

MICRO/NANO TECHNOLOGY CENTER

Micro/Nano Technology Center University of Louisville

Dry Etch Capabilities

NNCI Etch Workshop May 24-25, 2016





TRION METAL ETCHER MODEL: MINILOCK-PHANTOM III ICP/RIE

Trion etcher uses 7 gasses for chemistry: CHF3, SF6, CF4, O2, Cl2, BCl3, and Ar.



TRION METAL ETCHER

Gas chemistry: CHF3, SF6, CF4, O2, Cl2, BCl3, and Ar;

Wafer size: up to 8 inches wafer;

Temperature range: No temperature control;

Clamping: mounting wafer on a carrier w/o bonding;

Process allowed material & restrictions: metals primarily;

Masking materials: photoresist or SiO2;

Chamber conditioning: If fluorine based recipe was ran previously, a Chlorine based

recipe is ran prior to a real etching process with chlorine involved.





ESTABLISHED PROCESSES

| Material | ICP power/W | RIE power/W | Gas flow/sccm | Pressure/mTorr | Etching rate |
|--------------|-------------|-------------|----------------------------------|----------------|--------------|
| Titanium | 400 | 100 | SF6 (50) | 25 | 50 nm/min |
| Aluminum | 250 | 75 | BCL3(50)/Cl2(70) | 180 | 221 nm/min |
| Gold | 600 | 50 | Cl2(15)/Ar(5) | 5 | 15 nm/min |
| Platinum | 600 | 300 | Cl2(8)/Ar(32) | 10 | 35 nm/min |
| Chrome | 300 | 50 | Cl2(25)/O ₂ (5)/Ar(5) | 30 | 30 nm/min |
| GaAs | 600 | 100 | BCL3 (10)/Cl2(10) | 10 | 1.7 μm/min |
| GaN | 400 | 60 | Cl2(12)/Ar(6) | 10 | 160 nm/min |
| Poly-silicon | 300 | 10 | SF6 (25)/O2(5) | 10 | 500 nm/min |
| Thermal SiO2 | 300 | 10 | SF6 (25)/O2(5) | 10 | <10 nm/min |

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PLATINUM ETCHING

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After O₂ plasma cleaning



After O2 mixed with CF4 plasma cleaning



REGULAR MAINTENANCE

- Every week, O2 plasma clean process chamber for 30 min.
- Every week, refill oil in the roughing pump to turbo pump.
- Every 3 months, wiping inside of chamber & lid with DI water & light ScotchBrite. Cleaning with IPA and running O2 clean plasma

TROUBLE SHOOTING



Normal chlorine based plasma



Abnormal chlorine based plasma



BELLOWS WAS LEAKING



Before taking off the bellows





The old leaky bellows was taken out

New bellows was installed



MARCH RIE MODEL: RIE CS 1701

Tool uses 4 gasses: H₂, O₂, CHF₃, CF₄.





MAINTENANCE

Every month we check oil level in the roughing pump, water level in the chiller and function of H_2 generator.



MARCH RIE

Gas chemistry: H₂, O₂, CHF₃, CF₄.

Wafer size: up to 6 inches wafer;

Temperature range: No temperature control;

Clamping: wafer sits in the process chamber directly.

Process allowed material & restrictions: photoresist primarily, polyimide, SiO₂, Si₃N₄ **Masking materials:** photoresist, SiO₂, and Aluminum.

| Material | RIE power/W | Gas flow/sccm | Pressure/mTorr | Etching rate |
|--------------------------|-------------|---|----------------|--------------|
| Parylene | 250 | O ₂ (50) | 250 | 250 nm/min |
| Polyimide | 300 | O ₂ (50) | 300 | 350 nm/min |
| Photoresist | 300 | O ₂ (50) | 300 | 1.3 μm/min |
| Thermal SiO ₂ | 260 | H ₂ (3)/CF ₄ (125) | 250 | 87 nm/min |
| Silicon nitride | 250 | O ₂ (12.5)/CHF ₃ (50) | 200 | 110 nm/min |



PARYLENE ETCHING



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DRIE MODEL: STS, MULTIPLEX ASE

This STS ICP System uses fluorinebased gases for anisotropic deep silicon trench etching for research and development.

MAINTENANCE

Every month we check oil level in the roughing pump, chamber cleaning, position of loading arm, changing the water filter, replace batteries in VAT, lip seal replacement.

DRIE

Gas chemistry: SF6, C4F8, O2, Ar;

Wafer size: 4 inches wafer;

Temperature range: No temperature control;

Clamping: Helium clamp

Process allowed material & restrictions: no metals primarily;

Masking materials: photoresist or SiO2;

DRIE PILLAR ETCHING

| SF6 flow | O2 flow | C4F8 flow | Etch cycle | Passivatio | Coil | Platen | Cycles |
|----------|---------|-----------|------------|------------|-------|--------|--------|
| rate | rate | rate | time | n time | power | power | number |
| 130 sccm | 13 sccm | 85 sccm | 10 s | 4 s | 800 w | 12 w | 75 |

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XACTIX MODEL: XACTIX[®] E2[™]

The XeF₂ reaction with silicon is purely chemical and spontaneous (plasmaless).

XeF₂ vapor phase etching exhibits nearly infinite selectivity of silicon to photoresist, SiO₂, Si₃N₄, and aluminum.

MAINTENANCE

Every month we calibrate sensor gauge, check the chambers leak rate.

Gas chemistry: XeF2;

Wafer size: up to 6 inches wafer;

Temperature range: No temperature control;

Clamping: wafer sits in the process chamber directly;

Process allowed material & restrictions: photoresist primarily, polyimide, SiO₂

Masking materials: SiO2, Si3N4, most metals;

RELEASED STRUCTURES

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U of L Micro/Nano Technology Center (MNTC) http://louisville.edu/micronano

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