

Chapter 5: Photomasks and Pellicles

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CHAPTER

05

STAGE 5 OF 15

Photomasks and Pellicles

Only three firms in the world make the blank plates for the masks used to print the finest layers of leading-edge chips. Japan's AGC and Hoya are two of them.

IN PLAIN TERMS

A photomask is the stencil that lithography prints from, at least one for each layer of a chip¹³. The same mask prints its layer on wafer after wafer, so one mask shapes millions of chips. The most complicated layers are printed with extreme ultraviolet (EUV) light, and the rest can often be printed with deep ultraviolet light shone through a quartz plate. No glass lets EUV light through, so the mask for those layers is a mirror. The mirror is built up from about forty pairs of thin layers, and the light bounces off it. A dark pattern drawn on top of the mirror soaks up the light wherever no line should print. Any speck of dust on the mask repeats on every wafer it prints. So a thin membrane on a frame, called a pellicle, sits just above the mask and catches dust where it is too far out of focus to print. Japan's AGC and Hoya are two of the three firms that make those mirrors.

¹³ PHOTRONICS INC, Form 10-K annual report for the period ended 2025-10-31 (10-K). U.S. Securities and Exchange Commission (filing by PHOTRONICS INC) · 17 December 2025 [A](https://www.sec.gov/Archives/edgar/data/810136/000114036125045801/ef20057458_10k.htm)
www.sec.gov/Archives/edgar/data/810136/000114036125045801/ef20057458_10k.htm

IN SHORT

On CSET's count from TechInsights data, Austria's IMS Nanofabrication held 46.6 percent of the 2025 world market for electron-beam mask writers, which draw the pattern onto a mask⁷. Hoya says its share of the mask blank market is exceptionally high⁵.

SemiAnalysis put a full set of masks for a leading-edge chip at \$40 million in May 2026². In July 2022 it wrote that more companies will lack the volume to spread the fixed cost of mask sets³. On 8 September 2026 ASML and TSMC announced a plan to move from 6-inch to 12-inch masks²⁰. They expect the change to raise fab productivity and lower chipmaking costs²⁰.

7 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [A] chipexplorer.eto.tech/?parentNode=N25&selectedNode=N29

5 HOYA, Information Technology business, review of operations, Integrated Report 2026. HOYA · Accessed 9 September 2026 [A] www.hoya.com/ir/2026/en/review/it.html

2 EDA Market Primer. SemiAnalysis · 21 May 2026 [B] newsletter.semianalysis.com/p/eda-market-primer

3 The Dark Side Of The Semiconductor Design Renaissance – Fixed Costs Soaring Due To Photomask Sets, Verification, and Validation. SemiAnalysis · 24 July 2022 [B] newsletter.semianalysis.com/p/the-dark-side-of-the-semiconductor

20 ASML and TSMC Announce Initiative to Pioneer Industry Transition to Large-Format Photomasks for High NA EUV. TSMC · 8 September 2026 [A] pr.tsmc.com/english/news/3338

CHOKEPOINT CARD		EXTREME CONCENTRATION	HARD TO SUBSTITUTE
CONCENTRATION	SUBSTITUTABILITY		PRICE OR MARKET SIZE
Extreme	Hard		\$40M
	AGC said in December 2024 that only three firms supply the blank plates for EUV masks ¹ .		for a leading-edge mask set, SemiAnalysis's May 2026 figure ² . In July 2022 it put a 7 nm set above \$10M ³
WHO LEADS	JP AGC Ranks itself No.2 worldwide in EUV mask blanks on its own fiscal 2026 estimates⁴ JP Hoya Said in its 2026 report that its share of mask blanks is exceptionally high⁵ JP Lasertec Launched the world's first tool that inspects patterned EUV masks at the scanner's own wavelength in 2019⁶ AT IMS Nanofabrication CSET puts its 2025 share of the market for all electron-beam mask writers at 46.6%, using TechInsights data⁷ US Photronics \$849.3M of revenue in fiscal 2025⁸		
WHERE IT IS MADE	JP Japan Mask blanks (AGC, Hoya), DUV blanks (Shin-Etsu), inspection (Lasertec), writers (NuFlare), pellicles (Mitsui Chemicals) AT Austria IMS Nanofabrication multi-beam mask writers DE Germany Zeiss mask checking in EUV light (AIMS EUV) and mask repair US United States Photronics merchant mask shops, KLA inspection TW Taiwan TSMC, which held 10% of IMS at the end of 2024		
WHY SUBSTITUTION IS SLOW	AGC says it spent more than a decade meeting the blank's requirements, and mass production began only in 2017 ¹ . Germany's Zeiss calls its AIMS the only system that tests how a mask will print under conditions equivalent to the scanner's ⁹ .		
WHERE CHINA STANDS		WHERE THE US STANDS	
As of 2026 SMIC runs two mask shops of its own in Shanghai ¹⁰ . No Chinese firm appears in CSET's 2025 market shares for electron-beam mask writers, the machines that draw the pattern onto a mask ⁷ .		In December 2025 Photronics called itself a leading worldwide maker of photomasks ⁸ . As of 2026 KLA sells tools that inspect EUV and optical masks ¹¹ .	

1

The Japanese glass behind next-generation chips. AGC · 13 December 2024

A

www.agc.com/en/hub/pr/the-japanese-glass-behind-next-generation-chips.html

2

EDA Market Primer. SemiAnalysis · 21 May 2026

B

newsletter.semianalysis.com/p/eda-market-primer

3

The Dark Side Of The Semiconductor Design Renaissance – Fixed Costs Soaring Due To Photomask Sets, Verification, and Validation. SemiAnalysis · 24 July 2022

B

newsletter.semianalysis.com/p/the-dark-side-of-the-semiconductor

4

AGC Data Book. AGC Inc. · 29 May 2026 · p. 8

A

www.agc.com/en/ir/library/outline/pdf/reference.pdf#page=8

5

HOYA, Information Technology business, review of operations, Integrated Report 2026. HOYA · Accessed 9 September 2026

A

www.hoya.com/ir/2026/en/review/it.html

6

Lasertec Releases ACTIS A200HiT Series Actinic EUV Patterned Mask Inspection System. Lasertec · 31 October 2025

A

www.lasertec.co.jp/en/news/2025/20251031_3912.html

7

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

A

chipexplorer.eto.tech/?parentNode=N25&selectedNode=N29

Each EUV layer of an AI accelerator is printed from a mask built on a blank plate. Only three companies worldwide supply those plates, and Japan's AGC is one of them ¹. Hoya, also Japanese, is another ⁵. AGC says it is the only company in the world that takes an EUV blank all the way from the glass to the finished coating ¹².

How it works

ASML says a chip's most complicated layers are made on EUV machines, while the rest can often be printed on older deep ultraviolet machines ¹⁴. A mask starts as a blank, a polished plate with no pattern on it yet. For deep ultraviolet the blank is a window of quartz carrying a light-blocking film such as molybdenum silicide, and Shin-Etsu is one maker of those blanks ¹⁵. For EUV the blank is a mirror of about 40 molybdenum and silicon layer pairs, 7 nm to a pair, laid on glass ¹⁶. A dark tantalum film on top, called the absorber, will carry the pattern ¹⁷.

The blank is coated with a sensitive film called resist. A mask writer then draws the design into the resist with electrons. A single-beam writer flashes one shape at a time, while NuFlare's multi-beam writer for the most advanced masks controls 260,000 beams at once ¹⁸.

A wash removes the drawn resist. An etch then removes the blocking film or absorber wherever the resist is gone, and the rest of the resist is stripped. The plate now passes light, or reflects it, in the shape of one layer of the chip. On standard EUV scanners the pattern is drawn four times larger than it will print ¹⁹. An inspection tool compares the plate to the design, and a repair tool fixes the stray defects it finds.

EUV masks bring problems of their own:

- **Mask 3D effects.** Light strikes the mirror at a slant, and the absorber has height, so its edges cast small shadows that distort the printed shape. Software has to correct for the shadows in advance.

8 Photronics Reports Full Year and Fourth Quarter Fiscal 2025 Results. GlobeNewswire (release by Photronics) · 10 December 2025 [A] www.globenewswire.com/news-release/2025/12/10/3203040/0/en/Photronics-Reports-Full-Year-and-Fourth-Quarter-Fiscal-2025-Results.html

1 The Japanese glass behind next-generation chips. AGC · 13 December 2024 [A] www.agc.com/en/hub/pr/the-japanese-glass-behind-next-generation-chips.html

9 Mask Qualification Solutions by ZEISS SMT. Carl Zeiss · Accessed 9 September 2026 [A] www.zeiss.com/semiconductor-manufacturing-technology/products/photomask-solutions/mask-qualification.html

10 Mask Service. SMIC · Accessed 9 September 2026 [A] www.smics.com/en/site/mask

7 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [A] chipexplorer.eto.tech/?parentNode=N25&selectedNode=N29

11 Reticle Qualification. KLA Corporation · Accessed 20 October 2026 [A] www.kla.com/products/reticle-manufacturing

5 HOYA, Information Technology business, review of operations, Integrated Report 2026. HOYA · Accessed 9 September 2026 [A] www.hoya.com/ir/2026/en/review/it.html

12 AGC to Boost Production Capacity of EUVL Photomask Blanks. AGC · 27 April 2023 [A] www.agc.com/en/news/detail/1203819_2814.html

14 See ASML's DUV lithography systems. ASML · Accessed 9 September 2026 [A] www.asml.com/en/products/duv-lithography-systems

15 Photomask blanks. Shin-Etsu Chemical · 3 April 2019 [A] www.shinetsu.co.jp/en/products/electronics-materials/photomask-blanks/

16 The refined EUV mask model. arXiv · 19 December 2019 · p. 2 [A] arxiv.org/pdf/1912.09075#page=2

17 The refined EUV mask model. arXiv · 19 December 2019 · p. 1 [A] arxiv.org/pdf/1912.09075#page=1

18 EB Mask Writer. NuFlare Technology · Accessed 9 September 2026 [A] www.nuflare.co.jp/english/products/beam/

19 5 things you should know about High NA in EUV. ASML · 25 January 2024 [A] www.asml.com/en/company/stories/2024/5-things-high-na-euv

- **Write precision.** Every edge of the absorber has to sit within a few nanometers of where the design says.
- **Particles.** Anything on the mirror prints on every wafer until someone finds it.

High-NA scanners, the newest EUV machines, print finer lines with larger mirrors. To keep masks at their usual size, their mirrors shrink the pattern four times in one direction and eight times in the other ¹⁹. So each exposure covers half the area of a standard exposure, and a wafer takes twice as many exposures ¹⁹.

On 8 September 2026 ASML and TSMC announced a plan to move from the current 6-inch masks to 12-inch masks ²⁰. They expect the change to raise fab productivity, lower chipmaking costs and remove stitching constraints, the design limits that come from printing a large chip in two halves ²⁰. They aim to set up a 12-inch mask pilot line by 2031, so that High-NA scanners using 12-inch masks can enter advanced chip production by 2033 ²⁰.

Variants and trade-offs

Blanks

AGC says it spent more than a decade meeting the blank's requirements, which include near-zero thermal expansion, perfectly smooth and flat surfaces and no particle contamination ¹. It says mass production began only in 2017 ¹.

AGC publishes no market share figure for EUV blanks. In its data book, AGC ranks itself No.2 worldwide in EUV blanks, based on its own fiscal 2026 estimates ⁴. Hoya says its share of the mask blank market is exceptionally high, and that customers may gradually start buying EUV blanks from more than one supplier ⁵.

In April 2023 AGC said its EUV blank capacity would grow by about 30 percent in 2025 ¹². The growth would come from a line in Fukushima, a project that METI, Japan's industry ministry, selected under a program to strengthen supply chains ¹². AGC also said it was aiming for more than ¥40 billion of sales in the business by 2025 ¹². Its EUV blank sales grew 50 percent in 2023, AGC said in December 2024 ¹.

¹⁹ 5 things you should know about High NA in EUV. ASML · 25 January 2024 [\[A\] www.asml.com/en/company/stories/2024/5-things-high-na-euv](https://www.asml.com/en/company/stories/2024/5-things-high-na-euv)

²⁰ ASML and TSMC Announce Initiative to Pioneer Industry Transition to Large-Format Photomasks for High NA EUV. TSMC · 8 September 2026 [\[A\] pr.tsmc.com/english/news/3338](https://pr.tsmc.com/english/news/3338)

¹ The Japanese glass behind next-generation chips. AGC · 13 December 2024 [\[A\] www.agc.com/en/hub/pr/the-japanese-glass-behind-next-generation-chips.html](https://www.agc.com/en/hub/pr/the-japanese-glass-behind-next-generation-chips.html)

⁴ AGC Data Book. AGC Inc. · 29 May 2026 · p. 8 [\[A\] www.agc.com/en/ir/library/outline/pdf/reference.pdf#page=8](https://www.agc.com/en/ir/library/outline/pdf/reference.pdf#page=8)

⁵ HOYA, Information Technology business, review of operations, Integrated Report 2026. HOYA · Accessed 9 September 2026 [\[A\] www.hoya.com/ir/2026/en/review/it.html](https://www.hoya.com/ir/2026/en/review/it.html)

¹² AGC to Boost Production Capacity of EUVL Photomask Blanks. AGC · 27 April 2023 [\[A\] www.agc.com/en/news/detail/1203819_2814.html](https://www.agc.com/en/news/detail/1203819_2814.html)

In February 2025 AGC reported that the sales reached ¥40 billion in 2024, a year ahead of the 2025 target ²¹.

The sales then declined in 2025 and were recovering in 2026, AGC said in June 2026 ²². In August 2026 AGC set out capacity expansions of 20 to 50 percent across EUV blanks, polishing slurry and lens materials for lithography tools ²³. It gave no separate figure for the blanks, and mass production on the added capacity is to begin in 2028 ²³.

Writers

An electron-beam writer draws the pattern into the resist on the blank. Multi-beam writers fire many beams at once, and Japan's NuFlare sells them for the 3 nm node ¹⁸.

In September 2023 Intel called Austria's IMS Nanofabrication the established industry leader in the multi-beam mask writing tools that advanced EUV requires ²⁴. Counting all electron-beam mask writers, CSET, a research center at Georgetown University, put IMS's share of a \$994 million world market at 46.6 percent in 2025, using TechInsights data ⁷. NuFlare had 39.2 percent and JEOL 14.2 percent, in the same CSET analysis of TechInsights data ⁷.

Intel agreed in September 2023 to sell roughly 10 percent of IMS to TSMC at a valuation of about \$4.3 billion ²⁴. TSMC's subsidiary TSMC Development held that 10 percent at the end of 2024, at a fair value of \$432.8 million in TSMC's accounts ²⁵. Intel sold a combined 32 percent of IMS in 2023 and still held the other 68 percent on 27 December 2025 ²⁶.

Inspection and repair

A mask defect cuts the number of good chips on every wafer that mask prints, so masks are checked as blanks, after patterning and again at the fab. Actinic inspection uses 13.5 nm light, the wavelength of EUV lithography ⁶. In 2019

21 Financial Results for FY2024. AGC Inc. · 7 February 2025 · p. 45 [\[A\]](https://www.agc.com/en/ir/library/briefing/pdf/2025_0207e_1.pdf#page=45) www.agc.com/en/ir/library/briefing/pdf/2025_0207e_1.pdf#page=45

22 Semiconductor-related Business Briefing: Event Summary. AGC Inc. · 2 June 2026 · p. 17 [\[A\]](https://www.agc.com/en/ir/library/bizbriefing/pdf/2026_0602semiconductor_transcript.pdf#page=17) www.agc.com/en/ir/library/bizbriefing/pdf/2026_0602semiconductor_transcript.pdf#page=17

23 AGC Company Overview. AGC Inc. · August 2026 · p. 52 [\[A\]](https://www.agc.com/en/ir/library/outline/pdf/c_overview.pdf#page=52) www.agc.com/en/ir/library/outline/pdf/c_overview.pdf#page=52

18 EB Mask Writer. NuFlare Technology · Accessed 9 September 2026 [\[A\]](https://www.nuflare.co.jp/english/products/beam/) www.nuflare.co.jp/english/products/beam/

24 Intel to Sell Minority Stake in IMS Nanofabrication Business to TSMC. Intel · 12 September 2023 [\[A\]](https://www.intc.com/news-events/press-releases/detail/1645/intel-to-sell-minority-stake-in-ims-nanofabrication) www.intc.com/news-events/press-releases/detail/1645/intel-to-sell-minority-stake-in-ims-nanofabrication

7 Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N25&selectedNode=N29) chipexplorer.eto.tech/?parentNode=N25&selectedNode=N29

25 TAIWAN SEMICONDUCTOR MANUFACTURING CO LTD, Form 6-K report of foreign private issuer for the period ended 2024-12-31 (6-K). U.S. Securities and Exchange Commission (filing by TAIWAN SEMICONDUCTOR MANUFACTURING CO LTD) · 27 February 2025 [\[A\]](https://www.sec.gov/Archives/edgar/data/1046179/000104617925000019/tsmc2024q4consolidatedfina.htm) www.sec.gov/Archives/edgar/data/1046179/000104617925000019/tsmc2024q4consolidatedfina.htm

26 INTEL CORP, Form 10-K annual report for the period ended 2025-12-27 (10-K). U.S. Securities and Exchange Commission (filing by INTEL CORP) · 23 January 2026 [\[A\]](https://www.sec.gov/Archives/edgar/data/50863/000005086326000011/intc-20251227.htm) www.sec.gov/Archives/edgar/data/50863/000005086326000011/intc-20251227.htm

6 Lasertec Releases ACTIS A200HiT Series Actinic EUV Patterned Mask Inspection System. Lasertec · 31 October 2025 [\[A\]](https://www.lasertec.co.jp/en/news/2025/20251031_3912.html) www.lasertec.co.jp/en/news/2025/20251031_3912.html

Lasertec launched the world's first actinic inspection system for patterned EUV masks, the ACTIS A150 ⁶. In October 2025 it launched the ACTIS A200HiT series, which it says triples the A150's inspection speed ⁶. Lasertec reported net sales of JPY 230,485 million in the year to June 2026 ²⁷.

As of 2026 KLA's Teron systems for mask shops detect pattern and particle defects on both EUV and optical masks ¹¹.

Zeiss makes AIMS EUV, which checks a mask in EUV light under the scanner's own imaging conditions to judge how a defect will affect printing ⁹. Zeiss calls AIMS the only system that tests how a mask will print under conditions equivalent to the scanner's ⁹. Zeiss says the tool can be extended to ASML's High-NA scanner, the EXE:5000 ⁹. Zeiss also sells electron-beam repair tools that work on EUV masks ²⁸.

Pellicles

A pellicle is a thin membrane on a frame above the mask. Particles land on it, too far out of focus to print, and the pattern below stays clean.

In 2022 ASML described its most advanced EUV pellicle as a membrane 13 nanometers thick that can withstand up to 500 degrees Celsius in a high vacuum ²⁹. Every photon it absorbs is light that never reaches the wafer ²⁹. The light crosses it twice, on the way in and on the way back off the mirror, so absorption counts double. ASML released its first EUV pellicles in 2016 and calls the pellicle

⁶ Lasertec Releases ACTIS A200HiT Series Actinic EUV Patterned Mask Inspection System. Lasertec · 31 October 2025 [\[A\]](https://www.lasertec.co.jp/en/news/2025/20251031_3912.html)
www.lasertec.co.jp/en/news/2025/20251031_3912.html

²⁷ Lasertec, business report. Lasertec · September 2026 [\[A\]](https://www.lasertec.co.jp/en/ir/plan/message.html) www.lasertec.co.jp/en/ir/plan/message.html

¹¹ Reticle Qualification. KLA Corporation · Accessed 20 October 2026 [\[A\]](https://www.kla.com/products/reticle-manufacturing) www.kla.com/products/reticle-manufacturing

⁹ Mask Qualification Solutions by ZEISS SMT. Carl Zeiss · Accessed 9 September 2026 [\[A\]](https://www.zeiss.com/semiconductor-manufacturing-technology/products/photomask-solutions/mask-qualification.html) www.zeiss.com/semiconductor-manufacturing-technology/products/photomask-solutions/mask-qualification.html

²⁸ Mask Repair Solutions by ZEISS SMT. Carl Zeiss · Accessed 9 September 2026 [\[A\]](https://www.zeiss.com/semiconductor-manufacturing-technology/products/photomask-solutions/mask-repair.html) www.zeiss.com/semiconductor-manufacturing-technology/products/photomask-solutions/mask-repair.html

²⁹ Indistinguishable from magic: the EUV pellicle. ASML · 14 September 2022 [\[A\]](https://www.asml.com/en/news/stories/2022/the-euv-pellicle-indistinguishable-from-magic) www.asml.com/en/news/stories/2022/the-euv-pellicle-indistinguishable-from-magic

one of the breakthroughs that brought EUV lithography to high-volume manufacturing ²⁹.

Carbon nanotube membranes are the next step, aimed at next-generation High-NA, high-output EUV scanners ³⁰. In 2020 imec, a Belgian chip research center, mounted them on masks and exposed them in an ASML NXE:3300 scanner ³¹. The membranes passed up to 97 percent of the light in a single crossing, and imec found their effect on imaging low and correctable ³¹.

Mitsui Chemicals began commercial production of silicon-based EUV pellicles under an ASML license in 2021 ³⁰. In 2024 it said it would build a carbon nanotube membrane plant at Iwakuni-Ohtake, tentatively due to finish in December 2025 ³⁰. In December 2025 Mitsui Chemicals said the plant was scheduled for completion in its fiscal 2025, in line with its initial plan ³². The membranes are designed to pass 92 percent or more of the light and to withstand exposure power above 1 kW ³⁰.

Cost and design economics

In July 2022 SemiAnalysis put mask sets above \$1 million at 28 nm and above \$10 million at 7 nm ³. It expected 3 nm mask sets to reach the \$40 million range ³. Its May 2026 primer still puts a leading-edge mask set at \$40 million ². The same primer puts a single respin, remaking a chip after a design flaw, at \$50 million to \$100 million at leading-edge nodes ².

Mask costs restrict which firms can use a node. SemiAnalysis wrote that at 5 nm and 3 nm, only firms with large wafer volume see the cost per transistor fall ³. It wrote that more companies will lack the volume to spread the fixed cost of mask sets ³. It expected failed chip designs to show up first among AI chip startups, which work on much tighter budgets ³.

29 Indistinguishable from magic: the EUV pellicle. ASML · 14 September 2022 [A] www.asml.com/en/news/stories/2022/the-euv-pellicle-indistinguishable-from-magic

30 Mitsui Chemicals Sets up Production Facilities for CNT Pellicles to Be Used in Next-Gen EUV Lithography. Mitsui Chemicals · 28 May 2024 [A] jp.mitsuichemicals.com/en/release/2024/2024_0528_1/index.htm

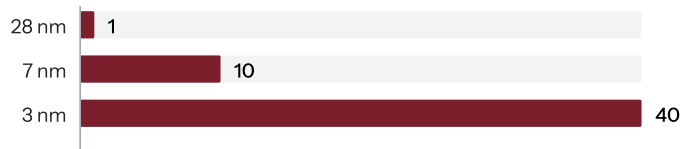
31 Imec demonstrates CNT pellicle utilization on EUV scanner. imec · 6 October 2020 [A] www.imec-int.com/en/press/imec-demonstrates-cnt-pellicle-utilization-euv-scanner

32 Business Strategy Presentation (L&HC, Mobility, ICT) in December 2025. Mitsui Chemicals · 17 December 2025 · p. 31 [A] jp.mitsuichemicals.com/content/dam/mitsuichemicals/sites/mci/documents/release/2025/event_251217e.pdf#page=31

3 The Dark Side Of The Semiconductor Design Renaissance – Fixed Costs Soaring Due To Photomask Sets, Verification, and Validation. SemiAnalysis · 24 July 2022 [B] newsletter.semianalysis.com/p/the-dark-side-of-the-semiconductor

2 EDA Market Primer. SemiAnalysis · 21 May 2026 [B] newsletter.semianalysis.com/p/eda-market-primer

What one mask set costs, by node, 2022 (\$M). The 28 nm and 7 nm figures are minimums and 3 nm was a projection \$M



Source: SemiAnalysis, The Dark Side of the Semiconductor Design Renaissance, July 2022. SemiAnalysis's May 2026 EDA Market Primer puts a leading-edge mask set at \$40M

Who makes it

Mask making splits between chipmakers that make masks for their own use and independent merchant firms that sell to them and others ¹³. Photronics says that chipmakers' own shops once supplied most of the market, and that production has more recently tended to move toward the independents ¹³. TSMC makes masks too, and lists mask making among the services it offers besides making wafers ³³.

Photronics calls itself a leading worldwide maker of masks for chips and flat panel displays ⁸. It had \$849.3 million of revenue in fiscal 2025, \$615.1 million of it from chip masks ⁸. The competitors it names in chip and display masks include Dai Nippon Printing, Hoya, Tekscend Photomask and two Chinese firms, Shenzhen Newway Photomask and Shenzhen Qingyi Photomask ¹³. It also competes with chipmakers' own mask shops ¹³.

SMIC, a Chinese foundry, runs two in-house mask shops in Shanghai that make masks for deep ultraviolet machines and older ones ¹⁰. Photronics began

¹³ PHOTRONICS INC, Form 10-K annual report for the period ended 2025-10-31 (10-K). U.S. Securities and Exchange Commission (filing by PHOTRONICS INC) · 17 December 2025 [A](https://www.sec.gov/Archives/edgar/data/810136/000114036125045801/ef20057458_10k.htm)
www.sec.gov/Archives/edgar/data/810136/000114036125045801/ef20057458_10k.htm

³³ TAIWAN SEMICONDUCTOR MANUFACTURING CO LTD, Form 20-F annual report for the period ended 2025-12-31 (20-F). U.S. Securities and Exchange Commission (filing by TAIWAN SEMICONDUCTOR MANUFACTURING CO LTD) · 16 April 2026 [A](https://www.sec.gov/Archives/edgar/data/1046179/000162828026025362/tsm-20251231.htm)
www.sec.gov/Archives/edgar/data/1046179/000162828026025362/tsm-20251231.htm

⁸ Photronics Reports Full Year and Fourth Quarter Fiscal 2025 Results. GlobeNewswire (release by Photronics) · 10 December 2025 [A](https://www.globenewswire.com/news-release/2025/12/10/3203040/0/en/Photronics-Reports-Full-Year-and-Fourth-Quarter-Fiscal-2025-Results.html)
www.globenewswire.com/news-release/2025/12/10/3203040/0/en/Photronics-Reports-Full-Year-and-Fourth-Quarter-Fiscal-2025-Results.html

¹⁰ Mask Service. SMIC · Accessed 9 September 2026 [A](https://www.smics.com/en/site/mask)
www.smics.com/en/site/mask

operating two mask plants in China, in Hefei and Xiamen, in 2019 ¹³. Its chip mask business in Xiamen is a joint venture in which Dai Nippon Printing holds 49.99 percent ¹³. No Chinese firm appears in CSET's 2025 market shares for electron-beam mask writers ⁷.

The chokepoint

Mask blanks are a small, highly concentrated business. In 2019 Lasertec launched the first tool that inspects patterned EUV masks in EUV light ⁶.

Pellicles already work in high-volume EUV manufacturing ²⁹. But ASML says no material is completely transparent to EUV light, so any pellicle in the light's path costs customers productivity ²⁹. In 2024 Mitsui Chemicals said it would set up production of carbon nanotube membranes for next-generation High-NA, high-output EUV scanners ³⁰.

FOUR THINGS TO REMEMBER

- A photomask is the stencil for one layer of a chip, and any flaw on it repeats on every wafer.
- Three firms make EUV mask blanks, and Lasertec launched the first tool that checks finished masks in EUV light.
- AGC spent more than a decade learning to make EUV blanks before mass production began in 2017.
- China makes masks for deep ultraviolet machines and older ones, in SMIC's own mask shops and at independent firms such as Shenzhen Qingyi and Shenzhen Newway.

¹³ PHOTRONICS INC, Form 10-K annual report for the period ended 2025-10-31 (10-K). U.S. Securities and Exchange Commission (filing by PHOTRONICS INC) · 17 December 2025 [\[A\]](https://www.sec.gov/Archives/edgar/data/810136/000114036125045801/ef20057458_10k.htm)
www.sec.gov/Archives/edgar/data/810136/000114036125045801/ef20057458_10k.htm

⁷ Supply Chain Explorer: Advanced Chips. Emerging Technology Observatory (ETO) · Accessed 9 September 2026 [\[A\]](https://chipexplorer.eto.tech/?parentNode=N25&selectedNode=N29)
chipexplorer.eto.tech/?parentNode=N25&selectedNode=N29

⁶ Lasertec Releases ACTIS A200HiT Series Actinic EUV Patterned Mask Inspection System. Lasertec · 31 October 2025 [\[A\]](https://www.lasertec.co.jp/en/news/2025/20251031_3912.html)
www.lasertec.co.jp/en/news/2025/20251031_3912.html

²⁹ Indistinguishable from magic: the EUV pellicle. ASML · 14 September 2022 [\[A\]](https://www.asml.com/en/news/stories/2022/the-euv-pellicle-indistinguishable-from-magic) www.asml.com/en/news/stories/2022/the-euv-pellicle-indistinguishable-from-magic

³⁰ Mitsui Chemicals Sets up Production Facilities for CNT Pellicles to Be Used in Next-Gen EUV Lithography. Mitsui Chemicals · 28 May 2024 [\[A\]](https://jp.mitsuichemicals.com/en/release/2024/2024_0528_1/index.htm) jp.mitsuichemicals.com/en/release/2024/2024_0528_1/index.htm

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

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

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