
Washington Nanofabrication Facility
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Mark Morgan
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Nanolithography - Advanced Packaging - Metrology
Semiconductor Processing - Process Engineering

UW WNF Dry Etch Equipment

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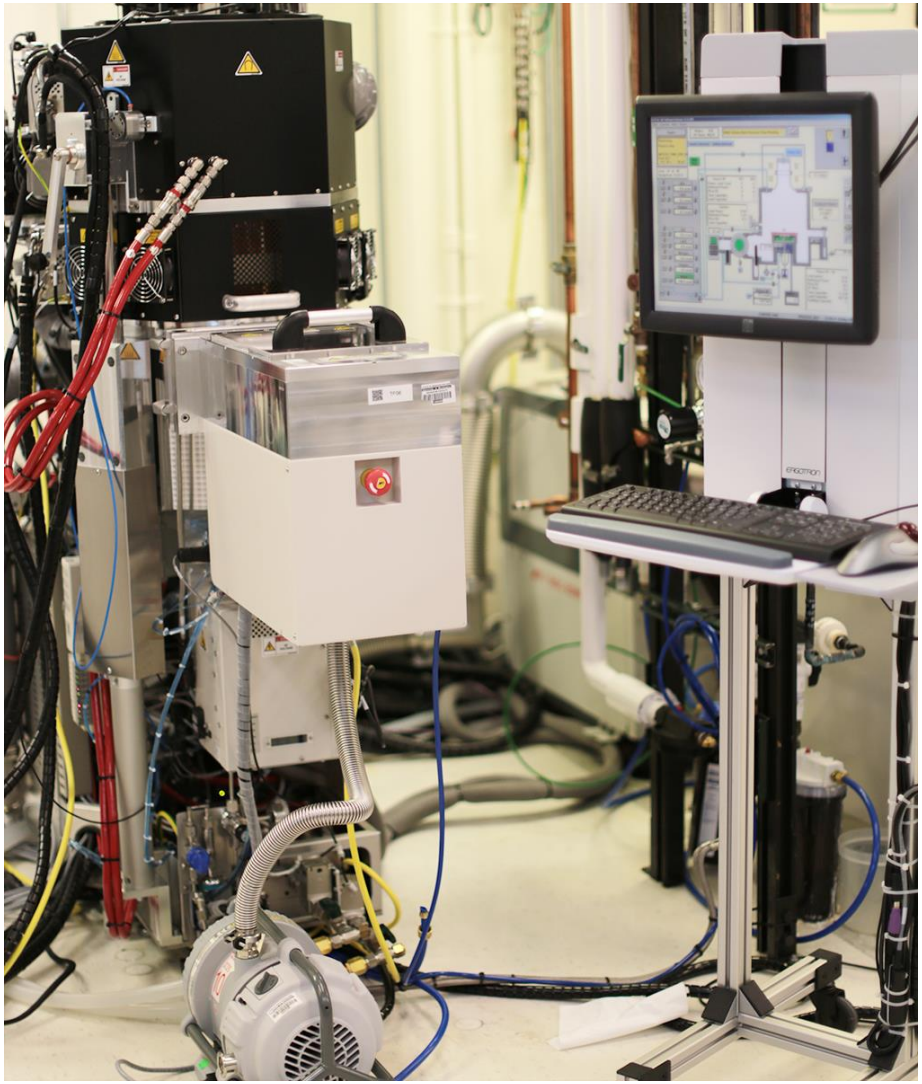
UW Etch Capability Overview

- SPTS Rapier Deep RIE
  - Time-multiplexed SF6-C4F8 silicon etching
  - Electrostatic Chuck, Endpoint Detection, Parameter ramping
- Oxford ICP tools
  - Fluorine chemistries, LN2 cooled chuck
  - Time-multiplexed silicon etching
  - Chlorine and CH4/H2 chemistries, heated chuck
- RIE tools
  - Advanced Vacuum Vision - open load
  - Trion - open load
- Ashing tools
  - Glow Research Autoglow
  - YES asher

SPTS Rapier DRIE

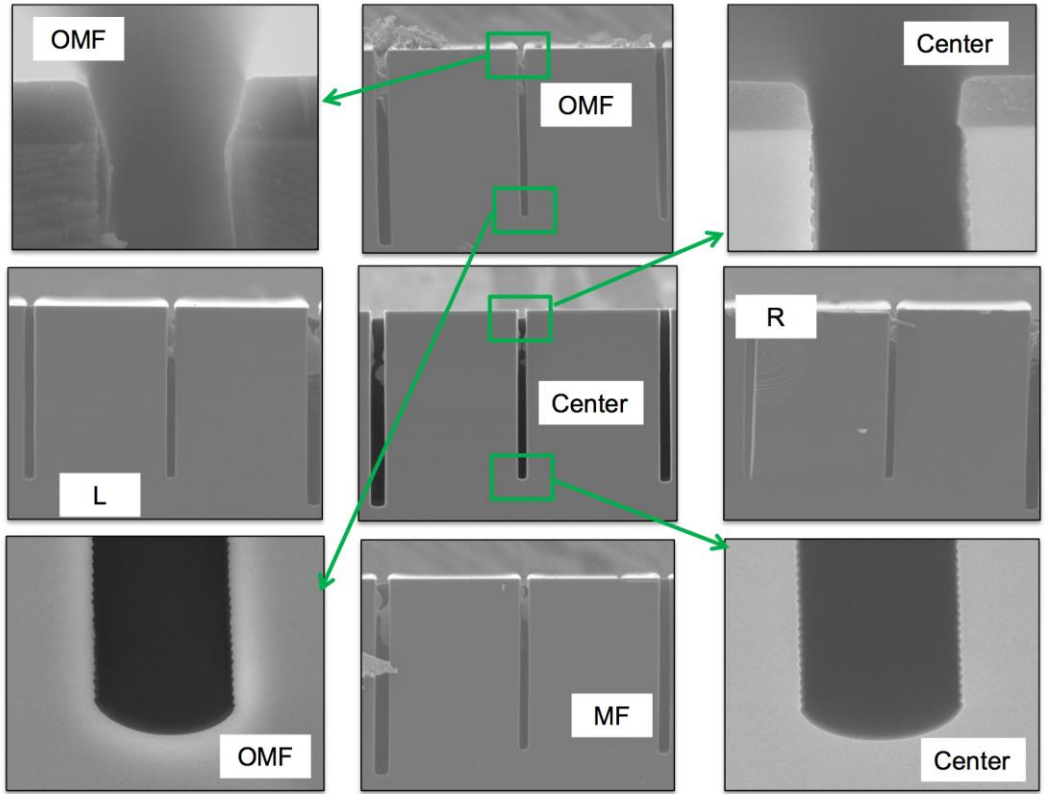
- 200mm Rapier Process Module
- LPX Single Wafer Loadlock Module
- Verity/Claritas Optical Endpoint Detection
- High vacuum pump: Adixen 2300M turbo
- Load lock roughing pump: Edwards XDS 35
- Chamber roughing pump: Edwards iH600
- Process gases:
  - SF6 (100 sccm), C4F8 (100 sccm), Ar (100 sccm), O2 (100 sccm)
- 100 mm (200 mm) wafers and mounted chips
- Electrostatic Chuck, He backing
- Chuck: Recirculator typically at -3 C
- Restrictions: Si etching only, no metal masks

SPTS DRIE



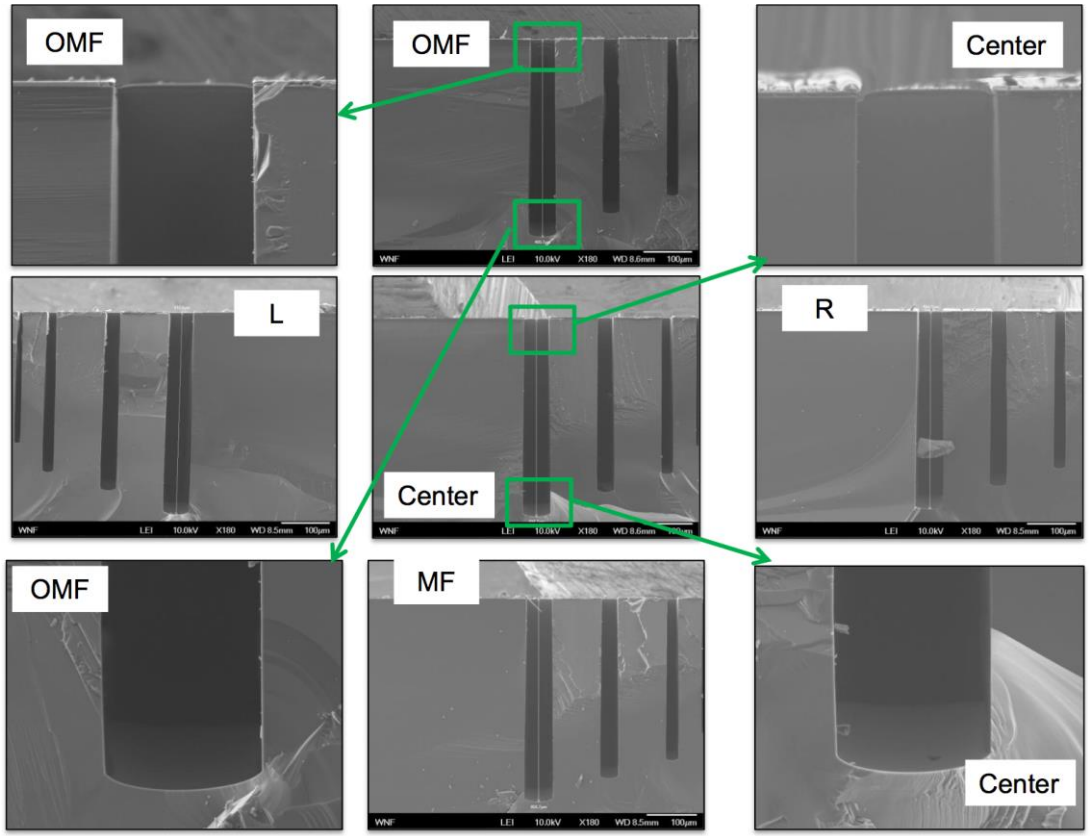
SPTS DRIE

- Primary use: time-multiplexed silicon etching MEMS, TSV, micro-machining
- HAR process - 3 x 60 um features
  - Etch rate: ~3 um/min
  - Selectivity: >35 to AZ9260
  - Uniformity: ±3%
  - Sidewalls: <150nm scallop, ±0.5° from vertical

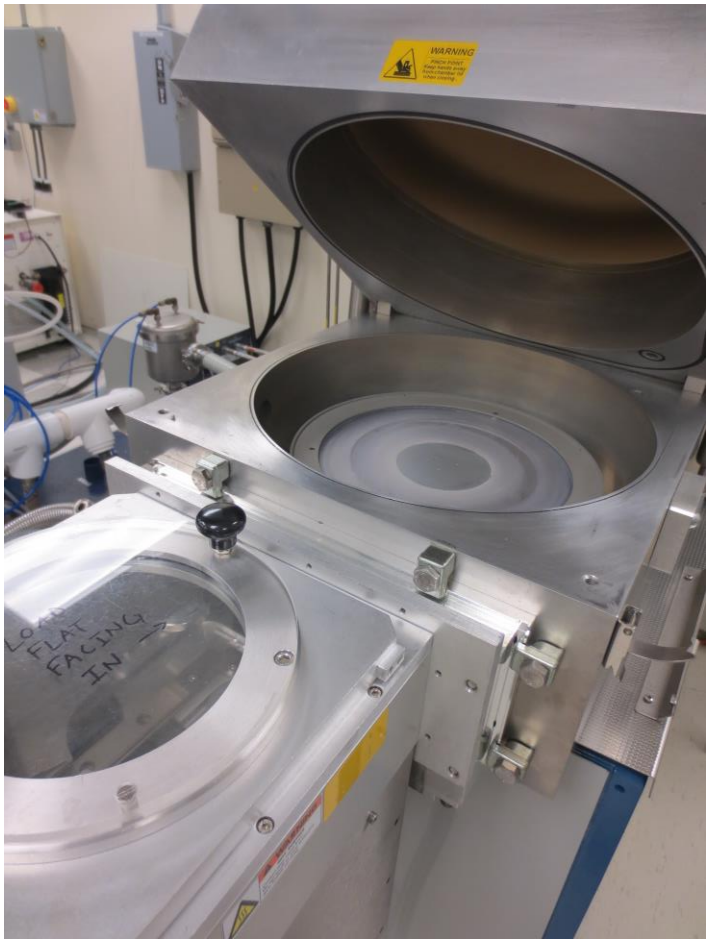


SPTS DRIE

- Primary use: time-multiplexed silicon etching MEMS, TSV, micro-machining
- Deep Trench process - 50 x 400 um features
  - Etch rate: ~5 um/min
  - Selectivity: >50 to AZ9260
  - Uniformity: ±3%
  - Sidewalls: <500nm scallop, ±0.5° from vertical



Oxford-DRIE



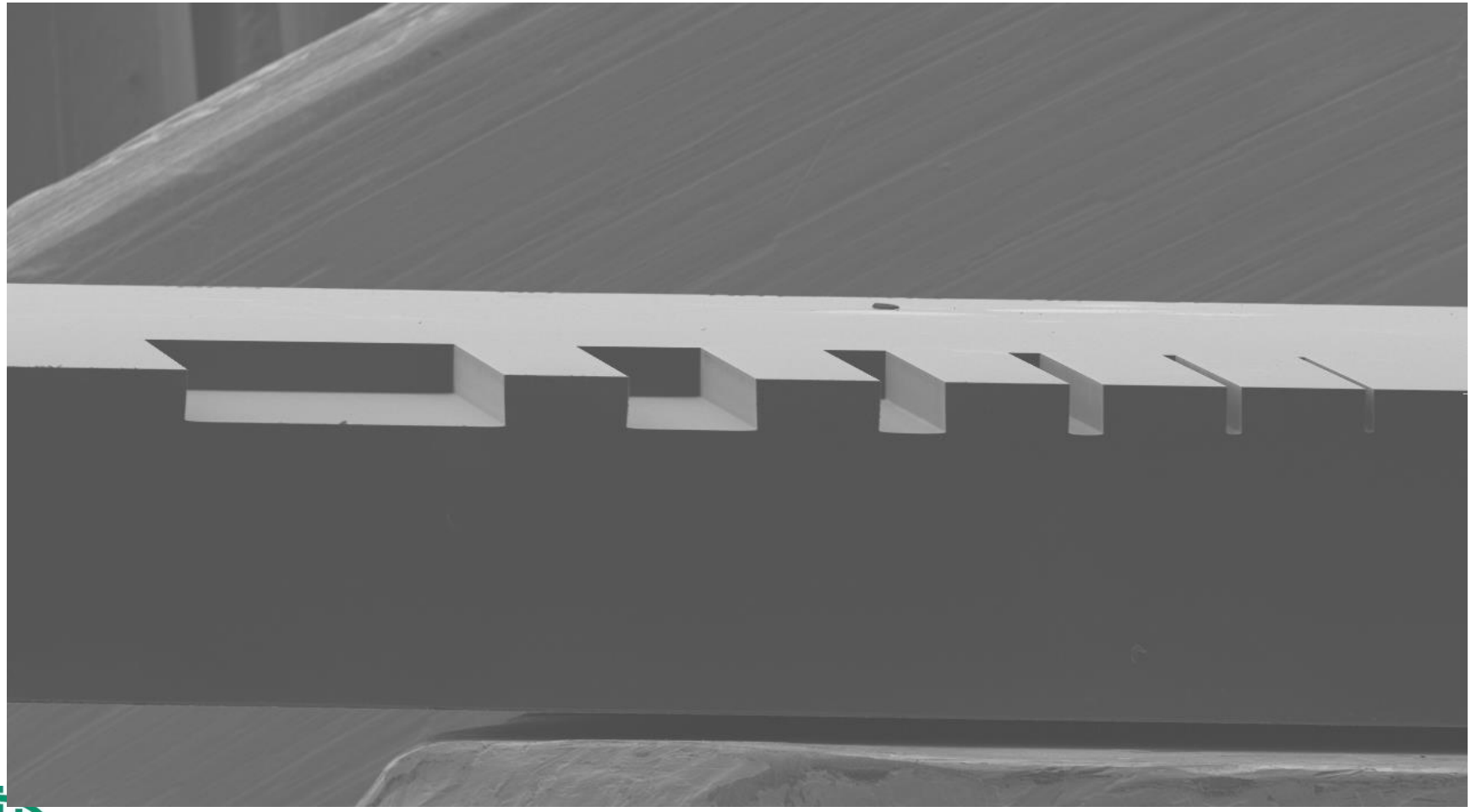
Oxford-DRIE

- Oxford PlasmaLab System100 ICP380
- High vacuum pump: Alcatel 1600M
- Load lock roughing pump: Edwards XDS 35
- Chamber roughing pump: Ebara A10S
- Process gases:
  - SF6 (100 sccm), O2 (100 sccm), C4F8 (100 sccm), Ar (100 sccm)
- 100 mm (150 mm) wafers and mounted chips
- Quartz clamp ring, He backing
- Chuck: LN2 cooled, but typically at 15 C

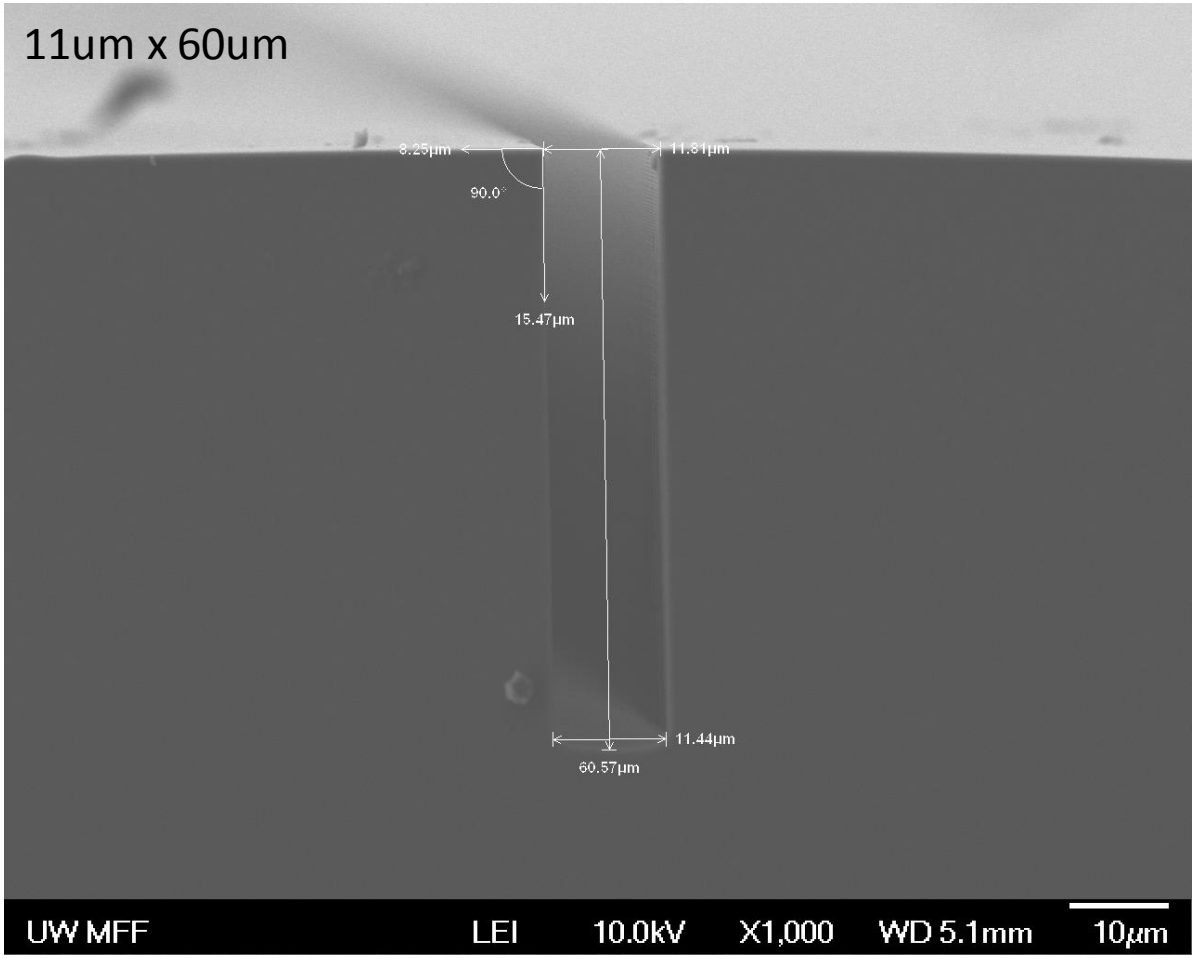
Oxford-DRIE

- Primary use: time-multiplexed silicon etching
- Other uses: handle wafer etch, sample thinning
- Standard process
  - Etch rate: ~3.5 um/min
  - Selectivity: >50 to AZ9260
  - Uniformity: ±6%
- Restrictions: Si etching only, no metal masks

Oxford-DRIE



Oxford-DRIE


11um x 60um
8.25µm
11.81µm
90.0°
15.47µm
11.44µm
60.57µm
UW MFF
LEI
10.0kV
X1,000
WD 5.1mm
10µm

ICP-Fluorine

ICP-Fluorine

- Oxford PlasmaLab System100
- High vacuum pump: Alcatel
- Shared roughing pump: Edwards rotary
- Process gases:
  - SF6/Ar, O2, CHF3, N2O, C4F8/N2, SiH4
- 100 mm wafers and mounted chips
- Quartz clamp ring, He backing
- Chuck: LN2 cooled

ICP-Fluorine

- Primary use: dielectric/polymer etching
  - Oxide
  - Nitride
  - Polyimide
  - Parylene
- Other uses: metal etching, low temperature oxidation
  - Niobium
  - Tungsten

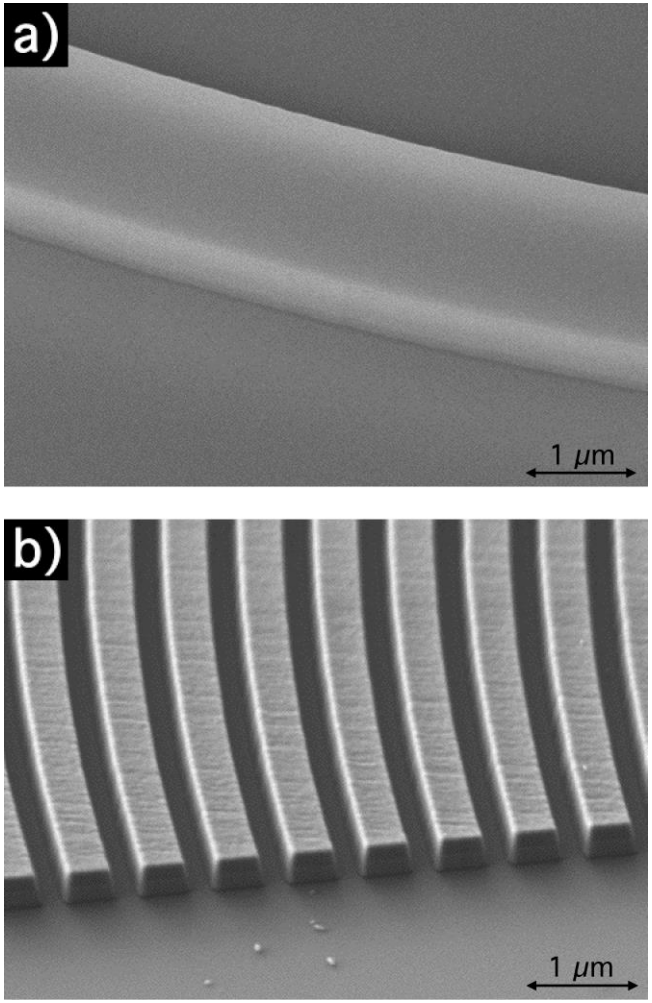
ICP-Chlorine

ICP-Chlorine

- Oxford PlasmaLab System100
- High vacuum pump: Alcatel
- Shared roughing pump: Ebara A10S
- Process gases:
  - $BCl_3/SiCl_4$, N_2/O_2, Cl_2, CH_4, H_2, Ar, SF_6
- 100 mm wafers and mounted chips
- Quartz clamp ring, He backing
- Tool operated up to 200 C

ICP-Chlorine

- Primary uses:
  - Si waveguide etching
- Additional uses:
  - Compound semi etching
    - InP, GaN
    - GaSb
  - Metal etching
    - Ti
    - Al



RIE-Vision

RIE-Vision

- Advanced Vacuum Vision 300 MK II
- High vacuum pump: Edwards EXT255H
- Roughing pump: Ebara A10S
- Process gases:
  - CHF3 (100 sccm), CF4 (100 sccm), SF6 (100 sccm), O2 (100 sccm), Ar (100 sccm)
- Chuck: holds seven 100 mm wafers
- Standard processes:
  - oxide, nitride, silicon, descum
- Pressure: 10 – 500 mTorr

RIE-Trion

RIE-Trion

- Trion Phantom II
- High vacuum pump: Varian VT301 Navigator
- Roughing pumsp: Ebara A10S, Edwards XDS 35
- Process gases:
  - O2 (100 sccm), CHF3 (100 sccm), SF6 (100 sccm)
- Pressures: 75 – 125 mTorr
- Standard processes:
  - Descum, strip, oxide, nitride, silicon

Barrel Etcher

Barrel Etcher

- Primary Uses
  - Descum (50-100 W, 1 Torr)
    - ~20 nm/min
  - Stripping (150 W, 1 Torr)
    - ~500 nm/min
  - Surface preparation for PDMS/PDMS and PDMS/glass bonding (25 W, 1 Torr)