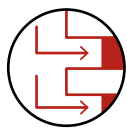


# 192 Layers and Beyond: Solving 3D NAND Material and Integration Challenges

Improvements in materials and process integration will enable high-yielding 3D NAND structures to support the ever-increasing device storage needs.

Contamination and material purity are more important than ever as device scaling continues.



## SILICON NITRIDE ETCH

Wet etching techniques from blanket nitride/oxide wafers do not translate to complex 3D NAND structures. Specially formulated chemistries are needed.



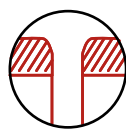
## THIN FILM RESISTIVITY

As device dimensions continue to shrink, the conductor line dimensions must also shrink. Significant increase in resistivity appears when dimensions shrink to nanometer scale.



## CMP FORMULATED CHEMISTRIES

The next generation of 3D NAND devices demands specially formulated cleans custom-designed to work with a specific slurry chemistry.



## BORON HARD MASK

Due to the aggressive and long plasma-etch chemistry used to define the channel holes, improvements are required in the hard mask material.

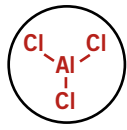
192+

## AT THE MEMORY ARRAY



## DEPOSITION

High-aspect ratios in 3D NAND devices create challenges for thin-film deposition processes. ALD with carefully developed precursor schemes are required for complex topologies in the memory stack.



## PRECURSOR

Critical factors for precursor development: molecular purity, elemental purity, vapor pressure, thermal stability at the operating temperature, and ability to produce desired electrical properties.



## NEW METALS

For future device nodes, alternatives to Tungsten with lower thin film resistivity or other beneficial properties are being considered. In addition, one problem with Tungsten is the Tungsten Hexafluoride precursor used to deposit it. Fluorine can cause significant yield loss in thin layers.

## AT THE CHIP



## CMP BRUSHES

The brushes used for post-CMP cleaning produce another source of potential contamination. Pre-cleaning, surface modifications, and avoiding preservatives are key steps.

## AT THE WAFER



## CMP CONDITIONERS

As new CMP pads are developed to meet the challenges of 3D NAND geometries, new conditioners must also be developed that are compatible with them.



## MATERIAL PURITY IN COATINGS

There are some aggressive and long plasma etch steps required for 3D NAND, which puts additional demands not only on the etching process itself but on the components in the chambers in which the wafers are etched.

## IN THE TOOL