



IntelliSense Wet Etching Platform and its Perfect Design Tool

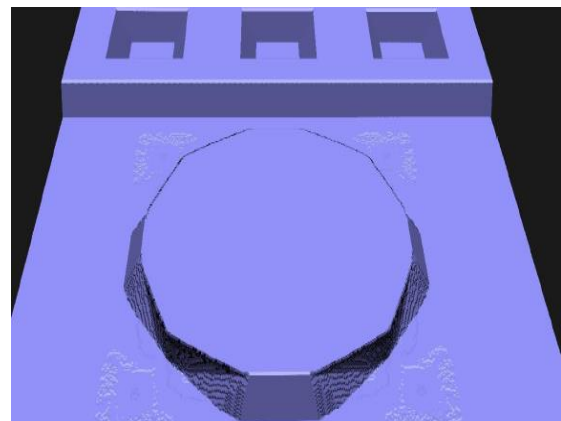
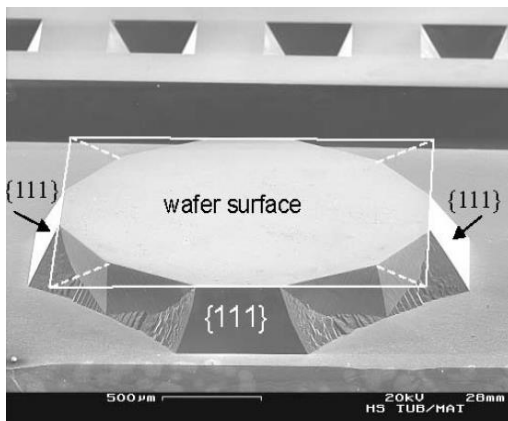
1. Advantages of Design Tool

(1) Wet etching of silicon. By applying the IntelliEtch/Anise/Blueprint modules of IntelliSuite, one can simulate and predict etching results under specific parameters and mask structure. The simulation supports arbitrary orientation of silicon wafers. Through the prediction of wet etching results for complex structure on the high-order orientation, one can easily evaluate the reliability and performance of the designed device, which contributes to a reduction of time and cost.

(2) Wet etching of quartz. By applying the IntelliEtch/Anise/Blueprint modules of IntelliSuite, one can precisely predict the quartz etching results with complex structures. Being able to carry out the actual process, in our foundry, we can offer customers an accurate and reliable quartz etching service.

(3) Wet etching of metal. Accurate and online control of a metal wet etching process, like gold, aluminum, nickel, chrome etc..

KOH Wet etching of silicon



NH4HF2 wet etching of quartz

Simulation details:

Quartz(0 0 0 1):
 $X[2 -1 -1 0]$
 $Y[0 1 -1 0]$
 $Z[0 0 0 1]$

Xsize: 10400 μm
 Ysize: 10400 μm
 Zsize: 250 μm

NOC: 640

Mask: HexagonalWells3x3
 Etchant: NH4HF2 at 70 C
 Etch time: 350min
 (1 % random events)

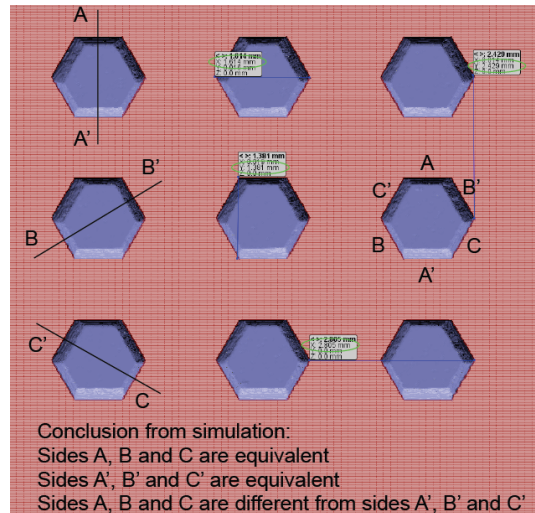
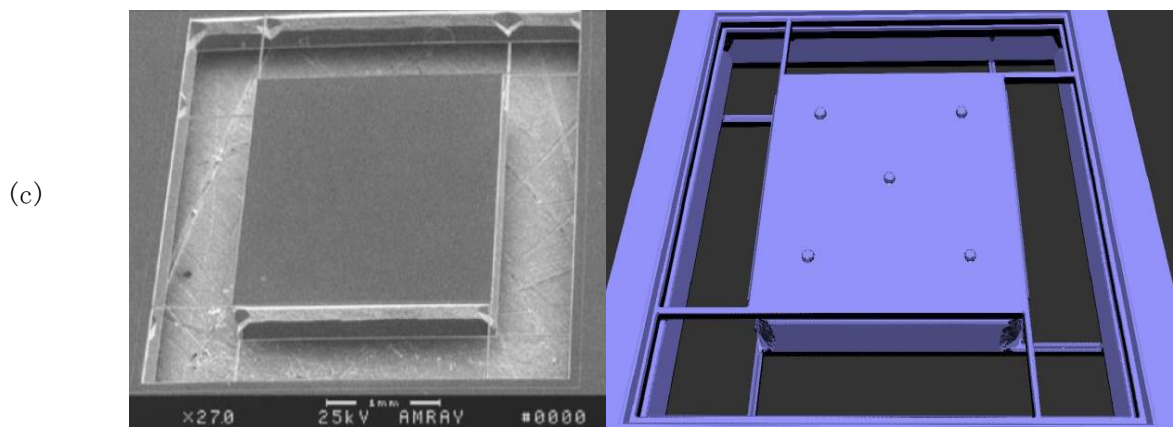
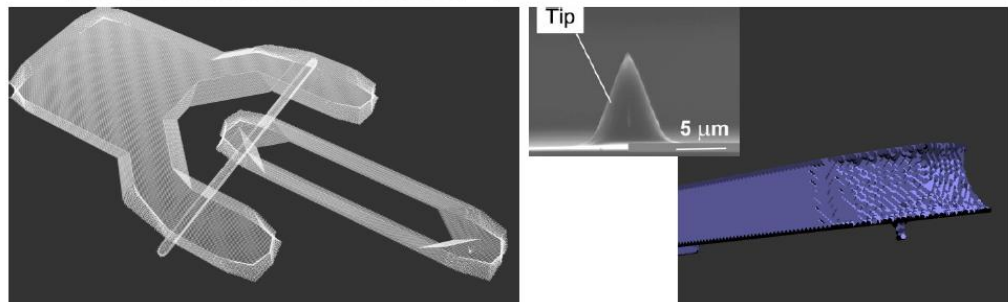
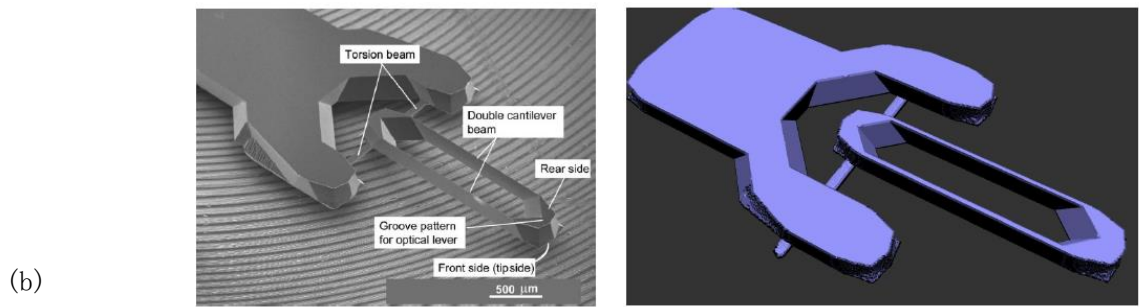
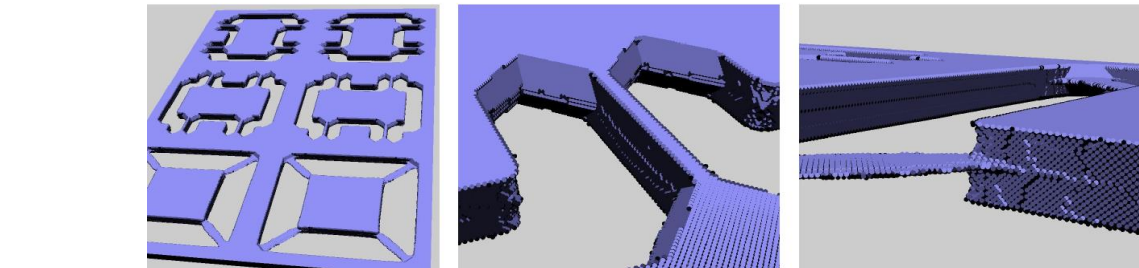
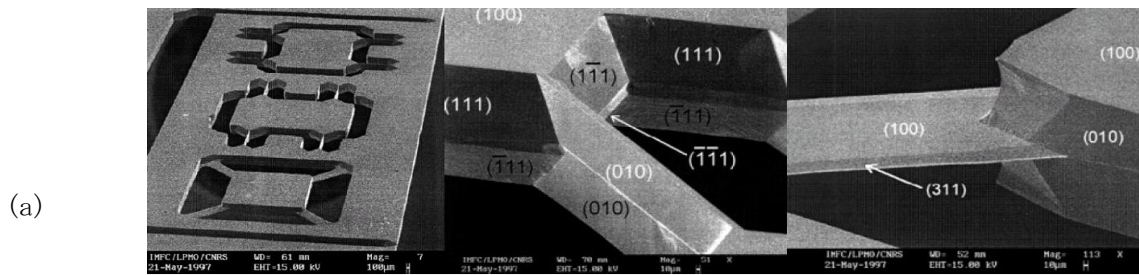




Illustration of the 3D device structures derived from the wet etching simulation





2. Diversification

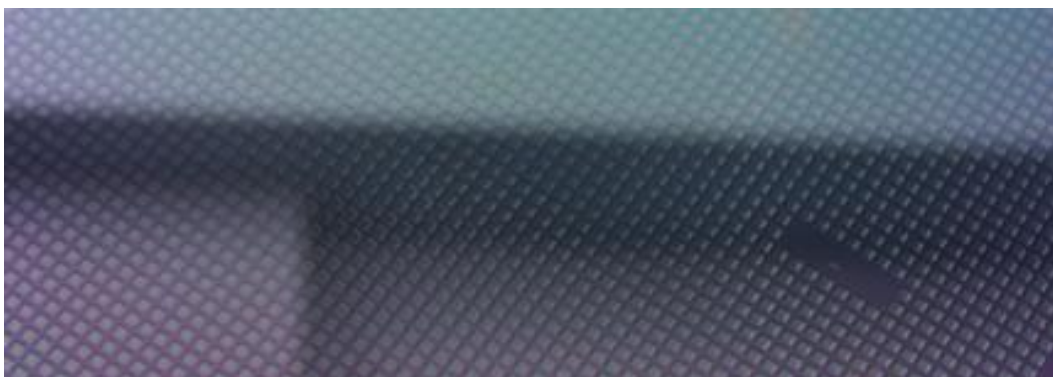
- (1) Specific fixture for one-side etching with ProTek resist protection: This technology can protect the surface device layer from contamination with various metal ions.
- (2) Anisotropic wet etching process using KOH and TMAH: IntelliSense can reach an accuracy of $\pm 1\mu\text{m}$ for the etching depth.
- (3) Anisotropic wet etching process using TMAH: By using the IntelliSense specific etching solution, a very smooth surface can be achieved.
- (4) CMOS process compatibility: TMAH can avoid K^+ ion contamination, which can protect the ICs assembled with a device chip.
- (5) SiO_2 and Si_3N_4 can be applied as the mask material when doing the TMAH wet etching.
- (6) TMAH is non-toxic and environment friendly.

3. Various etching processes

- (1) Isotropic and anisotropic wet etching of 4- and 6-inch silicon wafers.
- (2) Standard wet etching processing with KOH and TMAH
- (3) One-side wet etching of 4- and 6-inch silicon wafers. The opposite side of the device is protected.
- (4) Simultaneous wet etching of up to 25 silicon wafers.
- (5) IC standard cleaning process like RCA 1# and RCA 2#.

4. Accurate process control

- (1) After wet etching by TMAH solution to a depth of $354\mu\text{m}$, the roughness (R_a) of the silicon cup surface is $0.68\mu\text{m}$, which is smooth and flat.





(2) With a high etching rate, wet etching can be hardly applied when the device critical dimension is smaller than $3\mu\text{m}$. By contrast, dry etching can enable better control of the critical dimension. But the fabrication cost is correspondingly higher than wet etching due to the more expensive equipment. IntelliSense can offer a service of wet etching for structures with the critical dimension being $5\sim 7\mu\text{m}$.

**Test results of the wet etching for Nickel wires
with a critical dimension smaller than $7\mu\text{m}$**

