the radicals react with the surface and turn it into a gas, which the pump carries away. A second field pulls the ions straight down at the wafer, so the etch cuts

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- 7 Export Controls on Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 25 October 2023 · p. 16 [\[A\]](https://www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=16)
- 6 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N35&selectedNode=N41)
- 1 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N46&selectedNode=N103)
- 8 Inside Beijing's Chipmaking Offensive. Center for Security and Emerging Technology (CSET) · 14 July 2025 [\[A\]](https://cset.georgetown.edu/article/inside-beijings-chipmaking-offensive/)
- 9 Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 5 December 2024 · p. 32 [\[A\]](https://www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=32)
- 10 Commerce Strengthens Export Controls to Restrict China's Capability to Produce Advanced Semiconductors for Military Applications. U.S. Bureau of Industry and Security · 2 December 2024 [\[A\]](https://www.bis.gov/press-release/commerce-strengthens-export-controls-restrict-chinas-capability-produce-advanced-semiconductors-military)
- 11 Revenue from Contract with Customer, Excluding Assessed Tax (us-gaap:RevenueFromContractWithCustomerExcludingAssessedTax) reported by APPLIED MATERIALS INC /DE, XBRL company concept data. U.S. Securities and Exchange Commission (XBRL data for APPLIED MATERIALS INC /DE) · Accessed 9 September 2026 [\[A\]](https://data.sec.gov/api/xbrl/companyconcept/CIK0000006951/us-gaap/RevenueFromContractWithCustomerExcludingAssessedTax.json)
- 12 LAM RESEARCH CORP, Form 8-K current report for the period ended 2026-07-29 (8-K). U.S. Securities and Exchange Commission (filing by LAM RESEARCH CORP) · 29 July 2026 [\[A\]](https://www.sec.gov/Archives/edgar/data/707549/000070754926000033/lrcx_exhibitx991xq4x2026.htm)
- 15 Etch Essentials: The Building Blocks of AI Era Microchips (Semi 101). Lam Research · 12 June 2024 [\[A\]](https://newsroom.lamresearch.com/etch-essentials-semiconductor-manufacturing)
- 16 TELINDY™ Series. Tokyo Electron · Accessed 9 September 2026 [\[A\]](https://www.tel.com/product/telindy.html)

vertically and a narrow hole keeps its width as it deepens ¹⁵. When the etch reaches the material underneath, which the gas was chosen not to touch, it slows almost to a stop, and the tool ends the step.

The US export controls describe each deposition or etch tool by the process it is designed to run ¹⁷.

Accenture and the Global Semiconductor Alliance estimated in 2020 that a part-finished chip can cross international borders 70 or more times on its way to the end customer ¹³. The Semiconductor Industry Association repeated the figure in 2025 ¹³.

Variants and trade-offs

Deposition families

The market sizes and leading shares below are 2025 figures from Georgetown University's Center for Security and Emerging Technology (CSET), based on data from the research firm TechInsights. CSET puts the deposition tool market at \$26.2 billion ². It puts the dry etch market at \$21.9 billion ¹.

- **Physical vapor deposition (PVD)**, which knocks atoms off a solid target and lands them on the wafer, was a \$4.9 billion market in 2025 ³. Applied Materials held 82.4 percent of it and China's Naura 14.7 percent ³.
- **Chemical vapor deposition (CVD)**, which reacts gases at the wafer surface to grow a film, was an \$11.2 billion market in 2025, led by Applied Materials at 47 percent ¹⁸. The plasma-enhanced version (PECVD) runs cooler and made up most of it, \$7.5 billion ¹⁹.
- **Atomic layer deposition (ALD)** lays down less than one atomic layer at a time. Each step stops once every surface is covered, so it coats vertical walls as

¹⁵ Etch Essentials: The Building Blocks of AI Era Microchips (Semi 101). Lam Research · 12 June 2024 [\[A\]](https://newsroom.lamresearch.com/etch-essentials-semiconductor-manufacturing)
newsroom.lamresearch.com/etch-essentials-semiconductor-manufacturing

¹⁷ Export Controls on Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 25 October 2023 · p. 28 [\[A\]](https://www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=28)
www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=28

¹³ Testimony of David Isaacs, Semiconductor Industry Association, hearing on “Trade in Critical Supply Chains”. U.S. Senate Committee on Finance · 14 May 2025 · p. 2 [\[A\]](https://www.finance.senate.gov/download/051425-isaacs-testimony&download=1#page=2)
www.finance.senate.gov/download/051425-isaacs-testimony&download=1#page=2

² Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N35&selectedNode=N36)
chipexplorer.eto.tech/?parentNode=N35&selectedNode=N36

¹ Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N46&selectedNode=N103)
chipexplorer.eto.tech/?parentNode=N46&selectedNode=N103

³ Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N35&selectedNode=N42)
chipexplorer.eto.tech/?parentNode=N35&selectedNode=N42

¹⁸ Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N35&selectedNode=N47)
chipexplorer.eto.tech/?parentNode=N35&selectedNode=N47

¹⁹ Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N35&selectedNode=N38)
chipexplorer.eto.tech/?parentNode=N35&selectedNode=N38

evenly as horizontal floors. US regulators say that even coating makes it important for building 3D structures, such as 3D DRAM, 3D NAND, and the FinFET and gate-all-around transistors in logic chips⁷. ASM International leads it with 54.5 percent of a \$4.1 billion market in 2025⁶.

- **Epitaxy** grows layers that line up with the crystal beneath them, using high-temperature CVD tools²⁰. **Electroplating** deposits the copper used for wiring across the wafer²¹.

Etch families

- **Conductor etch**, which cuts gates, metals and silicon, was a \$12.2 billion market in 2025, led by Lam at 51.2 percent, by CSET's count from TechInsights data⁴.
- **Dielectric etch**, which cuts the insulating oxides and nitrides between them, was an \$8.7 billion market in 2025, led by Tokyo Electron at 55.9 percent, by CSET's count from TechInsights data⁵.
- **High-aspect-ratio etch** cuts the deep, narrow channels that let 3D NAND stack layers of memory cells²². Lam says slight departures from a channel's intended shape can hurt yield²². Lam runs this etch well below 0 degrees Celsius²². It says its Cryo 3.0 technology can etch channels up to 10 microns deep whose width varies from top to bottom by less than 0.1 percent of their depth²².

7 Export Controls on Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 25 October 2023 · p. 16 [\[A\]](https://www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=16) www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=16

6 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N35&selectedNode=N41) chipexplorer.eto.tech/?parentNode=N35&selectedNode=N41

20 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N35&selectedNode=N40) chipexplorer.eto.tech/?parentNode=N35&selectedNode=N40

21 The Semiconductor Supply Chain - Issue Brief. Center for Security and Emerging Technology (CSET) · 21 January 2021 · p. 39 [\[A\]](https://cset.georgetown.edu/wp-content/uploads/The-Semiconductor-Supply-Chain-Issue-Brief-1.pdf#page=39) cset.georgetown.edu/wp-content/uploads/The-Semiconductor-Supply-Chain-Issue-Brief-1.pdf#page=39

4 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N46&selectedNode=N50) chipexplorer.eto.tech/?parentNode=N46&selectedNode=N50

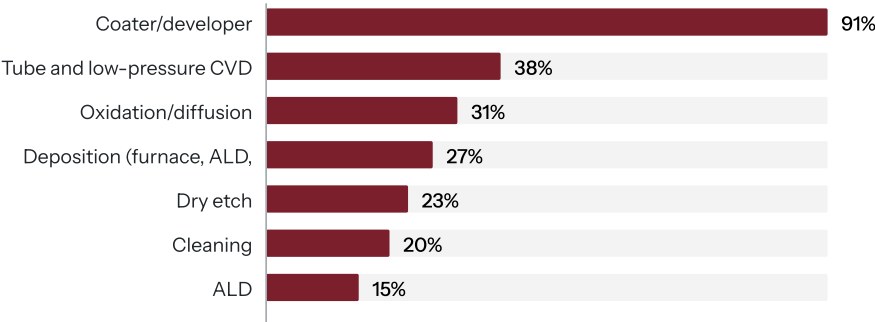
5 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N46&selectedNode=N51) chipexplorer.eto.tech/?parentNode=N46&selectedNode=N51

22 Lam Research Introduces Lam Cryo™ 3.0 Cryogenic Etch Technology to Accelerate Scaling of 3D NAND for the AI Era. Lam Research · 31 July 2024 [\[A\]](https://newsroom.lamresearch.com/2024-07-31-Lam-Research-Introduces-Lam-Cryo-TM-3-0-Cryogenic-Etch-Technology-to-Accelerate-Scaling-of-3D-NAND-for-the-AI-Era) newsroom.lamresearch.com/2024-07-31-Lam-Research-Introduces-Lam-Cryo-TM-3-0-Cryogenic-Etch-Technology-to-Accelerate-Scaling-of-3D-NAND-for-the-AI-Era

AI hardware needs sideways cuts, deeper holes and a second stack of metal wiring on the back of the wafer.

- **Gate-all-around** transistors need highly selective isotropic etch, which cuts sideways²³. The US Bureau of Industry and Security (BIS) controls isotropic dry etch tools that remove silicon-germanium at least 100 times faster than silicon, a selectivity of 100:1 or more¹⁷.
- **HBM** (high-bandwidth memory) needs holes etched straight through the silicon, called through-silicon vias (TSVs), so chips can be stacked and wired²⁴. BIS controls the tools that etch these holes at aspect ratios (depth to width) of 10:1 or more and at rates above 7 microns a minute⁹. The control covers only tools that also keep the holes' depth even to within 2 percent across the wafer⁹.
- **Backside power delivery** moves the wires that carry power to the back of the wafer²⁵. In July 2024 Applied Materials said it expected backside power to add \$1 billion to the market for its wiring tools, for every 100,000 wafers a month of new fab capacity²⁶.

Tokyo Electron world market share by tool type, 2025 %



Source: Gartner, as reported in Tokyo Electron's FY2026 Q4 results presentation

Who makes it

The industry association SEMI put world sales of chipmaking equipment at \$135.1 billion in 2025, up 15 percent from \$117.1 billion²⁸. Sales of wafer processing

23 **Export Controls on Semiconductor Manufacturing Items.** U.S. Government Publishing Office (Federal Register) · 25 October 2023 · p. 15 www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=15

17 **Export Controls on Semiconductor Manufacturing Items.** U.S. Government Publishing Office (Federal Register) · 25 October 2023 · p. 28 www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=28

24 **Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items.** U.S. Government Publishing Office (Federal Register) · 5 December 2024 · p. 15 www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=15

9 **Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items.** U.S. Government Publishing Office (Federal Register) · 5 December 2024 · p. 32 www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=32

25 **PowerVia Test Shows Industry-Leading Performance.** Intel · 5 June 2023 download.intel.com/newsroom/archive/2025/en-us-2023-06-05-powervia-test-shows-industry-leading-performance.pdf

26 **Applied Materials Unveils Chip Wiring Innovations for More Energy-Efficient Computing.** GlobeNewswire (release by Applied Materials) · 8 July 2024 www.globenewswire.com/news-release/2024/07/08/2909540/0/en/applied-materials-unveils-chip-wiring-innovations-for-more-energy-efficient-computing.html

28 **SEMI Reports Global Semiconductor Equipment Billings Reached \$135 Billion in 2025, Up 15% Year-on-Year.** SEMI · 7 April 2026 www.semi.org/en/SEMI-Reports-Global-Semiconductor-Equipment-Billings-Reached-135-Billion-in-2025

equipment, the category that includes deposition and etch tools, rose 12 percent²⁸.

No one firm dominates deposition and etch the way ASML dominates lithography. In dry etch, CSET's count for 2025 from TechInsights data puts Lam Research at 41.1 percent, Tokyo Electron at 23.4 percent and Applied Materials at 17.4 percent¹. Tokyo Electron's own results presentation, citing Gartner, gives it 23 percent of dry etch, 27 percent of deposition systems (furnace, ALD and low-pressure CVD tools) and 15 percent of ALD in 2025²⁷. The same presentation, again citing Gartner, gives it 91 percent of coater/developers in 2025²⁷. These machines coat wafers with photoresist and develop the pattern after lithography.

ASM International, the atomic layer deposition specialist, reached a record EUR 3.2 billion of revenue in 2025 as customers built 2 nm gate-all-around capacity²⁹. Molybdenum ALD, a new use of its tools that deposits the metal molybdenum, entered volume production that year²⁹.

What the world spent on chipmaking equipment \$B



Source: SEMI, Worldwide Semiconductor Equipment Market Statistics

China and the controls

China is the tool vendors' largest market, buying \$49.3 billion of equipment in 2025, half a percent less than in 2024²⁸. Taiwan's spending rose 90 percent to \$31.5 billion²⁸. South Korea's rose 26 percent to \$25.8 billion²⁸. China still takes a large share of every major vendor's sales.

- **Tokyo Electron:** 34.1 percent of sales in the year to March 2026, down from 41.7 percent³⁰. It was 30.4 percent in the quarter to June 2026³¹.

28 SEMI Reports Global Semiconductor Equipment Billings Reached \$135 Billion in 2025, Up 15% Year-on-Year. SEMI · 7 April 2026 [\[A\]](https://www.semi.org/en/SEMI-Reports-Global-Semiconductor-Equipment-Billings-Reached-135-Billion-in-2025) www.semi.org/en/SEMI-Reports-Global-Semiconductor-Equipment-Billings-Reached-135-Billion-in-2025

1 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N46&selectedNode=N103) chipexplorer.eto.tech/?parentNode=N46&selectedNode=N103

27 FY2026 (April 2025-March 2026) Financial Announcement, transcript. Tokyo Electron · 30 April 2026 · p. 28 [\[A\]](https://www.tel.com/ir/library/report/pjuomj00000000tf-att/fy26q4transcript-e.pdf#page=28) www.tel.com/ir/library/report/pjuomj00000000tf-att/fy26q4transcript-e.pdf#page=28

29 ASM reports Q4 and full-year 2025 results. ASM International · 3 March 2026 · p. 2 [\[A\]](https://www.asm.com/media/yvxbavwe/20260303-asm-reports-q4-and-full-year-2025-results.pdf#page=2) www.asm.com/media/yvxbavwe/20260303-asm-reports-q4-and-full-year-2025-results.pdf#page=2

30 FY2026 (April 2025-March 2026) Financial Announcement, transcript. Tokyo Electron · 30 April 2026 · p. 27 [\[A\]](https://www.tel.com/ir/library/report/pjuomj00000000tf-att/fy26q4transcript-e.pdf#page=27) www.tel.com/ir/library/report/pjuomj00000000tf-att/fy26q4transcript-e.pdf#page=27

31 Q1 FY2027 (April-June 2026) Financial Announcement, transcript. Tokyo Electron · 30 July 2026 · p. 6 [\[A\]](https://www.tel.com/ir/library/report/i242su0000000goz-att/fy27q1transcript-e.pdf#page=6) www.tel.com/ir/library/report/i242su0000000goz-att/fy27q1transcript-e.pdf#page=6

- **Lam Research:** about 34 percent of revenue in the year to June 2026, the same as a year earlier ³².
- **Applied Materials:** 28 percent in the third fiscal quarter of 2026, down from 35 percent a year earlier ³³.
- **ASM International:** more than 30 percent of 2025 revenue ²⁹.

Between 2019 and 2024, by CSET's analysis of TechInsights data, China-based suppliers went from 2 to 7 percent of deposition and from under 3 to almost 9 percent of etch and clean ⁸. In ALD they gained no share and held less than 1 percent in 2024 ⁸.

CSET's newer analysis of data that TechInsights published in July 2026 puts them at 9.8 percent of deposition in 2025 ². They held 10.1 percent of etch and clean that year ³⁴. In dry etch alone their share was 12.4 percent ¹. In ALD they held 2.6 percent in 2025, most of it from Piotech ⁶.

The Chinese toolmaker AMEC alone held 12.4 percent of dielectric etch in 2025, by CSET's count from TechInsights data ⁵. Its revenue was RMB 12.385 billion that year, up about 36.62 percent, and it spent RMB 3.744 billion on research and development, 30.2 percent of sales ³⁵.

The United States tightened its export controls at least five times between 2022 and 2025.

- **October 2022.** The 7 October interim final rule required a license for certain chipmaking equipment, and for some activities by US persons that support the making of certain chips in China ³⁶. It also extended US license rules to more

32 LAM RESEARCH CORP, Form 10-K annual report for the period ended 2026-06-28 (10-K). U.S. Securities and Exchange Commission (filing by LAM RESEARCH CORP) · 7 August 2026 [A]
www.sec.gov/Archives/edgar/data/707549/000070754926000037/lrcx-20260628.htm

33 Applied Materials Announces Third Quarter 2026 Results. GlobeNewswire (release by Applied Materials) · 13 August 2026 [A]
www.globenewswire.com/news-release/2026/08/13/3344890/0/en/applied-materials-announces-third-quarter-2026-results.html

29 ASM reports Q4 and full-year 2025 results. ASM International · 3 March 2026 · p. 2 [A] www.asm.com/media/yvxbavwe/20260303-asm-reports-q4-and-full-year-2025-results.pdf#page=2

8 Inside Beijing's Chipmaking Offensive. Center for Security and Emerging Technology (CSET) · 14 July 2025 [A]
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5 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [A]
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35 AMEC holds its 2025 annual results briefing (中微公司成功举办2025年度业绩说明会). Advanced Micro-Fabrication Equipment (AMEC) · 1 April 2026 [A] www.amec-inc.com/news/708.html

36 Implementation of Additional Export Controls: Certain Advanced Computing and Semiconductor Manufacturing Items; Supercomputer and Semiconductor End Use; Entity List Modification. U.S. Government Publishing Office (Federal Register) · 13 October 2022 · p. 1 [A] www.govinfo.gov/content/pkg/FR-2022-10-13/pdf/2022-21658.pdf#page=1

foreign-made items bound for 28 Chinese entities on the Entity List, the US list of foreign firms that exporters need a license to supply ³⁶.

- **October 2023.** The October rule, effective 17 November, rewrote the equipment entries ³⁷. It added sideways (isotropic) and vertical (anisotropic) dry etch (ECCN 3B001.c.1), spatial ALD (3B001.d.9), low-fluorine tungsten ALD and CVD (3B001.d.10) and carbon hard mask PECVD (3B001.d.5) ⁷.
- **December 2024.** BIS controlled 24 more types of equipment and three types of software, and added 140 entities to the Entity List ¹⁰. The new equipment entries include TSV etch, and deposition into features with aspect ratios above 200:1 ³⁸. BIS also wrote a foreign direct product rule that reaches some tools built outside the United States ¹⁰. The rule largely exempts foreign-made tools exported by firms located in Japan, the Netherlands and the 31 other countries it lists, whose governments can control these tools themselves ³⁹. Japan added advanced chipmaking equipment to its control list on 23 July 2023 ⁴⁰.
- **September 2025.** BIS removed the Chinese units of Samsung and SK hynix, and Intel Semiconductor (Dalian), from the Validated End-User program, effective 31 December 2025 ⁴¹. From that date, US tools bound for them need a license ⁴¹. BIS estimated that the change would add 1,000 license applications a year ⁴¹.
- **September 2025.** The Affiliates Rule extended Entity List restrictions to any company at least 50 percent owned by a listed entity ⁴². BIS then suspended it

36 Implementation of Additional Export Controls: Certain Advanced Computing and Semiconductor Manufacturing Items; Supercomputer and Semiconductor End Use; Entity List Modification. U.S. Government Publishing Office (Federal Register) · 13 October 2022 · p. 1 [A](https://www.govinfo.gov/content/pkg/FR-2022-10-13/pdf/2022-21658.pdf#page=1)

37 Export Controls on Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 25 October 2023 · p. 1 [A](https://www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=1)

7 Export Controls on Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 25 October 2023 · p. 16 [A](https://www.govinfo.gov/content/pkg/FR-2023-10-25/pdf/2023-23049.pdf#page=16)

10 Commerce Strengthens Export Controls to Restrict China's Capability to Produce Advanced Semiconductors for Military Applications. U.S. Bureau of Industry and Security · 2 December 2024 [A](https://www.bis.gov/press-release/commerce-strengthens-export-controls-restrict-chinas-capability-produce-advanced-semiconductors-military)

38 Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 5 December 2024 · p. 16 [A](https://www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=16)

39 Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 5 December 2024 · p. 28 [A](https://www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=28)

40 Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 5 December 2024 · p. 21 [A](https://www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=21)

41 Revocation of Validated End-User Authorizations in the People's Republic of China. U.S. Government Publishing Office (Federal Register) · 2 September 2025 [A](https://www.govinfo.gov/content/pkg/FR-2025-09-02/html/2025-16735.htm)

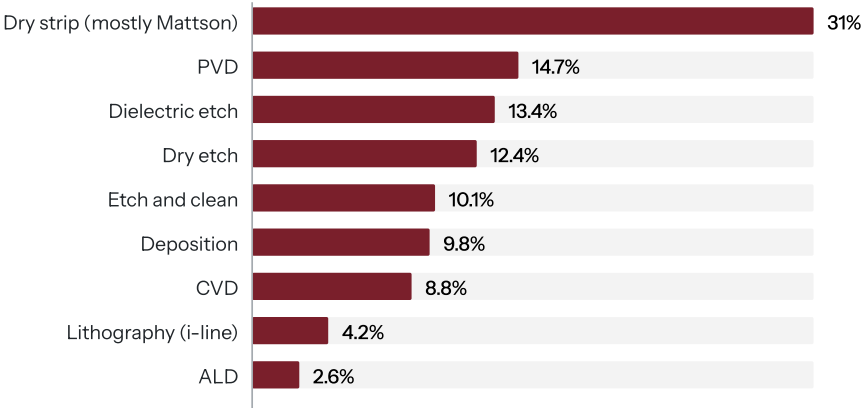
42 Expansion of End-User Controls to Cover Affiliates of Certain Listed Entities. U.S. Government Publishing Office (Federal Register) · 30 September 2025 · p. 1 [A](https://www.govinfo.gov/content/pkg/FR-2025-09-30/pdf/2025-19001.pdf#page=1)

until 9 November 2026 ⁴³.

The rules apply to the toolmakers as well as to their customers. In fiscal 2026 Applied Materials took a \$253 million charge to settle an export controls compliance matter with BIS ³³.

Of the tools in the chart below, China-based suppliers have their largest share in dry stripping, which clears leftover photoresist off the wafer and was a \$314.6 million market in 2025, by CSET's count from TechInsights data ⁴⁴. Kokusai held 35.7 percent of it, Mattson Technology 22.6 percent and Naura 8.3 percent ⁴⁴. Mattson is a US-based firm that Beijing E-Town bought in 2016 ⁸.

China-based suppliers' share of global tool segments, 2025 %



Source: CSET analysis of TechInsights data (published July 2026), ETO Chip Explorer

The chokepoint

Deposition and etch tools are a chokepoint, but a weaker one than lithography. Most deposition and etch steps have three or four credible vendors. Atomic layer deposition has at least five ⁶. The December 2024 rule targets tools for advanced atomic layer deposition and for coating holes more than 200 times deeper than they are wide ⁴⁵.

43 One Year Suspension of Expansion of End-User Controls for Affiliates of Certain Listed Entities. U.S. Government Publishing Office (Federal Register) · 12 November 2025 ^[A] www.govinfo.gov/content/pkg/FR-2025-11-12/pdf/2025-19846.pdf

33 Applied Materials Announces Third Quarter 2026 Results. GlobeNewswire (release by Applied Materials) · 13 August 2026 ^[A] www.globenewswire.com/news-release/2026/08/13/3344890/0/en/applied-materials-announces-third-quarter-2026-results.html

44 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 ^[A] chipexplorer.eto.tech/?parentNode=N46&selectedNode=N53

8 Inside Beijing's Chipmaking Offensive. Center for Security and Emerging Technology (CSET) · 14 July 2025 ^[A] cset.georgetown.edu/article/inside-beijings-chipmaking-offensive/

6 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 ^[A] chipexplorer.eto.tech/?parentNode=N35&selectedNode=N41

45 Foreign-Produced Direct Product Rule Additions, and Refinements to Controls for Advanced Computing and Semiconductor Manufacturing Items. U.S. Government Publishing Office (Federal Register) · 5 December 2024 · p. 33 ^[A] www.govinfo.gov/content/pkg/FR-2024-12-05/pdf/2024-28270.pdf#page=33

FOUR THINGS TO REMEMBER

- Deposition lays down thin films and etch cuts them into patterns. Making one chip takes 1,000 to 1,500 steps, by a 2025 industry estimate.
- Four American, Japanese and Dutch firms make most of these tools, and none dominates.
- Chinese makers held 12.4 percent of dry etch and 9.8 percent of deposition in 2025, on CSET's count.
- Chinese makers held 2.6 percent of atomic layer deposition in 2025, most of it from Piotech.

Made by **Yashvardhan Sharma** with Claude. Corrections and questions: contact@chipsupplychain.org.

UPDATED 20 OCTOBER 2026

A company filings, governments, standards bodies, universities and research institutions; **B** SemiAnalysis, Reuters, the Financial Times and Nikkei Asia.

HOW TO CITE THIS CHAPTER

Sharma, Yashvardhan. "Deposition and Etch." Chip Supply Chain: How AI Chips Are Made. Edition of 20 October 2026. <https://chipsupplychain.org/deposition-and-etch/>

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@misc{chipsupplychain2026depositionandetch,
  title      = {Deposition and Etch},
  author     = {Sharma, Yashvardhan},
  howpublished = {Chip Supply Chain: How AI Chips Are Made},
  year      = {2026},
  month     = {October},
  note      = {Edition of 20 October 2026},
  url       = {https://chipsupplychain.org/deposition-and-etch/}
}
```