

3D NAND TEM Specimen Preparation by FIB-SEM

Related Products : FIB-SEM System(FIB-SEM) , Transmission Electron Microscope(TEM)

Introduction

FIB-SEM is a system integrating fine processing by using a Ga ion beam and observation & analysis function by SEM. This feature enables precise preparation of TEM specimens while checking cross-sectional images during processing. In particular, in the field of semiconductors where miniaturization continues, it is widely used for a TEM specimen preparation from the desired location. 3D NAND is a NAND type flash memory and is widely adopted in the storage device of a smartphone and PC. It consists of regularly stacked fine structures ranging from tens to hundreds of nanometers (Figure 1). TEM analysis is generally performed for quality testing. Therefore, the FIB-SEM is indispensable for high-precision specimen preparation prior to TEM observation.

In this application note, we used the FIB-SEM system "JIB-PS500i" (Figure 2), which incorporates a high-resolution SEM and supports a streamlined STEM workflow, to obtain SEM images and prepare TEM specimens from three directions of the 3D NAND structure. The TEM observation results obtained are presented.

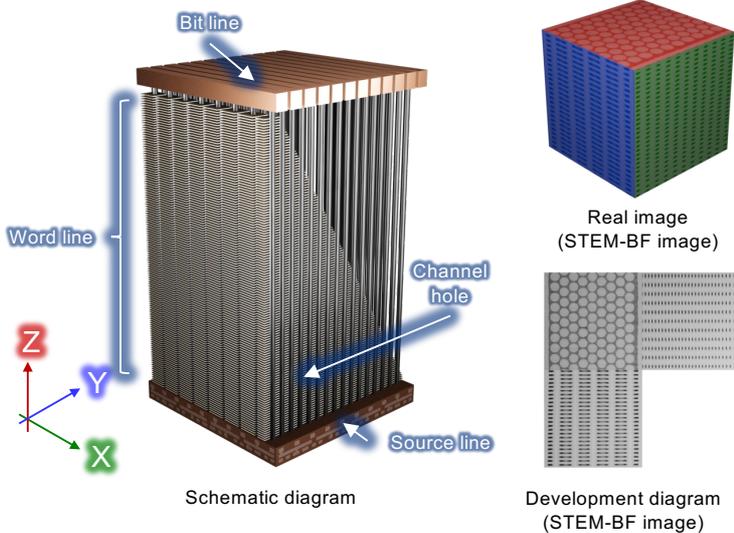


Figure. 1 3D NAND Structure



Figure. 2 JIB-PS500i Appearance

Steps of TEM specimen preparation by FIB

In TEM specimen preparation using the FIB for 3D NAND, the conventional method involves cutting a block from the substrate material, mounting it onto the FIB grid, and then thinning the block. With JIB-PS500i, since the stage can be tilted by more than 90°, confirmation of TEM specimens using STEM is possible without removing them from the system (Figure 3). This function allows for preparing a high-quality TEM specimen targeting a specific location.

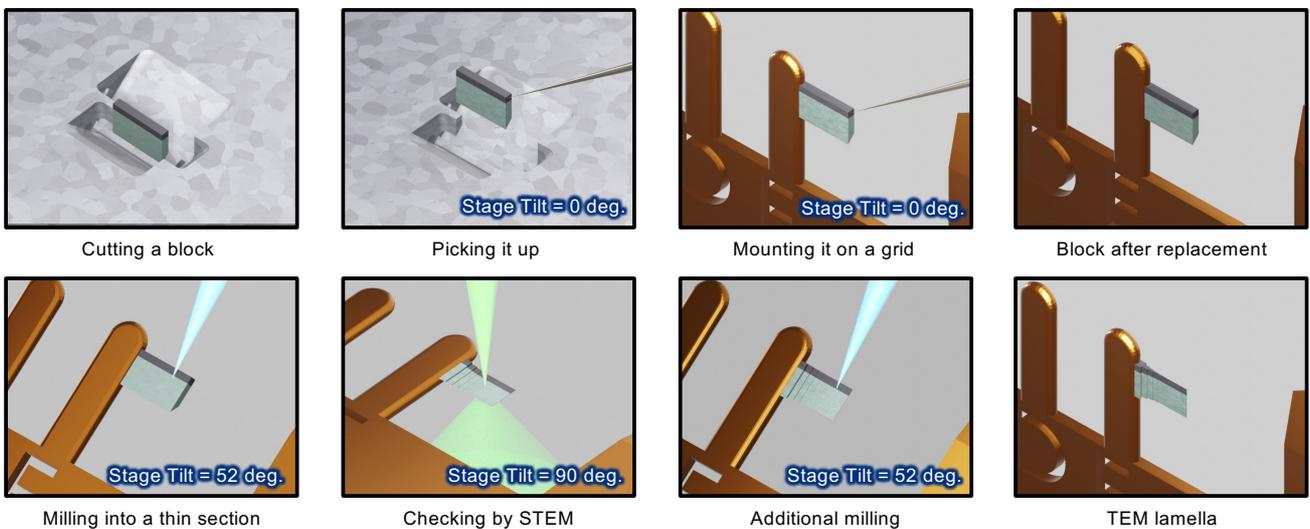


Figure. 3 Flow of TEM specimen preparation by using JIB-PS500i

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Results

SEM images and SEM-STEM images (taken by JIB-PS500i), and TEM-STEM images (taken by JEM-ARM200F) from three directions (**Figure 4 to 6**) are shown below.



YZ direction

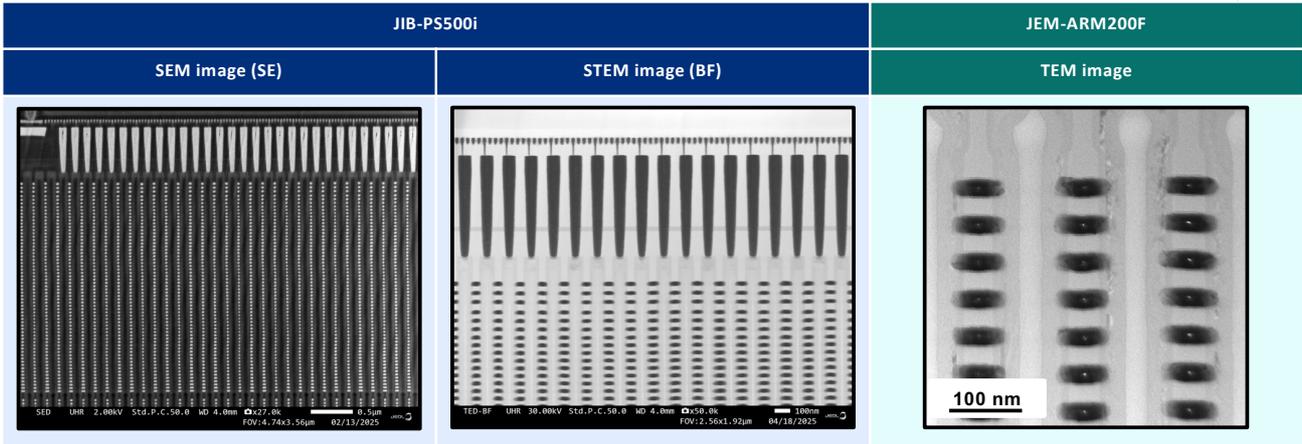


Figure. 4 SEM image, STEM image (JIB-PS500i) and TEM image (JEM-ARM200F) taken from YZ direction



XZ direction

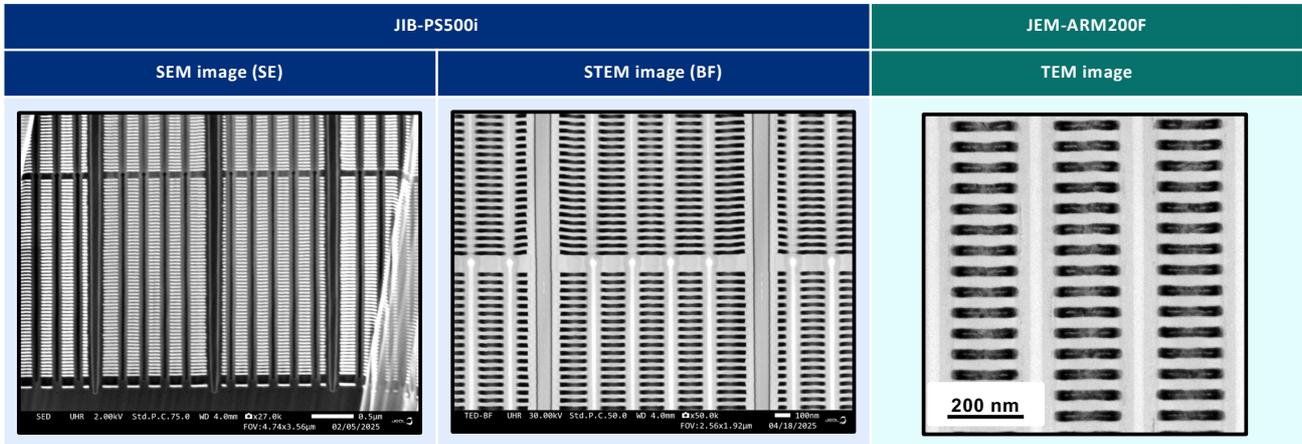


Figure. 5 SEM image, STEM image (JIB-PS500i) and TEM image (JEM-ARM200F) from XZ direction



XY direction



Figure. 6 SEM image, STEM image (JIB-PS500i) and TEM image (JEM-ARM200F) from XY direction

Conclusion

- Using the JIB-PS500i, SEM observation and TEM specimen preparation for 3D NAND were performed from three directions.
- High-quality TEM specimens can be prepared even for fine semiconductor structures such as 3D NAND, due to the high-resolution SEM image and easy STEM observation.

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