

## Baseline Etches: Wafer Preparation

- Base wafer – for Si etch test wafers, used both N and P type, CNF <100> stock wafers. For the etches done to this point, dopant type is not expected to affect the etch rate.

For SiO<sub>2</sub> etch test wafers, ~530nm of thermal oxide was grown on <100> Si wafers in the CNF oxide furnace tube.

For low-stress Si<sub>3</sub>N<sub>4</sub> test wafers, <100> Si wafers were deposited with LPCVD low-stress nitride (recipe 3, n=2.2) in the CNF furnaces.

For standard Si<sub>3</sub>N<sub>4</sub> test wafers, <100> Si wafers were deposited with LPCVD standard nitride in the CNF furnaces.

For Chrome test wafers, ~400nm of Cr was deposited in the CVC sputtering tool on SiO<sub>2</sub> test wafers.

- Process with Shipley 1827 resist (thickness ~1.2 microns):
  1. Spin P20 at 3000 rpm for 30s
  2. Spin Shipley 1827 resist at 3000 rpm for 30s
  3. Softbake 115 C, 60 seconds
  4. Expose on ABM 12 seconds (with 365nm and 405nm mirrors). Mask is “Contact Resolution Mask.”
  5. Develop in Hamatech automated developer, using process “300 MIF 90s.” \*
- Process with OiR 620-7i resist (thickness ~650nm):
  1. Spin P20 at 2000 rpm for 30s, acceleration 2000 rpm/s
  2. Spin OiR 620-7i resist at 2000 rpm for 60s, acceleration 2000 rpm/s
  3. Softbake at 90 C, 60 seconds
  4. Expose on Autostep i-line stepper.
    - a. For Si test substrates, exposure time is 0.26s
    - b. For SiO<sub>2</sub> test substrates, exposure time is 0.5s
    - c. For Cr test substrates, exposure time is 0.4s
  5. Post-Exposure Bake at 115 C, 60s
  6. Develop in Hamatech
    - a. For Si and SiO<sub>2</sub> test substrates, process “300 MIF 60s DP” was used.\*
    - b. For Cr test substrates, “726 MIF 60s DP” was used.

*\*Note that 300 MIF is no longer available in the Hamatech*

## Baseline Etches: Measurement Procedure

1. Wafers are cleaved into pieces, roughly 1 cm on a side
2. Using the Leitz microscope ellipsometer, the resist thickness was measured on the piece. Measurements are made in the center of the piece. No significant variation in thickness measurements across the piece has been observed.

Material models used are as follows:

- a. For resist (both Shipley 1827 and OiR 620-7i), use material “Positive Resist”
- b. For thermal SiO<sub>2</sub>, use material “SiO<sub>2</sub>”
- c. For standard Si<sub>3</sub>N<sub>4</sub>, use material “Silicon Nitride”

- d. For low stress Si<sub>3</sub>N<sub>4</sub>, use material “LS SiN n2.2”
3. Etch performed
4. Repeat step 2 to measure resist thickness
5. Using the P10 profilometer, the etch depth is measured once again in the center of the piece. The etched thickness is taken as the etch depth minus the resist thickness.

### **General Etch Process Notes**

- All recipes used can be found in the manuals next to the tools, with the exception of the PT72 and PT770, for which recipes are outlined below. Other etch notes are also found below.
- For chamber conditioning, please consult “ETCH\_BASELINE\_DATA.doc.”

### **PT72**

For all PT72 recipes, the main etch step was preceded by a gas stabilization step run at 0W for 45 sec with the same gases and gas flows as the main etch step.

- CF4 etch: CF4 (30 sccm), 150W, 40 mTorr
- CHF3/O2 etch: CHF3 (50 sccm), O2 (2 sccm), 200W, 40mTorr
- O2 Clean: O2 (60 sccm), 150W, 50 mTorr
- SF6/O2 etch: SF6 (13 sccm), O2 (40 sccm), 100W, 50mTorr

### **PT720 Right Chamber**

- Recipe file: 0SiEtch.bch
- Used low voltage bias (-250V). Other etch details are in the tool manual.

### **PT770 Left Chamber**

- Recipe file: 0SiEtch.bch, dnh37WG1.prc
- Native oxide etch:
  - Turbo: 20 mTorr
  - Time: 1:00 min
  - Cl<sub>2</sub>: 10.0
  - BCl<sub>3</sub>: 20.0
  - H<sub>2</sub>: 3.0
  - Ar: 0.0
- Etch Warmup a
  - Turbo: 25 mTorr
  - Time: 00:01 min
  - Cl<sub>2</sub>: 25.0
  - BCl<sub>3</sub>: 15.0
  - H<sub>2</sub>: 2.0
  - Ar: 0.0
  - RF1 Power: 50
  - RF2 Power: 850
- Etch Warmup b
  - Turbo: 25 mTorr
  - Time: 00:01 min

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- Cl<sub>2</sub>: 50.0
- BCl<sub>3</sub>: 7.0
- H<sub>2</sub>: 2.0
- Ar: 0.0
- RF1 Power: 60
- RF2 Power: 850
- Main Etch Step
  - Turbo: 30 mTorr
  - Cl<sub>2</sub>: 70.0
  - BCl<sub>3</sub>: 2.0
  - H<sub>2</sub>: 2.0
  - Ar: 0.0
  - RF1 Power: 65
  - RF2 Power: 850