# John O'Brien Nanofabrication Laboratory Instrumentation List

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# 1 Lithography

## MJB3 Mask Aligner (A)

Topside alignment Exposure wavelength: UV 400, 350-450 nm UV lamp: 350 W Hg Arc lamp. Eyepieces: 10x, 15x Objectives: 3.2x, 5x, 10x, 20x, 25x Exposure Resolution: 0.8 Microns Exposure modes: Soft, Hard and vacuum contacts. Substrate size: Pieces to 3" Mask dimensions: 3" and 4"

### MJB3 Mask Aligner (B)

Top and backside alignment. Exposure wavelength: UV 400, 350-450 nm UV lamp: 350 W Hg Arc lamp. Eyepieces: 10x, 15x Objectives: 3.2x, 5x, 10x, 20x, 25x Exposure Resolution: 0.8 Microns Exposure modes: Soft, Hard and vacuum contacts. Substrate size: Pieces to 3" Mask dimensions: 3" and 4"

# MJB 4 Mask Aligner

Topside alignment Light source, UV 400, 350 – 450nm Eyepieces: 10x Objectives: 5x, 10x, 20x Resolution: 0.8 um, Substrate size – pieces to 2" Mask size – 3", 4" and 5"

# MA/BA Gen4

Wafer Size up to 150 mm, Pieces down to 5 x 5 mm Square substrate size up to 6" x 6". Mask Size 4"x4" up to 7" x 7" Exposure Source LED 450W Wavelength Range UV400 350 - 450 nm Resolution down to 0.8 µm Digital camera 2X Objective 5X, 10X Top/Back side alignment

### Ebeam Lithography Raith EBPG5150

Thermal Field Emission, operation at 50 & 100 kV Up to 6" substrate 155 mm writing capability Minimum feature size <10nm Beam Current up to 350nA Pattern Generator 125 MHZ Genlsys – Beamer

## Heidelberg DWL 66+ (arriving mid-2022)

Min substrate: 5x5 mm<sup>2</sup> Max substrate: 9"x9" Resolution 10nm Manual, semi-automatic, and fully automatic alignment Grayscale and advanced grayscale exposure 405nm laser ("h-line" photoresists) Three different write modes (to allow high speed and high resolution to be balanced): High resolution (min feature size 0.3um) Mode IV: min size 2um Mode V: min size 4um Backside alignment

# 2 Etching

## **Oxford Pro 80 RIE**

Materials - Si, SiO<sub>2</sub>, Si<sub>3</sub>N<sub>4</sub> Open loading Gases – Ar, O<sub>2</sub>, SF<sub>6</sub>, CHF<sub>3</sub>, CF<sub>4</sub>, End point detection Substrate size – pieces to up to 200mm diameter RF power 300W

## **Oxford Plasma lab 100 ICP**

Si Bosch process Load lock Gases –  $O_2$ , Ar, CF<sub>4</sub>, C<sub>4</sub>F<sub>8</sub>, SF<sub>6</sub> and CHF<sub>3</sub>. Up to 6" wafer. 4" wafer clamping. He backside cooling. 3000W ICP generator 500W RF generator platen

# XeF<sub>2</sub> Isotropic Etcher

Gases –  $N_2$ Solid XeF<sub>2</sub> source, pulsed etching Etching materials - Si Up to 6" wafer

### Oxford Plasma Pro 100 Cobra 180

III-V materials Load lock ICP (Inductively Coupled Plasma) 1500W RF 300W Gases – H<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>, Ar, SF<sub>6</sub>, CH<sub>4</sub>, Cl<sub>2</sub>, BCl<sub>3</sub>, SiCl<sub>4</sub>, Temperature range -30C to 400C Substrate size – clamp with contact 2", 3" and 4". Need carrier wafer for pieces. Substrate cooling using-backside He

# 3 Deposition

## Oxford Pro 100 PECVD

Load lock Gases – 2% SiH<sub>4</sub>/N<sub>2</sub>, NH<sub>3</sub>, N<sub>2</sub>O, N<sub>2</sub>, He, CF<sub>4</sub> Up to 6" wafer Deposit materials: SiO<sub>2</sub>, Si<sub>3</sub>N<sub>4</sub>, SiNO. 240mm diameter electrode. Heated aluminum electrode for temperatures up to 400°C. Fixed height without wafer clamping. 300W RF generator 500W LR generator

### Lesker PVD 75

E-beam Evaporator 4 pockets, 5kV, 8cc Substrate size – pieces to 6" Substrate rotation Standard source to substrate distance is approx. 15" (381mm) Materials: Ti, Au, Pt, Pd, Cr, Ni and Ag

### Lesker PVD 75 Sputtering

Magnetron Sputtering, 5 targets 4DC/1RF DC Power – 500 Watts RF Power – 300 Watts Sample Size – 6" Target: 2" Substrate rotates Process gas: Ar, O<sub>2</sub> Materials: Au, Pt, Ti, Al, W, Mo, Cu, SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, ITO

### **VEECO Thermal ALD**

up to 200 mm<sup>2</sup> Savannah® S200: 585 x 560 x 980 mm Operational Modes: Continuous Mode, Exposure Mode (ultra-high aspect ratio) Deposition Uniformity:  $(Al_2O_3) < 1\%$  (1 $\sigma$ ) Precursor- Pt, Ru Ozone Generator

### Angstrom Ebeam Evaporator

4 pockets, 10kV, 25cc Substrate size – pieces to 6" Materials:Ti, Al, Al<sub>2</sub>O<sub>3</sub> Gas: Ar, 5% O<sub>2</sub> in Ar Variable angle stage with Substrate rotation Substrate heater Ion Milling – substrate cleaning Fully automated deposition tool with load lock.

# **Temescal E-Beam evaporator**

4 pockets, 10kV, 7cc Substrate size – pieces to 6", three sample plates. Substrate rotation Materials: Ti, Au, Pt, Pd, Cr, Ni and Ag

# CHA Electron Beam Evaporator

10 kW Solid State Electron Beam Power Supply with an EB Controller and Sweep Controller Electron beam gun with 6 each, 15cc pockets. Includes an EB Gun deposition shield with motor driven rotation and lift lid. The Inficon IC/6 Rate and Thickness Deposition Controller 8kW Heater Array and PLC Heater Power Supply Computer Control; PLC Automation Lift-off Fixturing, rotating dome for 22 each, 100mm back loaded substrates.

# 4 Additional processing tools

## YES-CV200RFS Plasma Photoresist Strip/descum (arriving mid-2022)

System for 2" to 200 mm wafers PLC control of valves, temperature set points, plasma generation power, auto operation, touch screen interface RF Plasma Power: 40 kHz, 100-1000 W capacitive, downstream Wafer Platen temperature range from ambient to 250° C Capacity: single wafer/pieces for 50mm - 200mm; Dual wafer/pieces for two 100mm Mass Flow Controllers Real Time data collection of all process control data

## AccuThermo AW 610M Rapid Thermal Processor (arriving mid-2022)

Wafer sizes: Small pieces, 2", 3", 4", 5", 6" wafer capability Recommended ramp up rate: Programmable, 10°C to 120°C per second. ERP Pyrometer 450-1250°C with  $\pm$ 1°C Thermocouple 100-800°C with  $\pm$ 0.5°C accuracy & rapid response. Temperature repeatability:  $\pm$ 0.5°C or better at 1150°C wafer-to-wafer Temperature uniformity:  $\pm$ 5°C across a 6" (150 mm) wafer at 1150°C. 4 gas lines with MFC

# Disco DAD 3350 Dicing Saw

Capable of handling a maximum of 8-inch or 250 x 250 mm workpieces LCD touch screen and Graphical User Interface (GUI) 1.8 kW spindle X-axis Cutting range 260 mm Cutting speed mm/s 0.1 ~ 600 Y-axis Cutting range 260 mm Index step: 0.0001 mm Z-axis Max. stroke: 32.2 mm Moving resolution: 0.00005 mm Repeatability accuracy: 0.001 mm

# 5 Metrology and imaging

### Profilometer – Bruker Dektak XT

Sample X/Y Stage Motorized 150mm (6 in.) X/Y, manual leveling Sample R-Theta Stage Motorized, continuous 360 degrees Scan Length Range 55mm (2in.); 150mm (6in.) with scan stitching capability Data Points Per Scan 120,000 maximum Max. Sample Thickness 50mm (1.95in.) Step Height Repeatability <5Å, 1sigma on 0.1μm step Vertical Range 1mm (0.039in.) Vertical Resolution 1Å max. (@ 6.55μm range) 3D capability Vertical Resolution (@ each range setting): 1 Å @ 6.5 μm; 10 Å @ 65.5 μm; 80 Å @ 524 μm; 150 Å @ 1mm

## **SEM - Phenom ProX**

Acc Voltage 5 – 15kV Resolution <10nm (BSED) Magnification 80-150,000x Simultaneous Optical/Electron imaging Sample Size – up to 32mm Tilt option EDS capability

# **Optical Microscope (Nikon LV 150)**

5x, 10x, 20x, 50x, 100x Brightfield & Darkfield Polarizer/Analyzer Halogen Lamp Camera – 5.9 MP resolution USB output/WIFI for exporting images

### JSM-6700F SEM

The JSM-6700F is a high-resolution SEM with a field emission gun (FEG) electron source. It is equipped with a secondary electron detector for topographic contrast imaging, a retractable backscattered electron detector for atomic number contrast imaging and an Oxford Inca EDX system for compositional analysis. Specifications: **Resolution:** 3.5nm **Probe Current:** 10<sup>-12</sup>-10<sup>-6</sup> A **Accelerating Voltage:** 0.5-30 kV **Specimen Size:** 125 mm **Detectors:** SE, EDX

### LATTICEAX 420 Scribe & break

Lattice Ax 420 delivers our highest cleaving accuracy of  $10-\mu m$  in <5 min making it ideal for the lab that values speed and high accuracy while at the same time needing to accommodate a variety of sample sizes, thicknesses and materials.