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APPLICATION BRIEF

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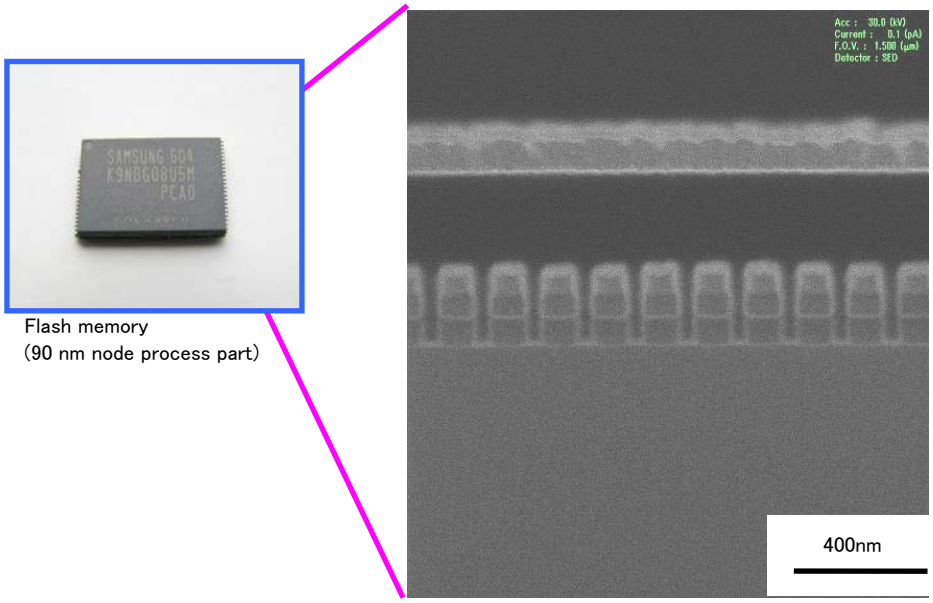
Eliminating FIB damage with a triple beam unit

1. Introduction

Damaged layers caused by focused ion beams (FIB) are a problem when manufacturing TEM samples for high-resolution observation of high-level integrated circuits such as compound semiconductors and silicon semiconductors. An FIB with an acceleration voltage of 30 kV creates a damage layer of nearly 30 nm on silicon. If the thickness of a TEM sample is 60 nm or less, the crystal structure of the sample becomes completely amorphous.

To solve this problem, SIINT has installed a low-acceleration argon ion gun on its triple beam unit. This argon ion gun removes the damage layer created by the original ion beam. Furthermore, this unit was designed so that the FIB, SEM and argon ion gun beams all cross at the exact same position. This makes it possible to prepare high-grade TEM samples at the same position in the same chamber easily and precisely.



Flash memory
(90 nm node process part)

SIM image of memory part (at 180K)

2. Comparative Results of Damage Layers

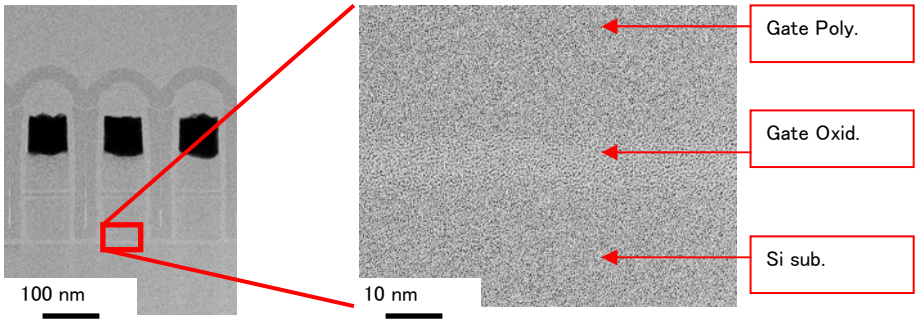
An actual sample was prepared and then observed using TEM. The results are shown in the images. The image on the left shows the flash memory chip used to prepare the TEM sample for comparing damage.

3. Summary

When the triple beam instrument is used to prepare TEM samples, damage can be reduced by lowering the acceleration voltage of the ion beam during final finish processing. Damage to the sample can be controlled by changing the acceleration voltage of FIB from 30 KV to 5 KV during final finish processing. However, if an argon beam is also used to clean measurement samples, high-grade TEM samples with very low levels of damage can be prepared.

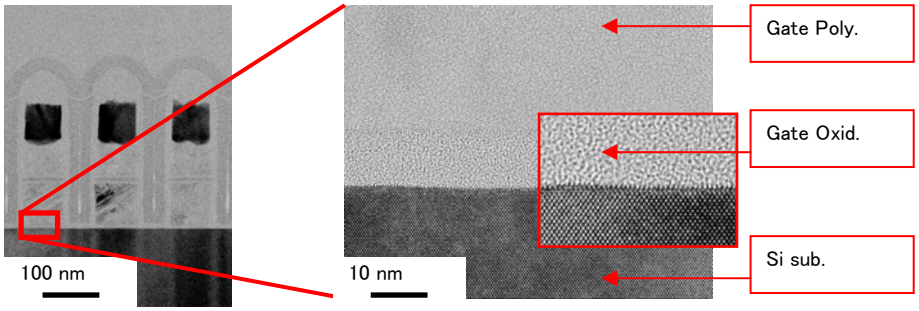
- **Results for FIB 30 kV**

Since the slice is almost completely amorphous, the image contrast is low.



- **Results for FIB 5 kV**

The contrast is good but stain-like damage can be seen on the silicon board.



- **Results for Argon 1 kV**

Contrast is good and almost no damage can be seen on the silicon board.