Queensland Microtechnology Facility

The QMF provides academia and companies with the ability to access world class SiC on Si material, high technology equipment and facilities at low cost that enables company start ups and SMEs to be competitive on the world stage.

- encouraging technology companies in Australia
- low cost R+D for start ups
- motivation for SMEs to stay
- attraction for international companies to Australia
- promotion of hi-tech manufacturing in Australia

Quality processing

Standard operating procedures - SOPs
- consistency in processing
- recipe driven processing
- standard recipes developed
- industry representative standard processes
- defined processes with known process performance

Capability summary

Accessible world class commercially orientated R+D facility
- Access subject to approval
- SiC technology focus
- configured for 150mm wafer processing
- 2” to 200mm wafer processing may also be accommodated
- provides standard silicon wafer process capability and a unique SiC processing capability that can be exploited
- Employs standard industrial processing technology enabling direct porting of products to industry for volume manufacture

Cleanroom Design

Based upon commercial wafer fab design philosophy but tailored to R+D requirements
- Ballroom clean room with sub wafer fab
- Minimise cleanroom size requirements
- Maxi mum packing density
- Max flexibility for equipment installs
- Lowest installation costs
- Lowest contamination

Subwafer fab

- Air return path
- Housing for all support equipment and service infrastructure
Photolithography

**HMDS oven**

YES 3/10

Provides HMDS treatment to overcome photoresist adhesion issues on Si, poly Si, SiO2, Silicon oxynitride, BPSG, TiN, TiW +?.

- configured for 150mm wafers and fragments - up to 200mm
- Process effective for up to 3 weeks
- image reversal via use of NH3

**Resist coat + Soft Bake**

SSE OPTIcoat ST22+

Precise photoresist coat of wafers and fragments
AZ 6612 resist
configured for 150mm wafers and fragments

Typical performance on 150mm wafer
- %U: < 0.5%
- thickness: 1µm
- edge bead removal: 5mm

**Resist development**

SSE OPTIcoat SST20

Resist development part of process flow

Configured for 150mm wafers and fragments - up to 200mm

**Exposure**

Quintel Ultra µ line7000

Resist exposure of 150mm wafers and fragments
Proximity mode >3µm features
- Vacuum contact to ~ 1µm
- 86° profile on targeted features
Configured for 150mm wafers and fragments - up to 200mm capable
Mask cleaner

Ultratech 602

up to 7" square
Cleaning of masks
note - for hard contact printing, mask should be cleaned after every exposure to maximise quality

Thin film measurement

Nanospec AFT 180

up to 200mm with manual rotation of wafer
Quick (<10sec) and accurate measurement of:
- SiC on Si <10nm to 3µm
- SiO on Si - <10nm to 4µm
- Si3N4 on Si - <10nm to 1µm
- Neg resist on Si - 50nm to 4µm
- Poly Si on oxide -50nm to 1µm
- Neg resist on SiO2 400nm to 3µm
- polyimide on Si - 50nm to 3µm
- Positive resist on Si -50nm to 4µm
- Positive resist on SiO2 400nm to 3µm
- reflectance mode for metal characterisation
- other films on Si on known RI

Critical Dimension measurement

Nanoline CD 50/51

150mm stage
Quality control and process engineering tool for assessment of lithography and etch processes

QMF Lithography capability

Resist type AZ6612 Good plasma stability
Thickness 1µm +/- 0.5% w-w
150mm wafer coating uniformity +/- 0.5%
3mm edge exclusion
Profile >80° (>87° for targeted feature)
Even with mask aligner , sub micron patterning with excellent profile control possible

However, consistent ~1 micron quality printing is an issue within wafer and wafer to wafer with mask aligners.
Metrology

Profileometer

Veeco Dektak D150

150mm (whole of 200mm can be measured by rotating wafer on stage)
Surface roughness determination
- step height measurements to determine etch rates
  <1nm
- 3D mapping

Thin film measurement

Nanospec AFT 210 system

up to 200mm with manual rotation of wafer
Quick (<10sec) and accurate measurement of:
- SiC on Si <10nm to 3µm
- SiO on Si - <10nm to 4µm
- Si3N4 on Si - <10nm to 1µm
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Optical microscope

Olympus MX50AF -IC inspection microscope

up to 200mm
optical inspection and image recording
- 100x, 500x and 1000x mag
- sub micron resolution
- bright field and dark field imaging
- Nomarski differential interference contrast imaging
Patterned Wafer Inspection System

**KLA Tencor Surfscan 7700**

3" 1mm thick  
100mm 525+/- 25µm  
150mm 675+/- 25µm  
200mm 725+/- 25µm  
Particle Sensitivity 0.15-µm diameter latex spheres on bare silicon and patterned process wafers  
Standard processes  
30 wafers per hour (200mm)

Chemical Etching

Wet bench for RCA cleaning - Non contaminating

**Weslan**

Set for 150mm wafer processing  
RCA clean to remove metal ion contamination of incoming and processed SiC wafers  
- 4 bath system with quick dump rinse systems  
- processing baths SC1, 1%HF, SC2, Piranha  
(shows improvement in std CV measurements)

Wet bench for non ion critical contamination applications

**SPS**

Set for 150mm wafer processing  
whole wafer and wafer batch processing as required  
- fragment capability

Ti etch  
SiO2 etch  
Al etch  
Ni etch  
Si etch

Spin Rinse Dryer

**Semitool SRD**

150mm  
Final rinse and dry after wet processing from Weslan
Thermal Processing

**Atmospheric furnace**

*Hi Tech furnaces UK*

up to 200mm  
Research and development of high quality growth of SiO2 on SiC.  
- also used for Si oxidation  
- gases include O2, Water vapour, NO, N2O, HCl  
- Temperature to >1300° C  
Dry oxide growth on 150mm Si wafers -20 wafer batch  
- Uniformity <2% 3mm edge exclusion  
- Wafer to wafer non uniformity <2% @ 1000°  
Wet oxidation from water bubbler enabling faster and thicker oxide growth

**LPCVD furnace**

*Hi Tech furnaces UK*

up to 200mm  
Deposition of polysilicon and Low Temperature Oxide  
Poly Si - 150mm wafers  
- growth rate 90nm/min  
- uniformity <3% 3mm edge exclusion  
- uniformity <1% wafer to wafer 8 wafer load  
LTO - good electrical isolation  
- uniformity ~10% 20mm edge exclusion

**Doping furnace**

*Hi Tech furnaces UK*

up to 150mm wafers  
- 200mm conversion possible  
Solid source doping of Si and poly Si  
- commissioning from June 2010  
P type - boron doping  
N type - phos doping
Polysilicon deposition

Typical results
- 8 x 150mm wafers
- 3mm edge exclusion
- Within wafer uniformity < 3%
- Wafer to wafer uniformity <1%

Dry Si Oxidation

Typical result
- Theory calc 350A
- Achieved 365A
- Within w %U +/- <3%
- W-W %U +/- <3%
- 2mm edge exclusion
- non uniformity measured < spec
- variation of Nanospec
- Thicker films more uniform
- +/-1%
- W-W non uniformity +/- 0.7%
Dry Etching

Plasma etch

**LAM 480**

150mm wafer handling
isotropic dielectric plasma etch - SiO2, Si3N4, polymers, Photoresist
Features >3µm
SiO2 etch non-uniformity +/- 6% 5mm edge exclusion

**STS ICP SR**

150mm wafer handling
SiC etch research and development
Other research development applications as required

Production proven chamber for metal etching – Al, Al alloy, Ti, TiN, TiW, W…

Deposition

Metal and dielectric deposition by sputtering

**Surrey Nano Systems**

up to 200mm
DC and RF magnetron sputtering
- Degas in load lock to 200°
- 4 x 100mm targets
- RF bias and etch
- substrate temp to 800°
- reactive sputtering with N2 and or O2
- metallisation for device fabrication including film stacks.
Standard process from Ni, Al, Ti, Cr, Si targets
**Sub Wafer Fab**

**Dicing saw**
*Disco 2HST*
up to 150mm wafers
wafer dicing - blades for Si, SiC and sapphire

**Tube furnace - 70mm dia**
Up to 50mm dia
Anneal, oxidation
-gases N2, Ar, O2
-temp to 1400° C

**Evaporator for SEM coating**
*Jeol - JEE-4X*
< 3cm square samples
simple metallisation of small samples

**DC sputter system**
*Emitech K575x*
<2cm square samples
SEM sample coater and non critical metallisation
-stage to 200°
- 2 x 1" target
Standard process – Cr Au

**RF sputter -metal and dielectric deposition**
*Denton*
small samples
R+D use mainly for dielectric films
- 100mm target
- gases Ar, O2
Standard base process ITO

**World class process gas abatement capability**
**exhaust process gas treatment**
Environmental mission – targeting zero global warming and toxic gas emissions from vacuum processing equipment
- TPU and GRC provide process flexibility for research
- treat large range process exhaust gas emissions to complement research needs
- Gas abatement systems also
- alleviate internal safety issues
- protect vacuum pumps