UNIVERSITY OF LOUISVILLE
MICRO/NANO TECHNOLOGY CENTER

Micro/Nano Technology Center
University of Louisville

Dry Etch Capabilities

NNCI Etch Workshop
May 24-25, 2016

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Micro/Nano Technology Center

Research at the speed of business.

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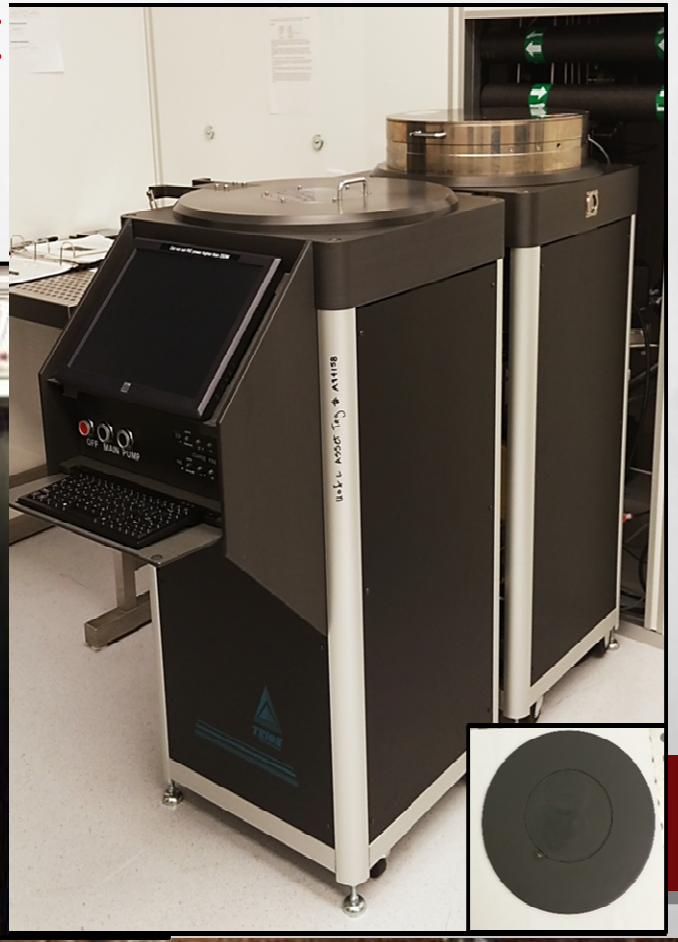
TRION METAL ETCHER

MODEL: MINILOCK-PHANTOM III ICP/RIE

Trion etcher uses 7 gasses for chemistry:
CHF_3, SF_6, CF_4, O_2, Cl_2, BCl_3, and Ar.



TRION METAL ETCHER

Gas chemistry: CHF_3, SF_6, CF_4, O_2, Cl_2, BCl_3, 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;

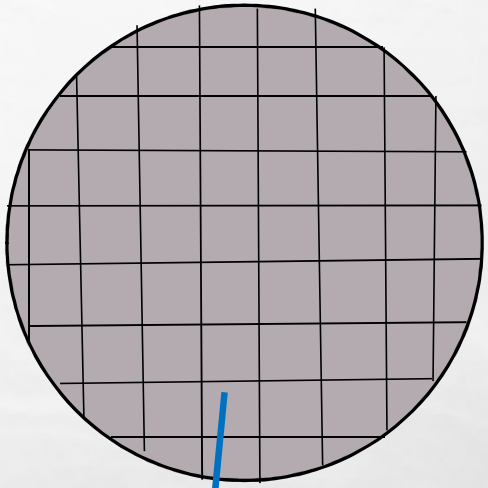
Masking materials: photoresist or SiO_2;

Chamber conditioning: If fluorine based recipe was ran previously, a Chlorine based recipe is ran prior to a real etching process with chlorine involved.

BASELINE PROCESS ESTABLISHMENT

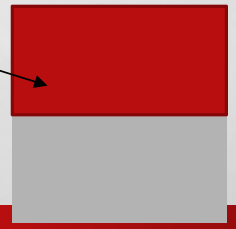
1st step: deposition

2nd step: dicing



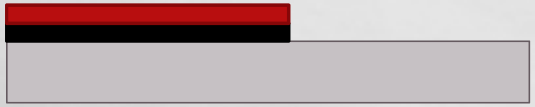
3rd step: pattern

photoresist



4th step: etching and depth measurement

photoresist



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ESTABLISHED PROCESSES

Material	ICP power/W	RIE power/W	Gas flow/sccm	Pressure/mTorr	Etching rate
Titanium	400	100	SF_6 (50)	25	50 nm/min
Aluminum	250	75	BCL_3(50)/Cl_2(70)	180	221 nm/min
Gold	600	50	Cl_2(15)/Ar(5)	5	15 nm/min
Platinum	600	300	Cl_2(8)/Ar(32)	10	35 nm/min
Chrome	300	50	Cl_2(25)/O_2 (5)/Ar(5)	30	30 nm/min
GaAs	600	100	BCL_3 (10)/Cl_2(10)	10	1.7 µm/min
GaN	400	60	Cl_2(12)/Ar(6)	10	160 nm/min
Poly-silicon	300	10	SF_6 (25)/O_2(5)	10	500 nm/min
Thermal SiO2	300	10	SF_6 (25)/O_2(5)	10	<10 nm/min

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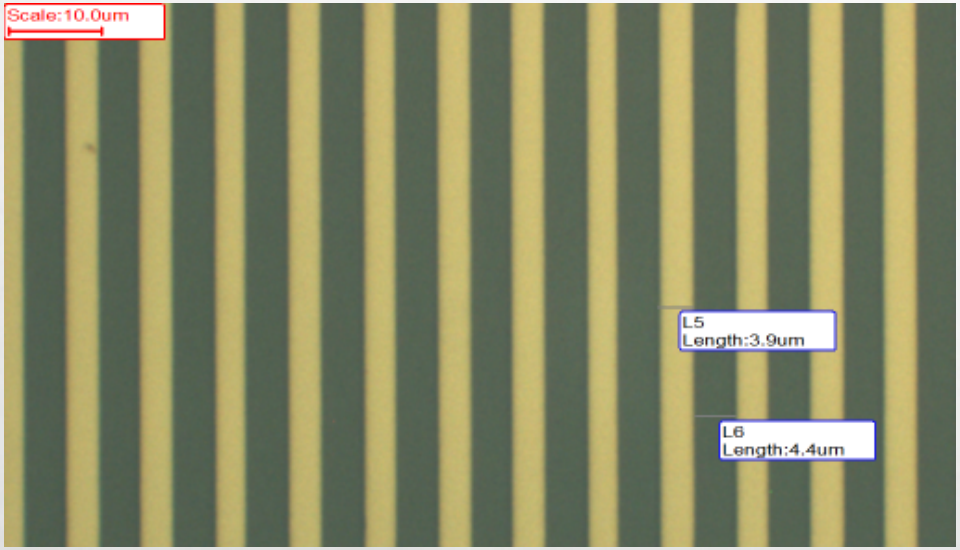
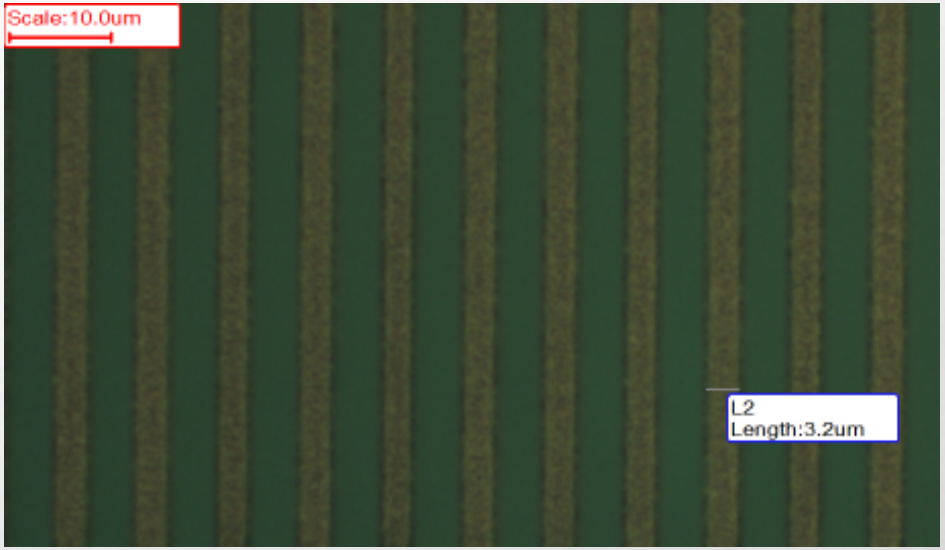
GOLD ETCHING



Photoresist was not roasted



Photoresist was roasted

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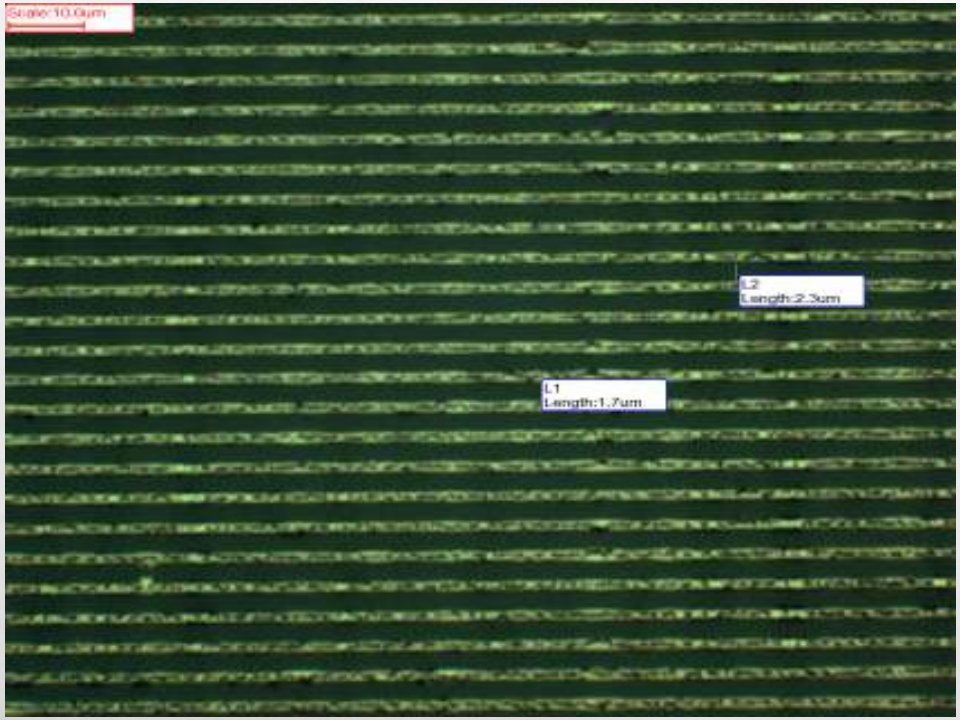
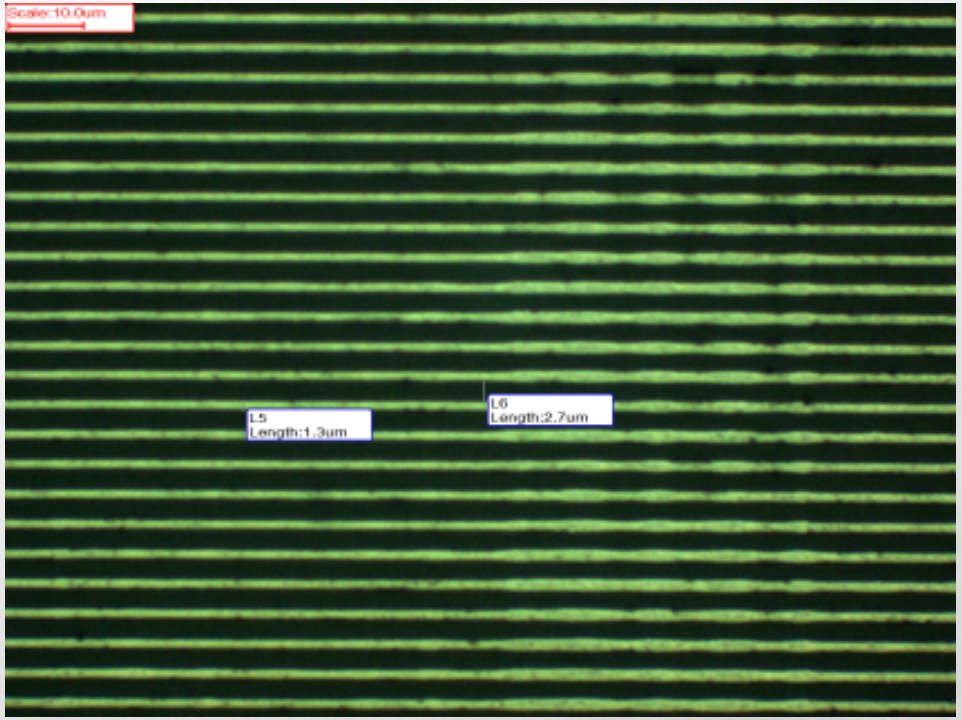
PLATINUM ETCHING



After O_2 plasma cleaning

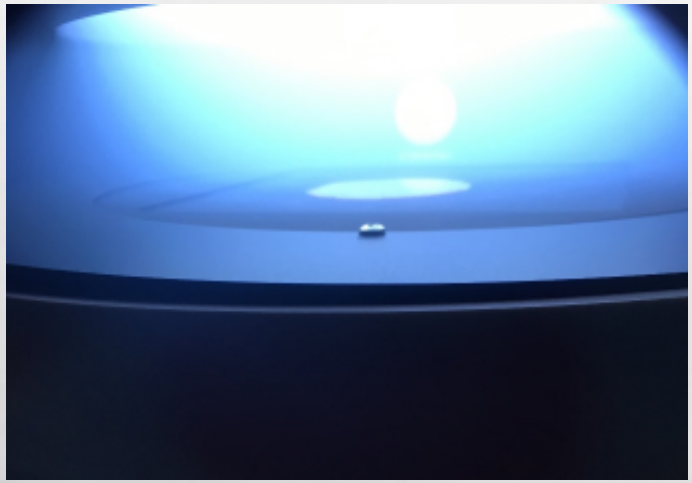


After O_2 mixed with CF_4 plasma cleaning

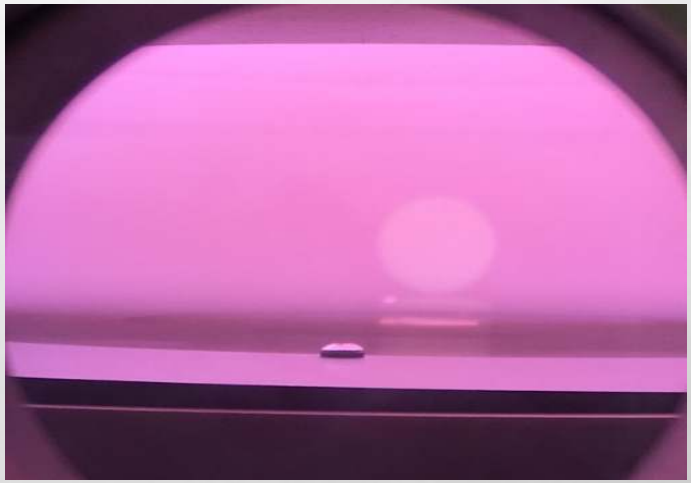
REGULAR MAINTENANCE

- 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

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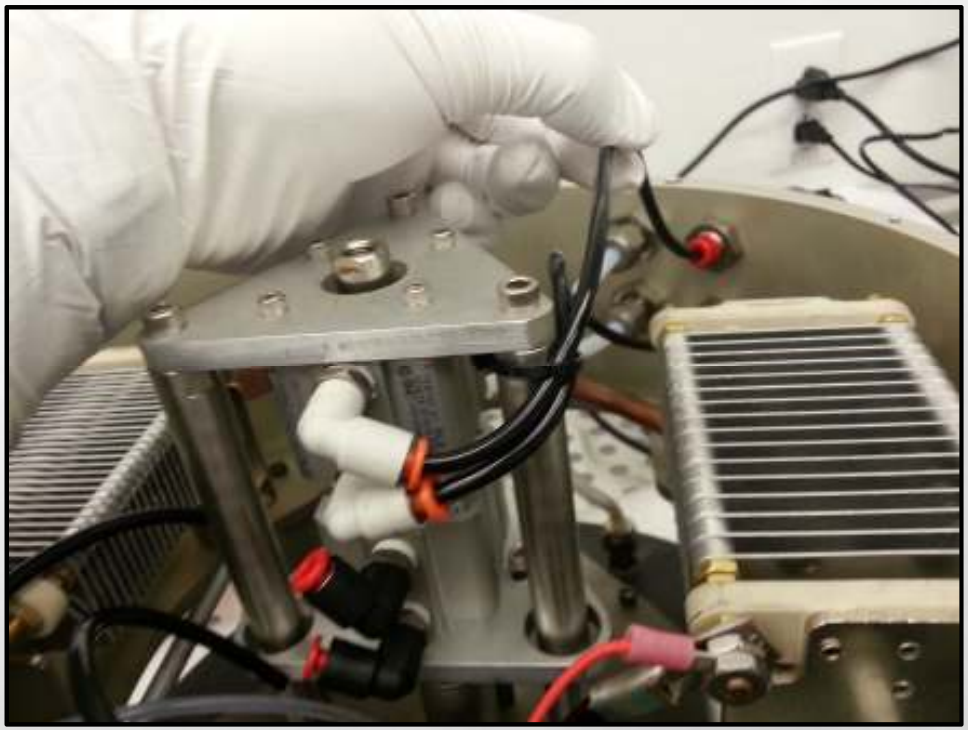
BELLOWS WAS LEAKING



Before taking off the bellows

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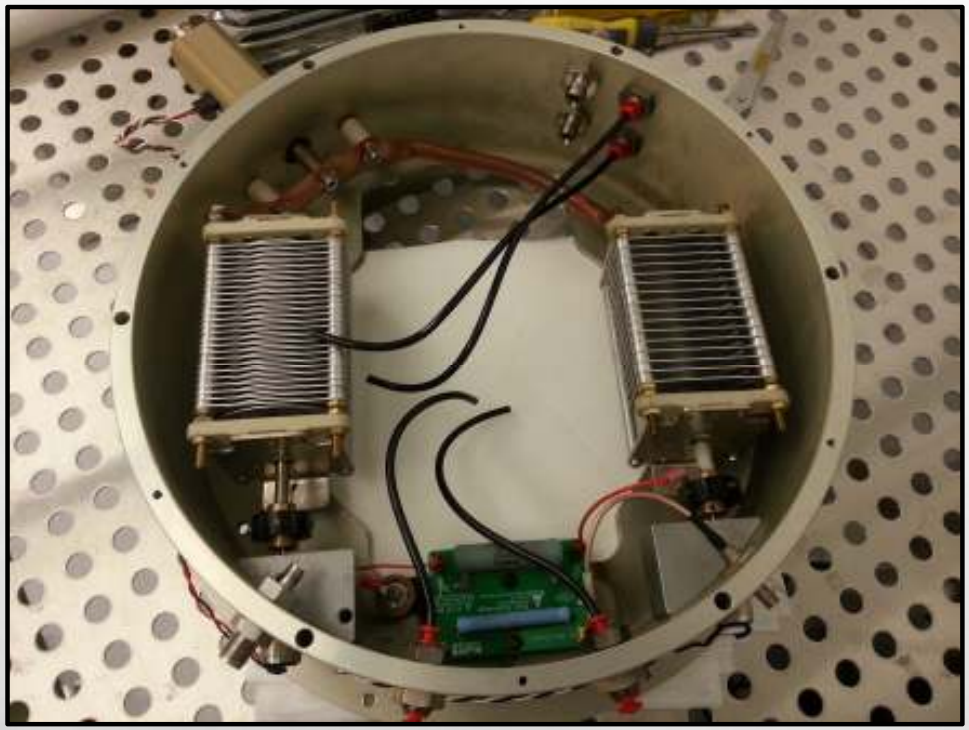
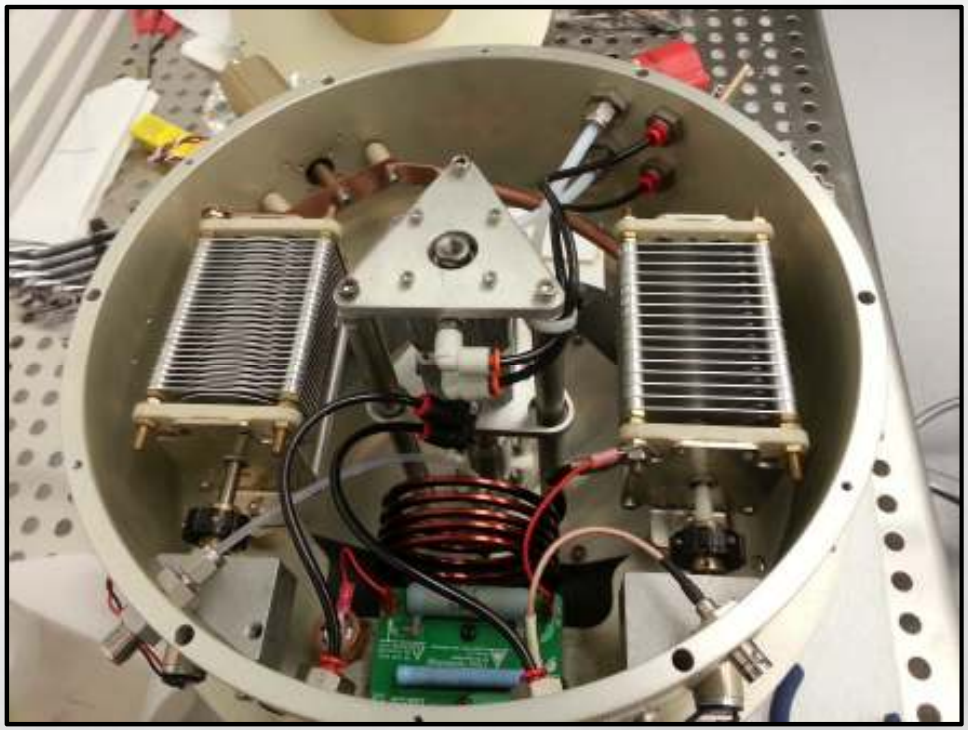


The old leaky bellows was taken out



New bellows was installed

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MARCH RIE

MODEL: RIE CS 1701

Tool uses 4 gasses: H_2, O_2, CHF_3, CF_4.

MAINTENANCE

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

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MARCH RIE

Gas chemistry: H_2, O_2, CHF_3, CF_4.
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, SiO_2, Si_3N_4
Masking materials: photoresist, SiO_2, 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

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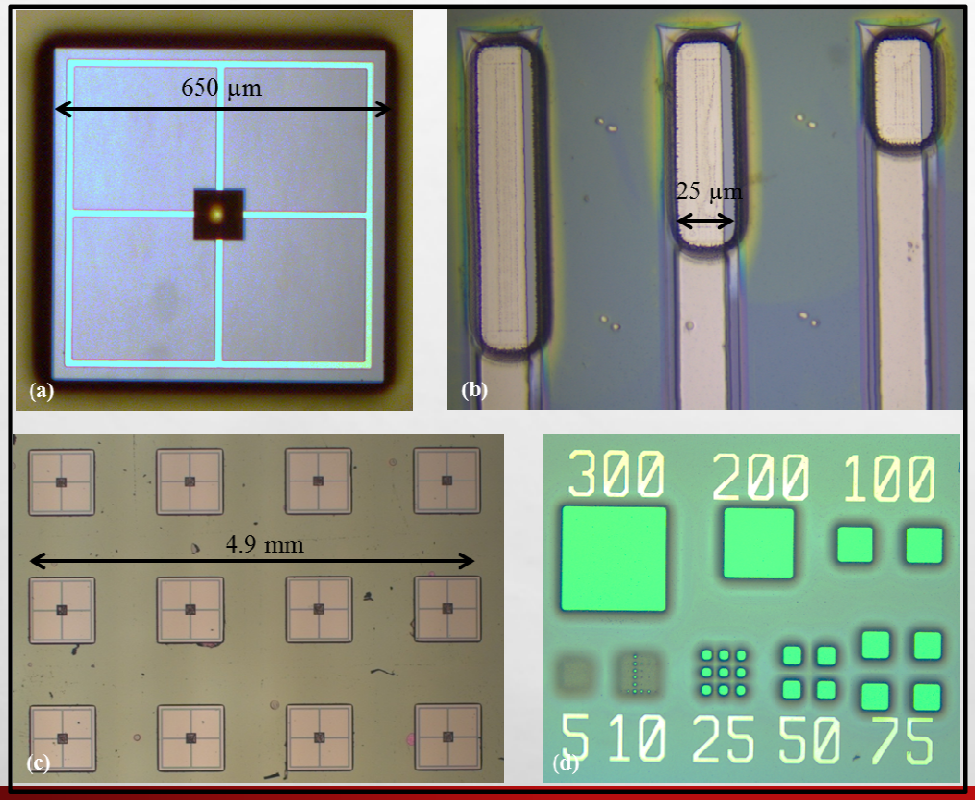
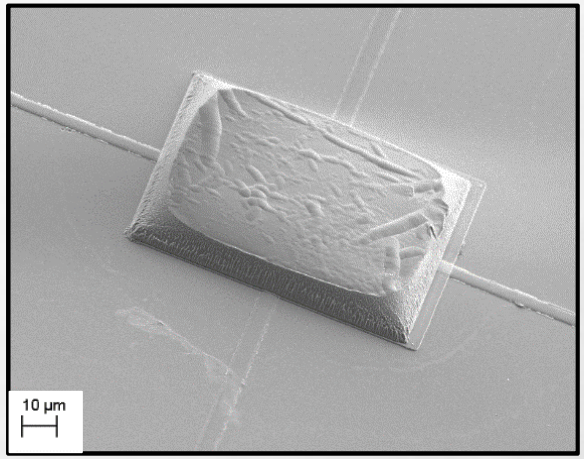
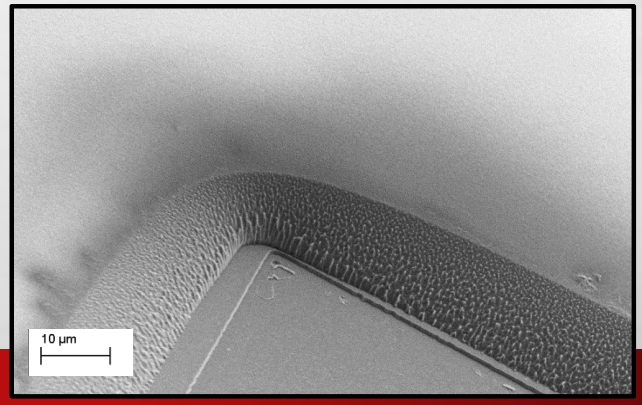
PARYLENE ETCHING







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DRIE

MODEL: STS, MULTIPLEX ASE

This STS ICP System uses fluorine-based 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: SF_6, C_4F_8, O_2, 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 SiO_2;

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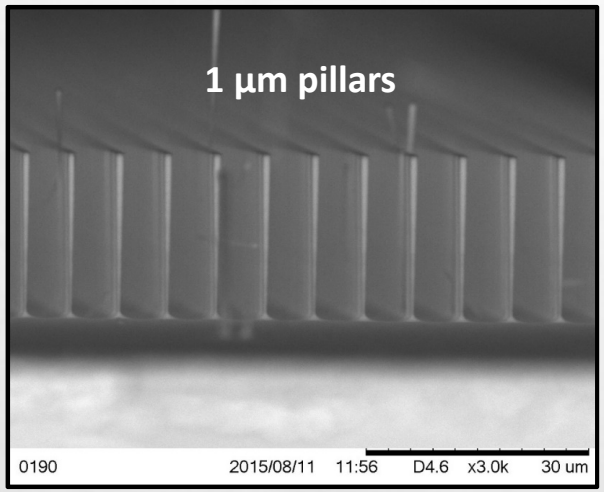
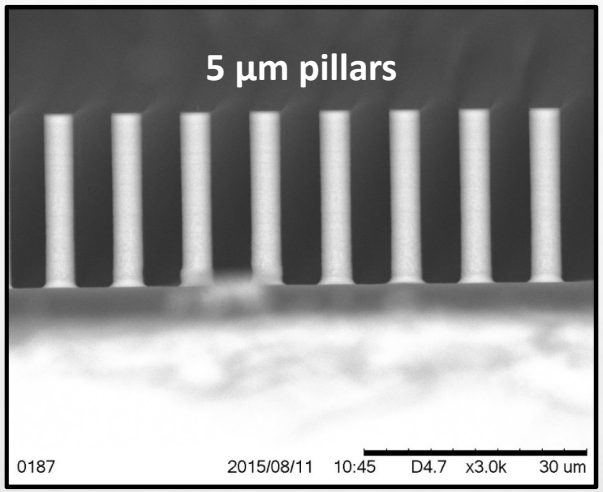
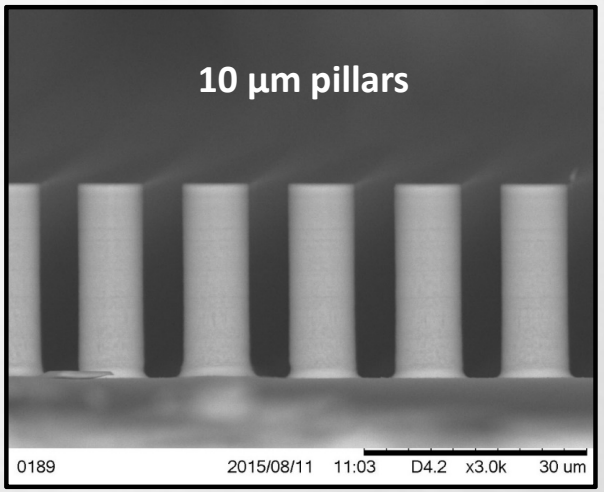
DRIE PILLAR ETCHING







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

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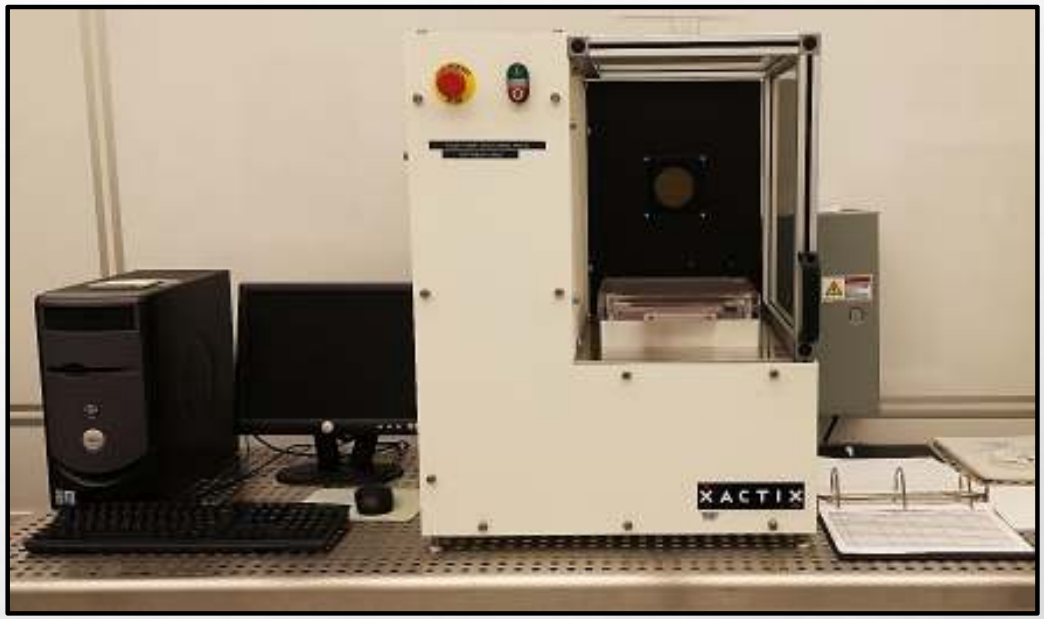
XACTIX

MODEL: XACTIX® E2™

The XeF_2 reaction with silicon is purely chemical and spontaneous (plasmaless).

XeF_2 vapor phase etching exhibits nearly infinite selectivity of silicon to photoresist, SiO_2, Si_3N_4, and aluminum.



MAINTENANCE

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

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XACTIX

Gas chemistry: XeF_2;

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, SiO_2

Masking materials: SiO_2, Si_3N_4, most metals;

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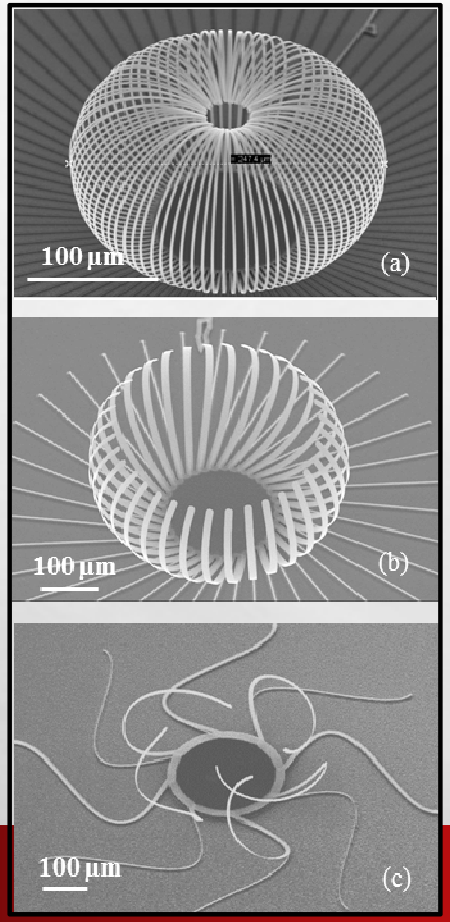
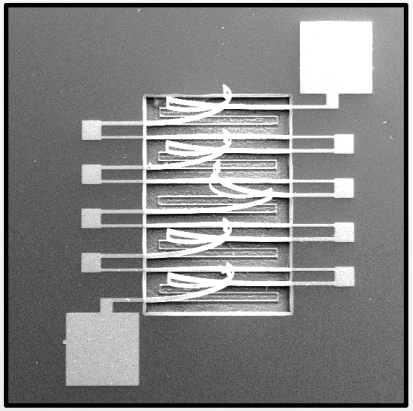
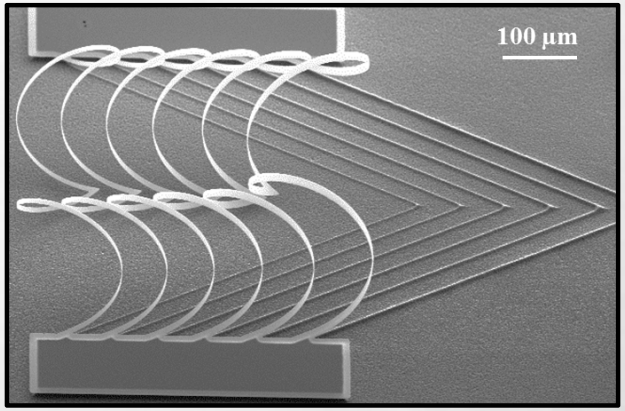
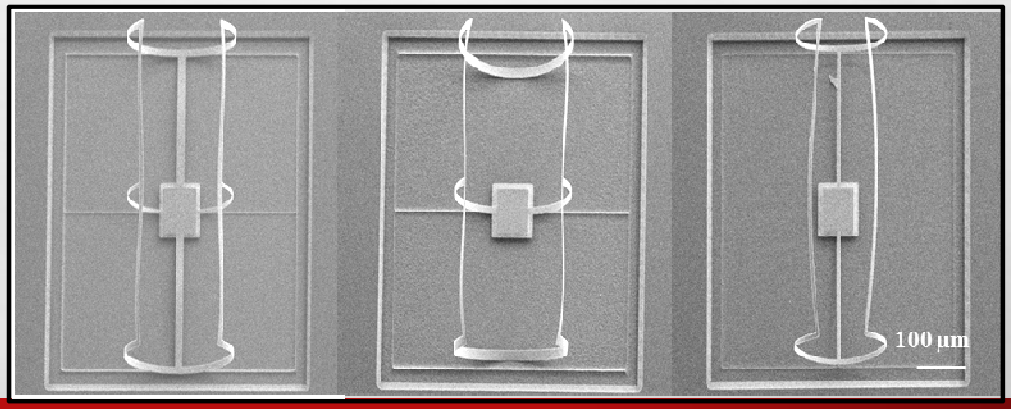
RELEASED STRUCTURES









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