



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
Maximise 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

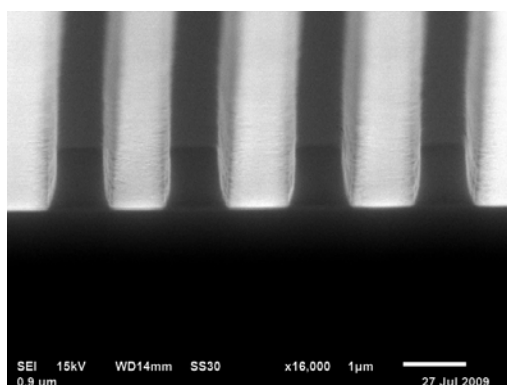
Thin film measurement

Nanospec AFT 180

up to 200mm with manual rotation of wafer

Quick (<10sec) and accurate measurement of:

- SiC on Si <10nm to 3 μ m
- SiO on Si - <10nm to 4 μ m
- Si₃N₄ on Si - <10nm to 1 μ m
- Neg resist on Si - 50nm to 4 μ m
- Poly Si on oxide -50nm to 1 μ m
- Neg resist on SiO₂ 400nm to 3 μ m
- polyimide on Si - 50nm to 3 μ m
- Positive resist on Si -50nm to 4 μ m
- Positive resist on SiO₂ 400nm to 3 μ m
- reflectance mode for metal characterisation
- other films on Si on known RI



1 μ m lines / space

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 1 μ m +/- 0.5% w-w

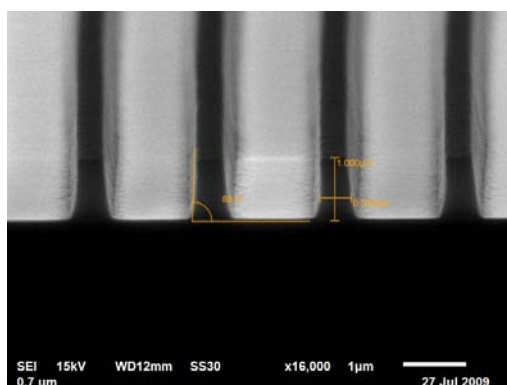
150mm wafer coating uniformity <+/- 0.5%

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.



0.5 μ m features

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 <math><1\text{nm}</math>
- 3D mapping

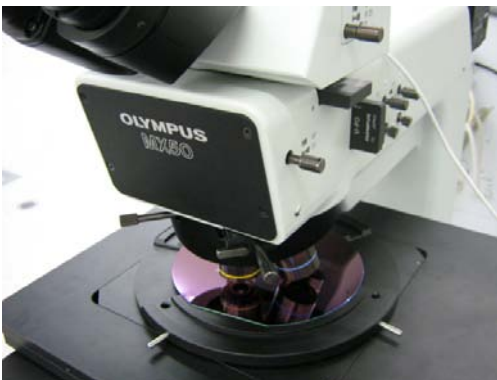
Thin film measurement

Nanospec AFT 210 system

up to 200mm with manual rotation of wafer

Quick (<math><10\text{sec}</math>) and accurate measurement of:

- SiC on Si - <math><10\text{nm}</math> to $3\mu\text{m}$
- SiO on Si - <math><10\text{nm}</math> to $4\mu\text{m}$
- Si₃N₄ on Si - <math><10\text{nm}</math> to $1\mu\text{m}$
- Neg resist on Si - 50nm to $4\mu\text{m}$
- Poly Si on oxide - 50nm to $1\mu\text{m}$
- Neg resist on SiO₂ 400nm to $3\mu\text{m}$
- polyimide on Si - 50nm to $3\mu\text{m}$
- Positive resist on Si - 50nm to $4\mu\text{m}$
- Positive resist on SiO₂ 400nm to $3\mu\text{m}$
- reflectance mode for metal characterisation
- other films on Si on known RI



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+/- 25 μ m
150mm 675+/- 25 μ m
200mm 725+/- 25 μ m
Particle Sensitivity 0.15- μ m 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

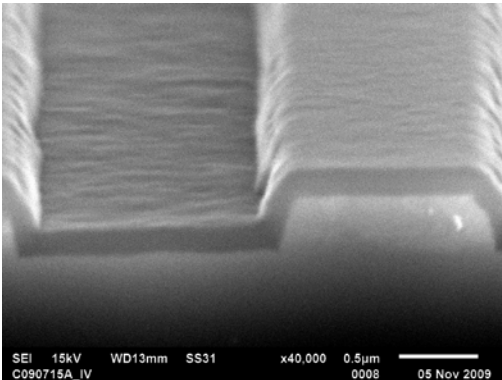
Hi Tech furnaces UK

up to 200mm

Deposition of polysilicon and Low Temperature Oxide

Poly Si - 150mm wafers

- growth rate 90nm/min
 - uniformity <3% 3 mm 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

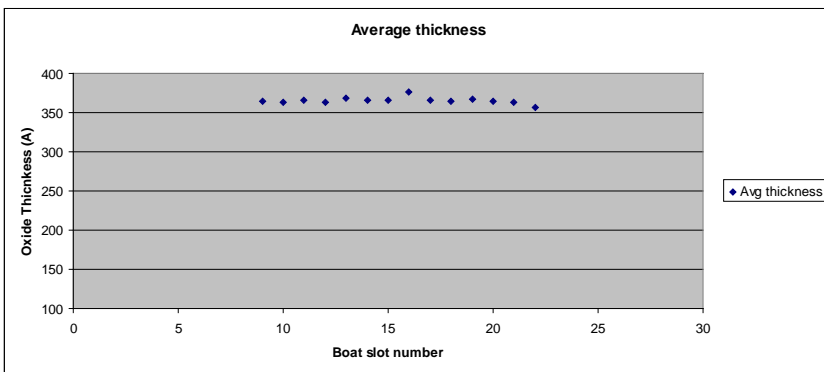
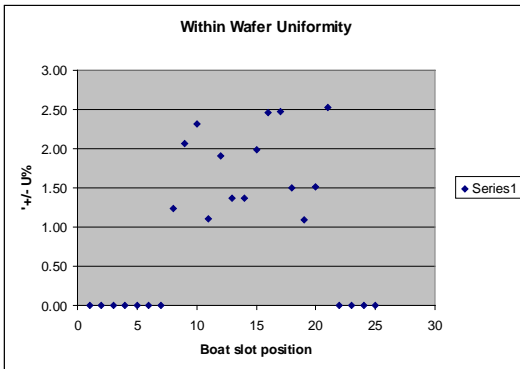
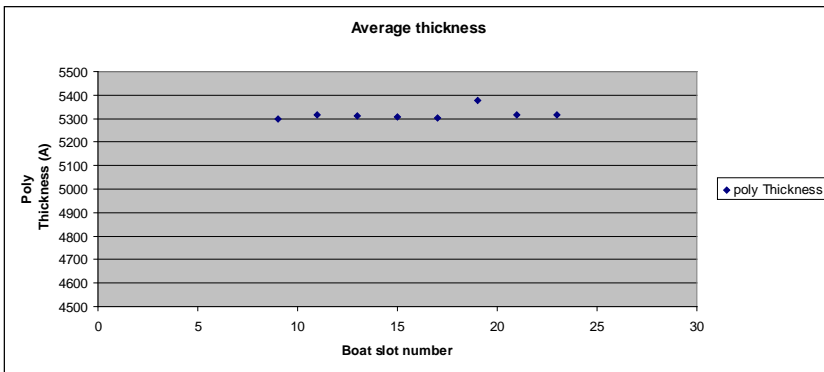
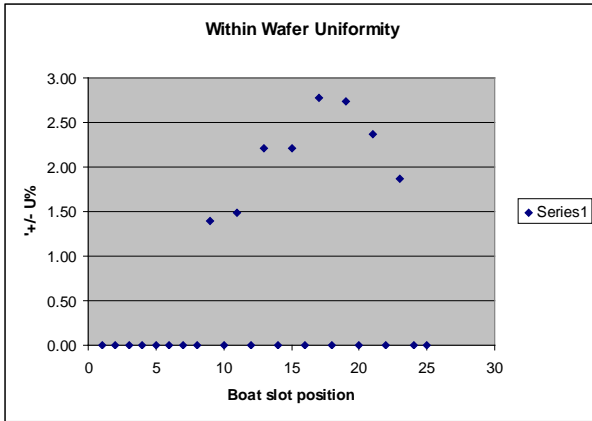
- 200mm conversion possible

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

