

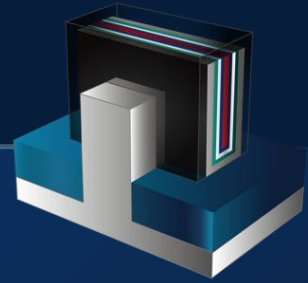
# Applied VeritySEM® 5i Metrology

Advancing 3D Patterning

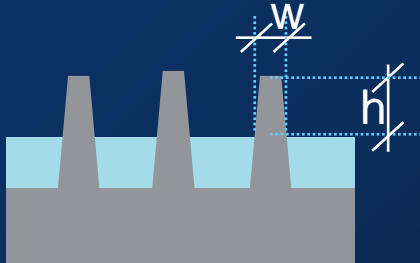


February 23, 2015

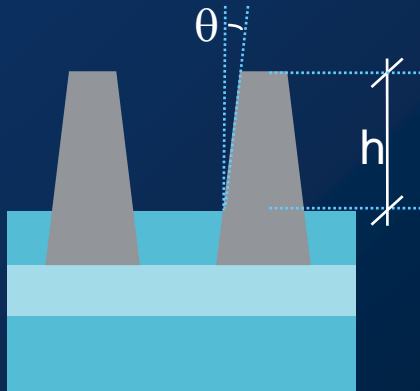
# Key FinFET Metrology Challenges



## Industry Measurement Needs



- Fin width ( $w$ )
- Fin height ( $h$ )



- Gate height ( $h$ )
- Edge slope ( $\theta$ )

## Traditional Top View

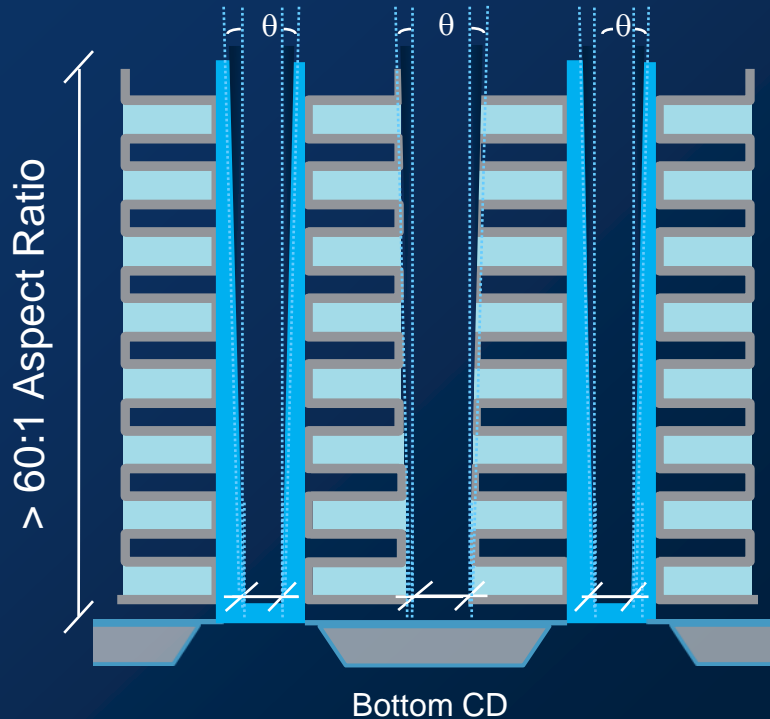


SPIE published by GLOBALFOUNDRIES and Applied Materials

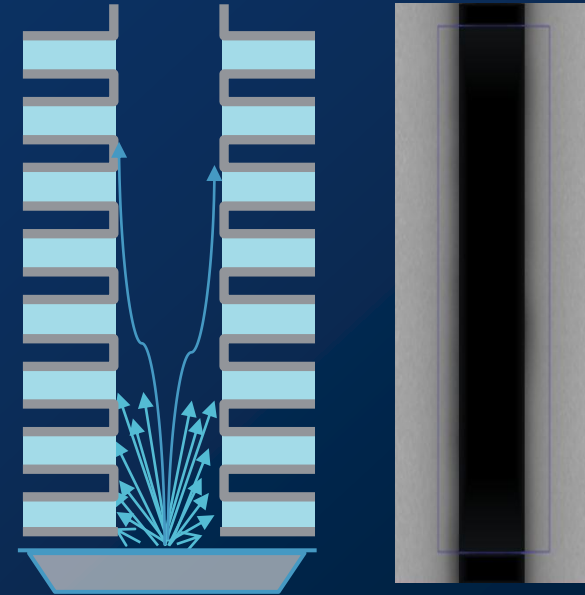
Traditional CD SEM **cannot accurately measure height and slope**

# Key 3D NAND Metrology Challenges

## Industry Measurement Needs



## Traditional Top View

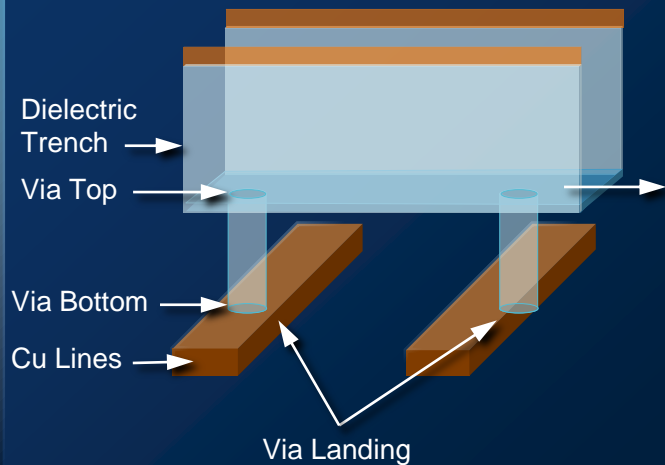


- Measure bottom CD and edge slope ( $\theta$ ) of high aspect ratio (HAR) trenches

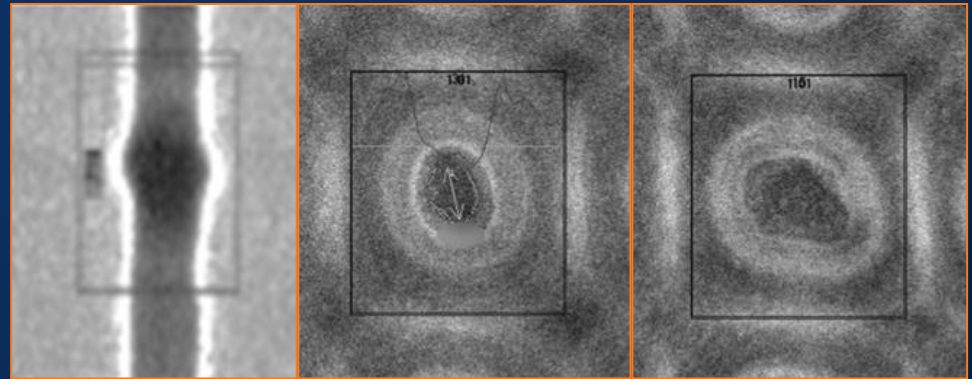
Traditional CD SEM **cannot clearly visualize trench bottom**

# Key Interconnect Metrology Challenges

## Industry Needs



## Traditional Top View






SPIE published by GLOBALFOUNDRIES and Applied Materials

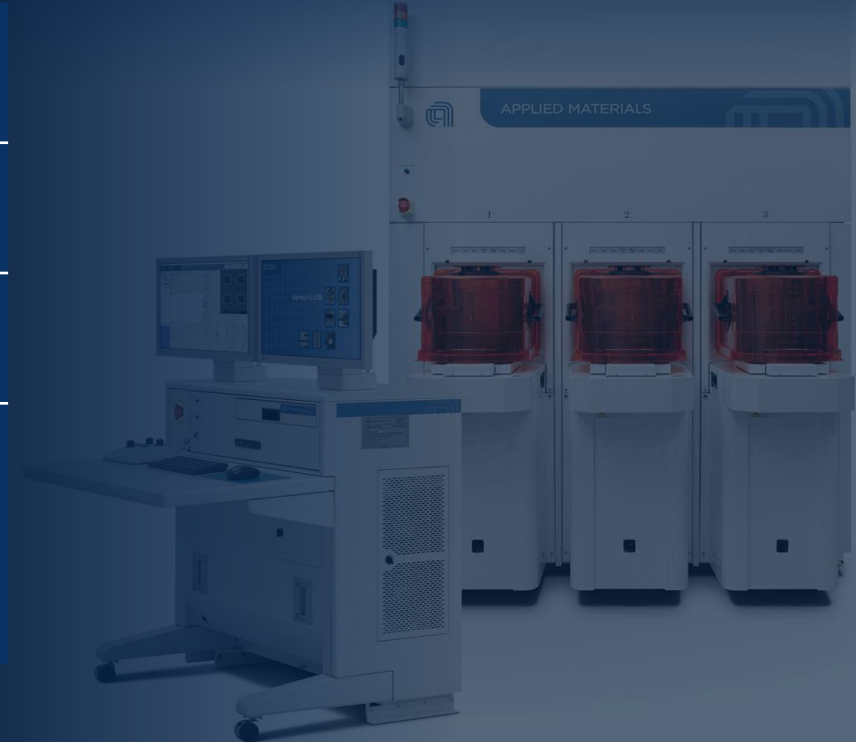
- Measure dual damascene via bottom and top dimension
- Monitor full via-in-trench opening to verify absence of residue at the via bottom

Traditional CD SEM **cannot clearly visualize via-in-trench opening**

# Introducing the Applied VeritySEM<sup>®</sup> 5i

The industry's first in-line 3D CD SEM metrology tool

Capability / Benefit	Core Technology
Accurate measurement for the 1x node	 State-of-the-art high-resolution SEM
FinFET height and slope measurement	 Tilted beam metrology
HAR metrology for 3D NAND	 Back-scattered electron (BSE) metrology
Via-in-trench BEOL metrology	

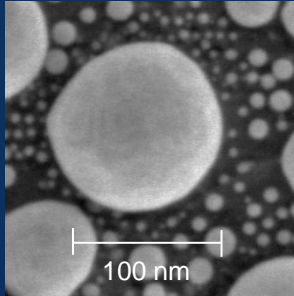


From lithography-limited 2D scaling to **metrology-enabled 3D patterning**

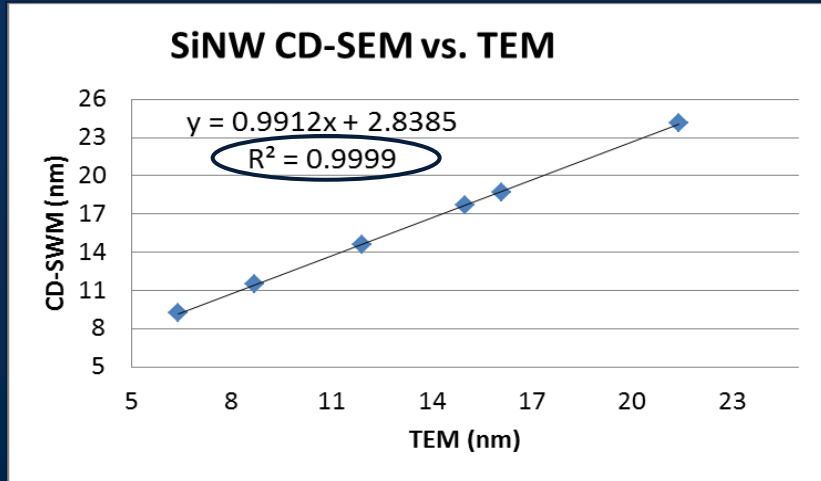
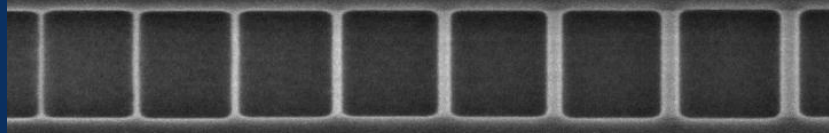
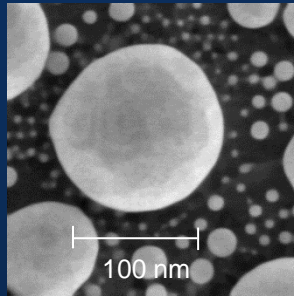
# High Resolution SEM



VeritySEM 4i+



VeritySEM 5i



SPIE published by IBM and Applied Materials

- 1.2nm resolution, with image enhancement
- Proven measurement correlation with TEM\* down to 6nm on silicon nanowires
- Innovative algorithms integrated to enhance fine pattern details

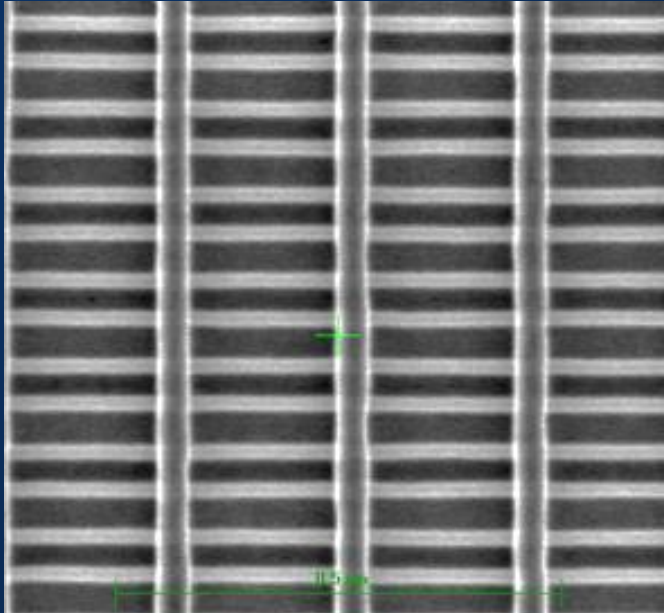
Delivers **state-of-the-art accuracy** at smallest scale

\*TEM: Transmission Electron Microscope – Industry standard tool for reference metrology

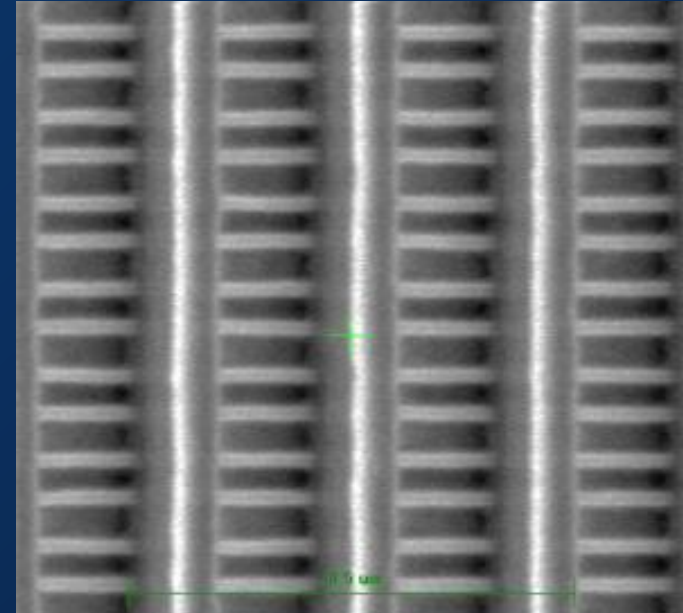
# Tilt Beam Metrology for FinFET



VeritySEM 5i Top View



VeritySEM 5i Tilt Beam



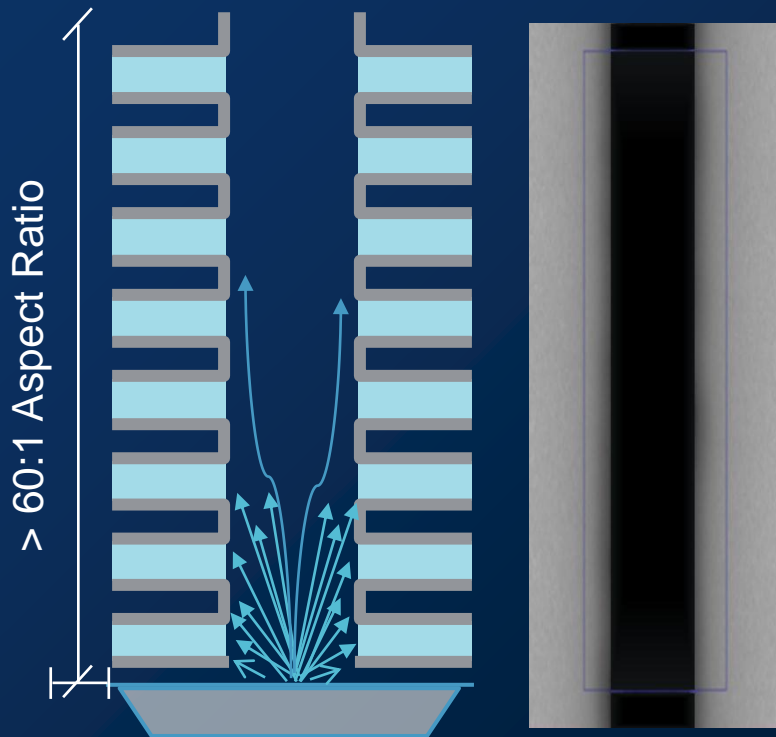
3D information ( $h, \theta$ )

Provides **precise** height and sidewall **measurements**

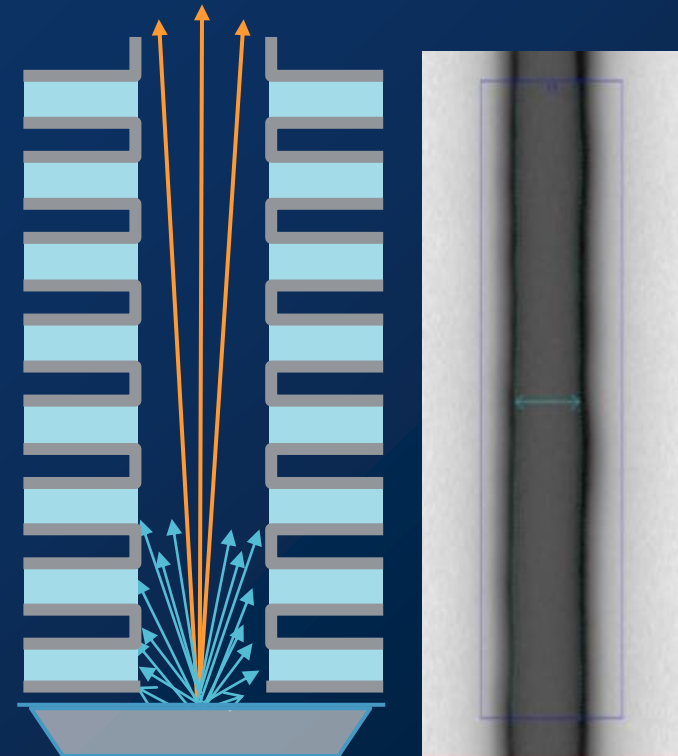
# 3D NAND HAR Imaging Metrology



Traditional Top View



VeritySEM 5i HAR Imaging



Bottom and edge slope measurements

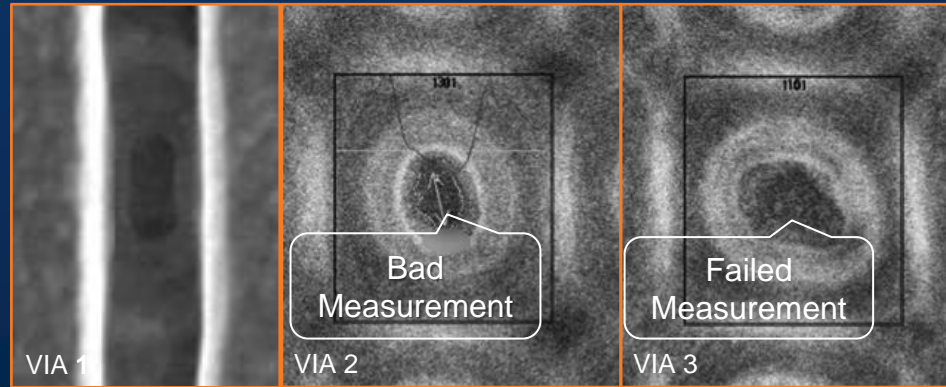
Enables **in-line metrology** for 3D NAND



# HAR Interconnect Via-in-Trench Metrology

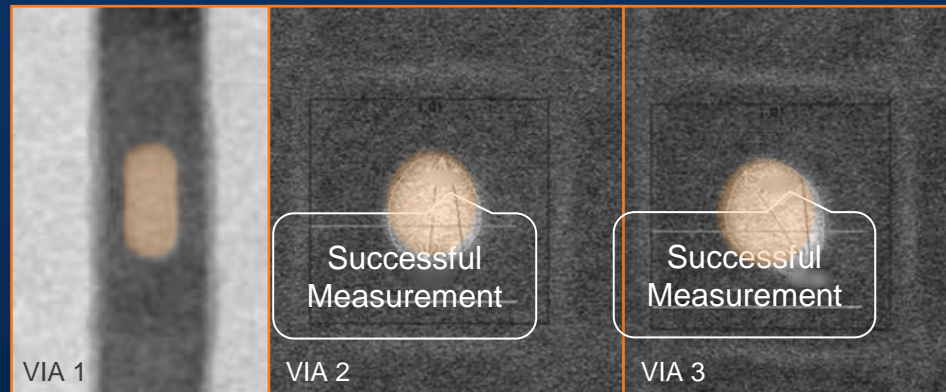


Traditional CD SEM is limited in seeing via bottom



SPIE published by GLOBALFOUNDRIES and Applied Materials

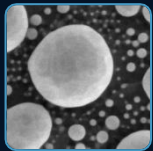
HAR imaging enables via-in-trench metrology



Accurately controls via resistance and CD uniformity

# Applied VeritySEM<sup>®</sup> 5i Metrology

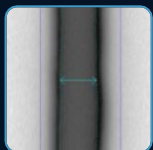
- The only in-line 3D CD SEM system for high-volume production of advanced 3D devices



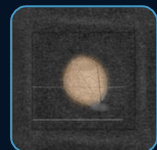
State-of-the-art high-resolution SEM column for **leading-edge dimensions**



Tilt beam for **FinFET**



HAR metrology for **3D NAND**



HAR metrology for **BEOL via-in-trench**

- Leverages market-leading SEMVision<sup>™</sup> G6 core technologies
- Accelerates time to market
- Drives up the yield curve



**Metrology innovation** for the **3D era**

