Queensland Microtechnology Facility processing and analysis equipment overview March 2014

Equipment /area	Make and Model	Equipment Description	wafer size compatibility	QMF use / purpose	Typical Standard Operation Procedure (SOP) performance	Process possible/ not qualified SOP
Lithography area / suite				Housing lithography processing equipment and surfs can	- Cleanroom class class 10 / M2.5 / ISO 4 - yellow light - temperature 21 +/-0.2° - RH 45 +/- 3%	
HMDS oven	YES 3/10	HMDS vacuum bake vapour prime and anhydrous ammonia gas image reversal system	configured for 150mm wafers and fragments - up to 200mm	Provides HMDS treatment to overcome photoresist adhesion issues on Si, poly Si, SiO2, Silicon oxynitride, BPSG, TiN, TiW +?. Process effective for up to 3 weeks		
Resist coat	SSE OPTIcoat ST22+	Recipe driven resist coater - resist pump auto dispense - edge bead removal - up to 10,000rpm - spin resolution 1rpm - accuracy 2 rpm - acceleration up to 50,000 rpm /sec	configured for 150mm wafers and fragments - up to 200mm	Recipe controlled precise photoresist coat of wafers and fragments	AZ 6612 resist - 150mm wafer - %U: < 0.5% - Thickness: 1µm - Edge bead removal: 5mm	second resist pump available
Soft bake	SSE OPTIcoat ST22+	Hot plate - with or without vacuum clamp - up to 300° - 0.1° C resolution - uniformity @100° < 0.5°	configured for 150mm wafers and fragments - up to 200mm	Precise resist thermal treatment: - prior to exposure - post exposure - post development	part of process flow	
Exposure	Quintel Ultra µ line7000	Front side mask aligner - 5 exposure modes - alignment <0.5µm	configured for 150mm wafers and fragments - up to 200mm	Resist exposure of 150mm wafers and fragments	Proximity mode >3µm features -Vacuum contact to ~ 1µm - 86° profile on targeted features	
Resist development	SSE OPTIcoat ST22	Recipe driven development - Developer and water auto dispense - up to 10,000rpm - spin resolution 1rpm - accuracy 2 rpm - acceleration up to 50,000 rpm /sec	configured for 150mm wafers and fragments - up to 200mm	Recipe controlled resist development	part of process flow	
thin film measurement	Nanospec AFT 180	Non contact optical measurement of films	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	Non contact optical measurement of lines from 0.5 to 125µm wide	150mm stage	Quality control and process engineering tool for assessment of lithography and etch processes		
Mask cleaner	Ultratech 602		up to 7" square	Cleaning of masks note - for hard contact printing,to maximise quality, mask should be cleaned after every exposure		

Main cleanroom - ball room				Housing of none lithography processing and analytical equipment	- Cleanroom class 1000 / M4.5 / ISO6 - temperature 21 +/-1°	
Wet processing						
Wet bench for RCA cleaning - Non contaminating	Weslan	Custom build - heated bath system RCA clean SC1 , HF (circulation and filter bath - no heating) and SC2 baths Piranha clean bath Quick dump rinser x 2	up to 150mm wafer	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	3 temperature control baths Quick dump rinsers x2 Megasonic bath - particle removal	up tp 150mm wafer	whole wafer and wafer batch processing as required - fragment capability		Ti etch SiO2 etch Al etch Ni etch Si etch
wafer rinse dryer	Semitool SRD	Up to 25 wafers in cassette washed and dried	150mm	Final rinse and dry after wet processing from Weslan		
Fume cupboard - HF compatible			small wafer and fragment processing			

Deposition and etch						
Epitaxial SiC growth	Griffith MkI system	proprietary design - under patent application	up to 150mm	Epitaxial SiC on Si growth - Research and development - n type - p type - n and p film stacks	Uniformity <1% 2mm edge exclusion Typical Thickness - nanometres to over 1µm	
Epitaxial SiC growth	MkII SPTS - Epiflx R+D		2" to 300mm	Research and development of device quality SiC on Si films Qualification of production reactor Application specific process development	Uniformity <1% 2mm edge exclusion Typical Thickness - nanometres to over 1µm	
Plasma etch	LAM 480	plasma etch	150mm wafer handling	isotropic dielectric plasma etch - SiO_2, Si_3N_4, polymers and photoresist	Features >3µm SiO_2 etch non -uniformity <+/- 6% 5mm edge exclusion	
Plasma etch	STS LPX ICP SR including wafer cooling from electrostatic clamping	Advanced process capability -up to 200mm wafer compatible -Electrostatic chuck -load lock -versatile for many different applications -reactor used in volume production for metal etch (Al etch metallisation)	150mm wafer handling	SiC etch research and development Other research development applications as required gases available include: Ar, O_2, N_2, NO, C_4F_8, SF_6, Cl_2, HCl, $SiCl_4$, BCl_3, HBr …..		Poly Silicon etch SiO_2 etch Al and Al alloy etch Ti and TiN etch note: volume production proven chamber for metal etching
Resist strip and plasma etch	Tegal 915	Barrel plasma etch system for striping or etching batches od wafers	batch processing up to 200mm wafers	Resist strip or fluorine etching process gases: O_2, SF_6	Max batch size 150 x 100mm wafers 100 x 125mm 100 x 150mm 50x 200mm	Plasma etching of resist / organics where etch uniformity is not critical. Isotropic etching of SiO_2/ Si_3N_4 / SiC / ??
Atmospheric furnace	Hi Tech furnaces UK	Small batch cantilever furnace - custom build - auto wafer unload/load with door opening - upto 25 wafer load - temperature across flat zone typically << 0.5° - temperature up to 1300°C - upto 8 gas lines	up to 200mm	Research and development of high quality growth of SiO_2 on SiC. - also used for Si oxidation - gases include O_2, Water vapour, NO, N_2O, 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	Small batch cantilever furnace - auto wafer unload/load with door opening - upto 25 wafer load - temperature across flat zone typically <<1° - temperature up to 750°C - upto 8 gas lines	up to 200mm	Deposition of polysilicon and Low Temperature Oxide gases available SiH_4, N_2, O_2 ++ Polysi from SiH_4 - undoped LTO from SiH_4 + O_2	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	
Atmospheric furnace	Hi Tech furnaces UK	Small batch cantilever furnace - custom build - auto wafer unload/load with door opening - upto 25 wafer load - temperature across flat zone typically << 0.5° - temperature up to 1200°C - upto 4 gas lines	up to 150mm wafers - 200mm conversion possible	Solid source doping of Si and polysi		P type - boron doping N type - phos doping
Vacuum ovens -2 off	MTI	max 250°	up to 200mm	storage of n and p type solid source diffusion dopants		

Metal and dielectric deposition by sputtering	Surrey Nano Systems - Gamma	DC and RF sputter capability - 4 100mm targets - load lock degas - RF sputter etch - Platen temp up to 850° - reactive sputtering - O2 and N2 - closed loop plasma spectrum analyser reactive sputter control	up to 200mm	DC and RF magnetron sputtering - Degas in load lock to 250° - 4 x 100mm targets - RF bias and etch - substrate temp to 800° - reactive sputtering with N2 and or O2 - metallisation for device fabrication Ti/ TiN /Al film stack, Ni, ++	Aluminium 1% Si 300° C < 5% non uniformity Reflectivity relative to Si @ 435nm > 195% @ 480nm > 210%	Ni deposition Al deposition Ti deposition TiN deposition Cr deposition Si deposition ++
MOCVD -housed in QMF annex	Aixtron 200RF/4S (commissioning Q1 2014)		2"	Epitaxial deposition AlN /GaN, alloys, MQW		

Cleanroom analysis equipment						
thin film measurement	Nanospec AFT 210 system	Non contact optical measurement of films	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		
Optical microscope	Olympus MX50AF -IC inspection microscope	100, 125, 150 and 200mm wafer stage recesses - Mag upto x 1000 - Bright field and dark field imaging - Nomarski differential image contrast - '10 Megapixel camera with up to x4 optical zoom	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		
Profileometer	Veeco Dektak D150 including XY stage and vision software	Stylus profilometer -resolution 0.1nm -repeatability 0.6nm 1 sigma -max scan length 55mm -X-Y motorised stage -3D mapping	150mm (whole of 200mm can be measured by rotating wafer on stage)	Surface roughness determination - step height measurements to determine etch rates < 1nm resolution - 3D mapping		
Atomic Force Microscope	Park AFM NX20		200mm stage	AFM images and surface roughness quantification Nano indentation capability installed	<1nm rms measurement	
Film stress measurement	Tencor Flexus 2320		2"- 200mm 200mm stage	film stress measurement determined from radius of curvature measurement heating to 500°		
Resistivity measurement - 4 point probe	Magne-tron Instruments M800			metal and Si resistivity measurement		
Ellipsometer	Rudolph AutoEL IV		up to 150mm	Automatic measurement, standard processes. - Multi-wavelength - Automatic R-θ sample stage, - Transparent single and double films - Transparent double films - absorbing single - absorbing double layers, - polysilcon over single film, - thickness, - NU, KU, NL, KL, TL calculations.	λ=633, 546 and 405nm	
Patterned Wafer Inspection System	KLA Tencor Surfscan 7700		3" 1mm thick 100mm 525+/- 25µm 150mm 675+/- 25µm 200mm 725+/- 25µm	Defect determination on bare Si, coated Si and patterned wafers Particle Sensitivity 150nm Calibrated by diameter latex spheres on bare silicon	30 wafers per hour (200mm)	

non cleanroom equipment						
Dicing saw	Disco 2HST	fully automatic dicing saw	up to 150mm wafers	wafer dicing - blades for Si, SiC and sapphire		
Tube furnace - 70mm dia	Labec - custom design		Up to 50mm dia	Anneal, oxidation -gases N2, Ar, O2 - temp to 1400° C		
Tube furnace - 75mm dia	Carbolite		Up to 50mm dia	Vacuum processing -inert gas		
Evaporator for metal deposition	Jeol - JEE-4X	Thermal evaporator for small samples - SEM coater	< 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 turbo pumped		
RF sputter -metal and dielectric deposition	Originally Denton	GU converted Denton evaporator to RF sputter heated platen for up to 20mm samples	small samples	R+D use mainly for dielectric films - 100mm target - gases Ar, O2 turbo pumped		
Electrical test and physical analysis						
SEM	Jeol JSM 6510LV - 2009	Tungsten filament 3nm resolution low and high vacuum modes	up to 150mm	Imaging SiC films, lithography, etch profiles etc		
Profileometer	Tencor alpha-step 200		100mm	Surface roughness determination - step height measurements to determine etch rates >2nm		
Film stress measurement	Tencor Flexus 2320		2"- 200mm 200mm stage	film stress measurement determined from radius of curvature measurement		
Semiconductor parametric analyser	HP 4145B			4 Channel, current-voltage measurement, DC		
Power device analyser / curve tracer	Agilent B1505 A			parametric analysis for high voltage devices		
Hot chuck	MDC		up to 150mm	Room temperature to 300ºC, 4 probes to connect to sample		
LCR meter	HP4284			AC impedance measurement 20Hz-1MHz, L.C.R		
Femto Ammeter	Keithley 6430	sub femtoamp remote source meter		DC current - voltage measurement		
Quasistatic CV	Keithley 595			Characterise oxide /semiconductor interfaces and non-volatile memory		
Hall effect measurement	GU design/ build		1cm square approx.	Measure doping levels of semiconductors		
Microscope with dimension measurement	Nikon Measurescope	4 point probe measurement	up to 200mm	Inspection and XY measurement to 1µm		
Probe Station				4 probes, dark, shielded		