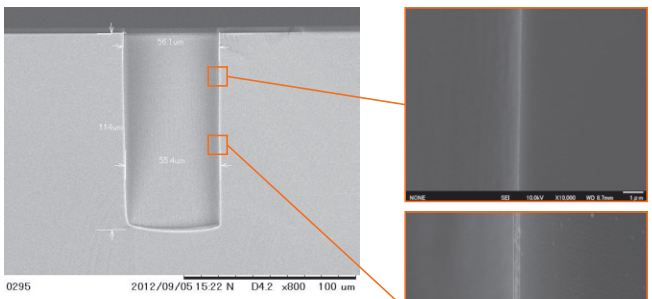
The Bosch Process Data
Low-scallop Etching Process and Sidewall Smoothing Process

■Introduction

The Bosch process is a dry etching process for silicon, and is capable of high-selectivity and high-aspect ratio etching. This process consists of repeated alternating isotropic etching and sidewall passivation/protection deposition steps. One of the disadvantages of the Bosch process is that scallops are formed on the sidewalls. As the scallop sizes become larger, the sidewall surface becomes rougher. In simple deep hole etching and etching from the backside, the scallops are not a big problem. However, the large scallops may reduce the reliability of vertical-structure devices and MEMS devices. For example, in the fabrication of a trench MOS, the scallops can cause leakage current and slow device response.
To resolve the problems caused by scallops, we have developed a low-scallop etching process and a sidewall smoothing process.

■Low-scallop Etching Process

We developd a low-scallop process with faster gas switching. The faster gas switching leads to shorter process times for each step. The Bosch process consists of alternating silicon etching and CF_x passivation film deposition. The scallops form during the silicon etching step, and scallop sizes are propostional to the etching times. Therefore, the faster gas switching is effective for achieving a low-scallop process.
Fig.1 shows an example of the low-scallop process.



Pattern Width=< 2.7 μm
Etch Depth=114 μm
Etch Rate=10 μm/min
Scallop Size=<50nm

Fig.1 Low-scallop Etching Process with High-speed Gas Swithcing

■Sidewall Smoothing Process

The sidewall smoothing process removes scallops with florine-oxgen chemistry after the Bosch process*. This process improves surface smoothness while keeping the critical dimension of high-aspect etching.
Fig.2 shows an example of the smoothing process.

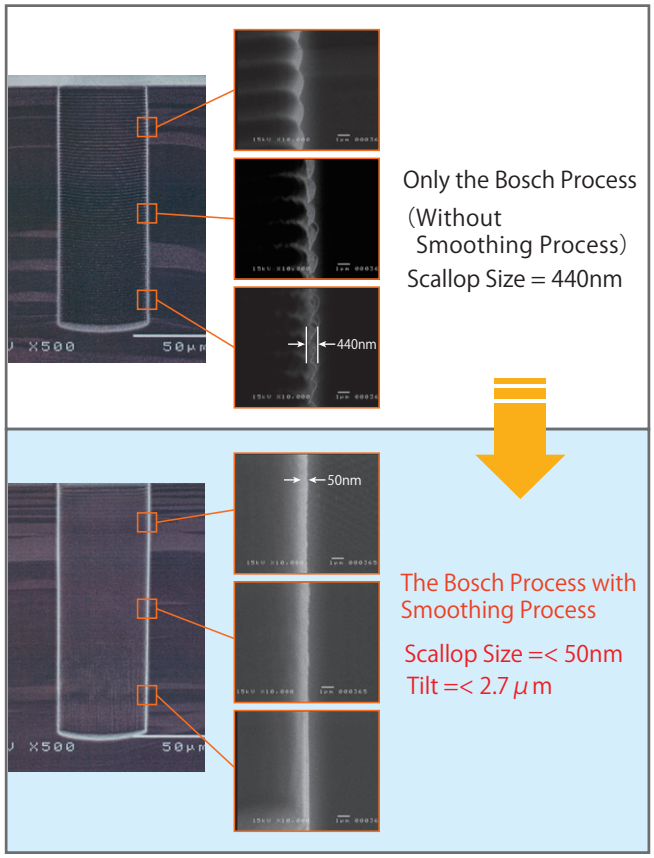


Fig.2 Sidewall Smoothing Process

■Summary

We developed a low-scallop etching process with high-speed gas switching and a sidewall smoothing process.
Even though each improvement is effective for reducing scallop size and for smoothing sidewall surfaces, the combination of both improvements is much more effective for device fabrication.

* Patent pending