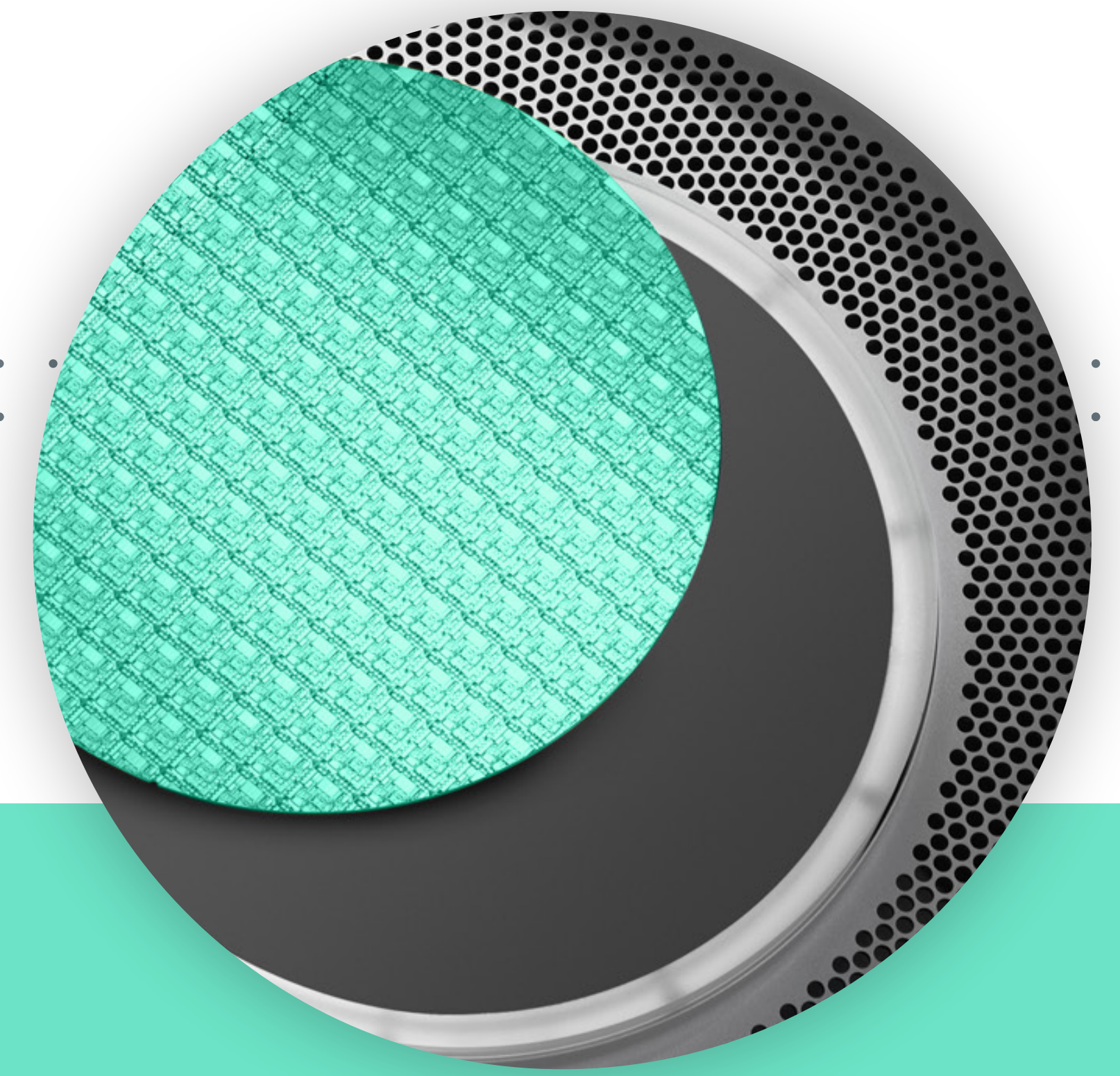


The *Emergence* of Cryogenic Etching

The rise of artificial intelligence (AI) has placed significant demands on semiconductor performance, particularly in the realm of etching technology.



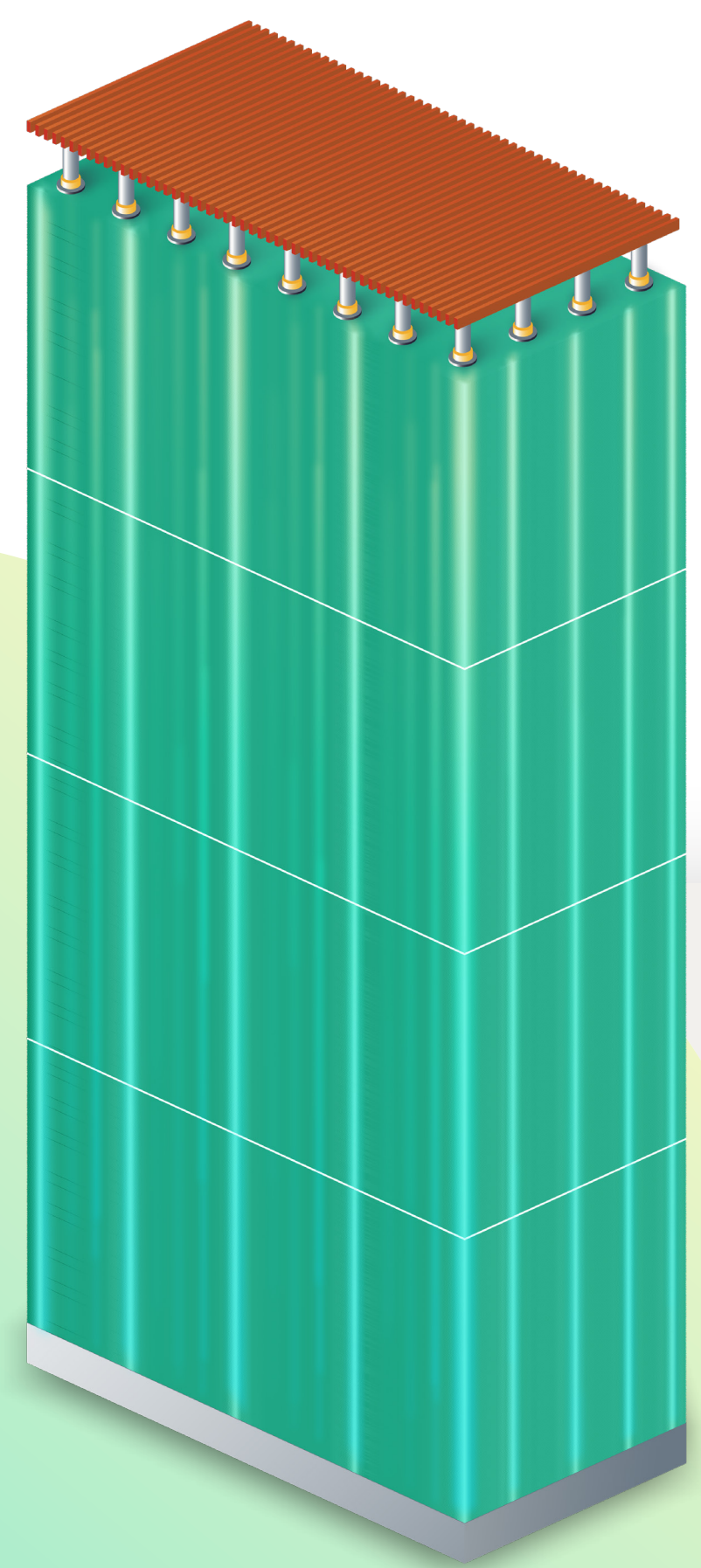
Performance and Capacity Requirements

AI requires **massive amounts of data** for training, necessitating high levels of parallel processing, non-volatile memory, and fast data transfer rates. The performance requirements for these AI innovations are pushing 3D manufacturers to work to scale vertically, laterally, and logically. Etch technologies have since evolved to address these challenges, using energetic ions, temperature controls, and innovative chemistries.

For decades, Lam Research has been an industry leader in addressing key challenges in this process – etching deeper, faster, as well as enabling complicated lateral and vertical scaling.

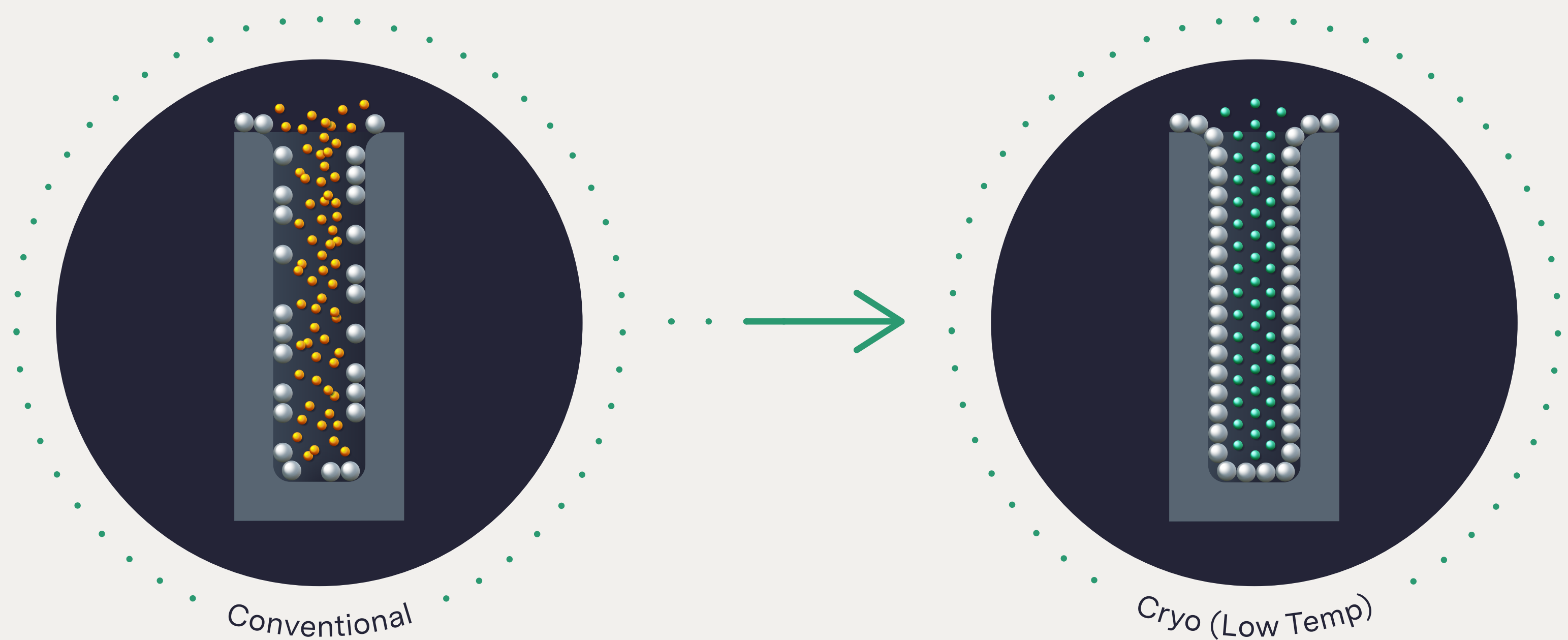
Evolving 3D Innovations

The road to 1,000-layer 3D NAND is more than just etching deeper, narrower channels faster, it's etching the perfect channel shape needed for all forms of scaling.



Lam Cryo™ 3.0

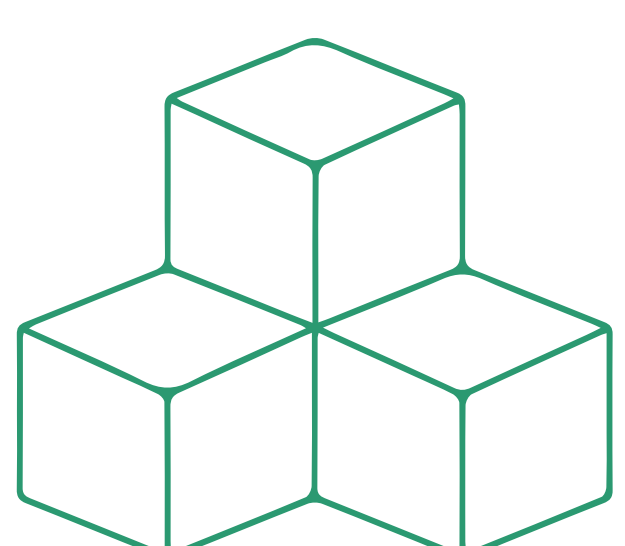
While Lam has been using this technology for years, we are now introducing **Lam Cryo™ 3.0**, which leverages lower temperatures for more-precise etching. The technology enables the use of new, novel chemistries to deliver increased high aspect ratio etch capabilities.



Lam Cryo™ 3.0 Performance

Lam Cryo™ 3.0 to set the next benchmark for the industry for this critical etch in 3D NAND manufacturing

Parameter	Lam Cryo™ 3.0	
Depth	10 μm	Vertical 1.6x vs. current production
Etch rate vs. non-cryo etch	2.5x faster	
Max CD	108 nm	Lateral >10% cell density increase
Bottom CD	99 nm	
ΔCD	9 nm	Logical >2x improvement in profile deviation
Profile deviation $\Delta\text{CD}/\text{Depth}$	<0.1%	



Lam's cryogenic dielectric etch technology is also compatible with Lam's popular Flex® dielectric etch technology and Vantex® reactive ion etch systems on the Sense.i® platform – enabling customers to easily leverage and expand on investment in their existing infrastructure.

Lam cryogenic technology delivers enhanced etch rates, vertical high aspect ratio profiles, and reduces the environmental impact of the etching process.