Lam Research Introduces Lam Cryo™ 3.0 Cryogenic Etch Technology to Accelerate Scaling of 3D NAND for the AI Era

Production-proven innovation addresses critical manufacturing challenges as memory makers target 1,000-layer 3D NAND by decade end

FREMONT, Calif., July 31, 2024 /PRNewswire/ -- Lam Research Corp. (Nasdaq: LRCX) today extended its leadership in 3D NAND flash memory etching with the introduction of Lam Cryo™ 3.0, the third generation of the company's production-proven cryogenic dielectric etch technology. As the proliferation of generative artificial intelligence (AI) continues to propel the demand for memory with higher capacity and performance, Lam Cryo 3.0 provides etch capabilities critical for the manufacturing of future leading-edge 3D NAND. Leveraging ultra cold temperatures, high power confined plasma reactor technology, and innovations in surface chemistry, Lam Cryo 3.0 etches with industry-leading precision and profile control.

Lam Cryo 3.0 cryogenic etch breakthrough paves the way for 1000-layer 3D NAND to meet AI's rising data storage demands

"Lam Cryo 3.0 paves the way for customers on the path to 1,000-layer 3D NAND," said Sesha Varadarajan, senior vice president of Global Products Group at Lam Research. "With five million wafers already manufactured using Lam cryogenic etch, our newest technology is a breakthrough in 3D NAND production. It creates high aspect ratio (HAR) features with angstrom-level precision, while delivering lower environmental impact and more than double the etch rate of conventional dielectric processes. Lam Cryo 3.0 is the etch technology our customers need to overcome the AI era's key NAND manufacturing hurdles."

To date, 3D NAND has primarily advanced through the stacking of vertical layers of memory cells, which are enabled by etching deep and narrow HAR memory channels. Slight, atomic-scale deviations from the target profile of these features can negatively affect electrical properties of the die and potentially impact yield. Lam Cryo 3.0 is optimized to address these and other etch challenges to scaling.

"AI is driving exponential demand in capacity and on the performance of flash memory both at the cloud and the edge. This is compelling chipmakers to scale NAND flash in the race to achieve 1000-layer 3D NAND by the end of 2030," said Neil Shah, co-founder and vice president of research at Counterpoint Research. "Lam Cryo 3.0 cryogenic etch technology is a significant leap beyond conventional techniques. It etches memory channels that are more than 50 times deeper than their width with near perfect precision and control, achieving a profile deviation of less than 0.1%. This breakthrough significantly enhances advanced 3D NAND yields and overall performance to enable chipmakers to compete well in the AI era."

The Industry's Most Advanced Cryogenic Etch Technology
Lam Cryo 3.0 utilizes the company's unique, high powered confined plasma reactors, process improvements and temperatures well below -0^{o}C, which permit the harnessing of new, novel etch chemistries. When combined with the scalable, pulsed plasma technology of Lam's latest Vantex® dielectric system, etch depth and profile control is significantly increased. Using Lam Cryo 3.0 technology, 3D NAND manufacturers can etch memory channels with depths of up to 10 microns with less than 0.1% deviation* in the feature's critical dimension from the top to the bottom.

Other highlights include:

- Outstanding Productivity: Compared to conventional dielectric processes, Lam Cryo 3.0 etches two-and-a-half times faster, with better wafer-to-wafer repeatability, helping 3D NAND manufacturers to achieve high yield at lower cost.

- Higher Sustainability: Lam Cryo offers 40% reduction in energy consumption per wafer, and up to a 90% reduction in emissions compared to conventional etch processes.**

- Maximize Equipment Investment: For the optimal profile control and the fastest and deepest dielectric etch, Lam Cryo 3.0 can be integrated into Lam's newest Vantex system. It is also compatible with the company's portfolio of Flex® HAR dielectric etchers, used by all major memory manufacturers for 3D NAND mass production.

Leading 3D NAND Dielectric Etching

Lam Cryo 3.0 further extends to the company's two-decade-leadership in wafer fabrication etch technologies, which includes seven generations of 3D NAND. Lam introduced the world's first cryogenic etch offering into volume production in 2019. Of the over 7,500 Lam HAR dielectric etch chambers utilized in NAND production today, nearly 1,000 of them use cryogenic etch technology.

Lam Cryo 3.0 is now available to leading memory manufacturers. It is the latest addition to Lam's broad portfolio of etch, deposition and clean solutions for 3D NAND manufacturing. To learn more about Lam Cryo 3.0, visit https://www.lamresearch.com/products/our-solutions/cryogenic-etching/ .

Media Resources:

- Lam Newsroom Media Center: Contains Lam Cryo 3.0 images and press materials
- Counterpoint Research, white paper, "How to Scale to 1,000-Layer 3D NAND in the AI Era," July 2024
- Lam Blog, "Lam Cryo 3.0: What You Need to Know"

About Lam Research

Lam Research Corporation is a global supplier of innovative wafer fabrication equipment and services to the semiconductor industry. Lam's equipment and services allow customers to build smaller and better performing devices. In fact, today nearly every advanced chip is built with Lam technology. We combine superior systems engineering, technology leadership, and a strong values-based culture, with an unwavering commitment to our customers. Lam Research (Nasdaq: LRCX) is a FORTUNE 500® company headquartered in Fremont, Calif., with operations around the globe. Learn more atwww.lamresearch.com.

* Profile deviation calculated by maximum critical dimension minus minimum critical dimension divided by memory channel depth.
** Source: Lam Research. Based on new etch chemistries possible with Lam Cryo 3.0. 90% reduction in Kg CO_2 per wafer. Estimated emissions reduction calculated using IPPC (Intergovernmental Panel on Climate Change) guidelines for greenhouse gas inventories. The estimated reduction has not been independently verified.

Caution Regarding Forward-Looking Statements
Statements made in this press release that are not of historical fact are forward-looking statements and are subject to the safe harbor provisions created by the Private Securities Litigation Reform Act of 1995. Such forward-looking statements relate to, but are not limited to: market, industry and industry segment expectations; product performance and benefits to customers from the use of our technologies and products; and emissions and energy savings to be realized through the use of our technologies and products. Some factors that may affect these forward-looking statements include: trade regulations, export controls, trade disputes, and other geopolitical tensions may inhibit our ability to sell our products; business, political and/or regulatory conditions in the consumer electronics industry, the semiconductor industry and the overall economy may deteriorate or change; the actions of our customers and competitors may be inconsistent with our expectations; supply chain disruptions or manufacturing capacity constraints may limit our ability to manufacture and sell our products; natural and human-caused disasters, disease outbreaks, war, terrorism, political or governmental unrest or instability, or other events beyond our control may impact our operations in affected areas; as well as the other risks and uncertainties that are described in the documents filed or furnished by us with the Securities and Exchange Commission, including specifically the Risk Factors described in our annual report on Form 10-K for the fiscal year ended June 25, 2023 and our quarterly report on Form 10-Q for the fiscal quarter ended March 31, 2024. These uncertainties and changes could materially affect the forward-looking statements and cause actual results to vary from expectations in a material way. The Company undertakes no obligation to update the information or statements made in this release

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