Tool Node	Infrastructure Platform	Location	Title	Make	Model	Tool Description	Year of manufacture	Key Differentiator	Capability	Capability Category	Capability Subcategory	Capability description
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Tepla Gigabatch 300 (ANU)	Tepla	Gigabatch 300	Used to strip resist and clean samples. Useful during the fabrication of photovoltaic, optoelectronic or nano-photonic technologies as a vital part of the complete lithography process.	2010	Plasma asher	Cleaning	Lithography	Support systems	Cleaning, an essential step when operating on the micro and nanoscale, is used to remove contaminants from the surface of the substrate before it is used in another fabrication process. This sometimes means simply burning away material, often using an asher to do this. Ashers use heat to remove unwanted material, such as photoresist. They are often used to clean a wafer, although they can sometimes be used to selectively etch away material as well.
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Custom Preparation suite (ANU)	Custom	Preparation suite	Coating samples for SEM, vacuum oven to avoid curing polymers in air	2011-2013	SEM coater, vacuum oven, spinners, wire bonder	Scanning Electron Microscopy (SEM)	Testing and validation	Scanning Electron Microscopy (SEM)	Scanning Electron Microscopy (SEM) is the process whereby a tightly focused electron beam is scanned onto the surface to be imaged. As the primary electrons hit the atoms in the surface, a number of secondary electrons are emitted, and collected by the instrument's detector, which assigns a level of grey accordingly, thereby creating a pixel for a digital image. The machines can routinely image features down to about 10nm, and in some special cases down to several nm in size. SEM is a key tool for process characterisation of surface topography. Most samples fabricated in the cleanroom undergoes at least one round of SEM imaging, in order to assess the quality of the fabrication and its defects. This information is fed into the process optimisation loop until a satisfying sample is produced. The tool is also used to image samples such as fixated cells and failed components.
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Bruker Dektak XT (ANU)	Bruker	Dektak XT	Instrument used to measure height steps, typically after lithography or etching	2012	Stylus profilometer	Stylus profilometry	Testing and validation	Profilometry	Stylus profilometry is a direct form of profilometry that can be used to characterise the surface steps and the roughness of a material. A stylus profilometer drags a metal tip along the surface of a sample and measuring the distance traced by the stylus tip and its deflection along the vertical axis to register slight changes in the surface height of a material. This measurement is then converted into a cross-sectional plot and can be used to resolve steps as small as 10nm. Optical profilometry employs phase-shifting and/or vertical scanning interferometry to resolve the topology of complex 3D structures. The technique marries precision z-axis control with interference based techniques to resolve features from the angstrom to millimetre scale. The technique lends itself well to die-based measurements for ISO/QA and large area mapping.
ACT Node	Next generation semiconductor opto-electronic devices	ANU	JetFirst JeFirst (ANU)	JetFirst	JeFirst	To anneal and bake semiconductors or polymer samples. Maximum temperature: 1,400 degrees C (5 minutes max, lower temperatures up to 15 minutes max).	2012	Rapid thermal annealer	Annealing	Materials synthesis and modification	Material modification	Annealing is a process that can reduce residual stress in a substrate that has accumulated during prior processes such as deposition. The material is heated to high temperatures and allowed to cool at a controlled rate. This allows the material's crystal structure to relax into a less intrinsically stressed state, and to settle into a more desirable microstructure as it cools.
ACT Node		ANU	Aixtron 3x2FT (ANU)	Aixtron	3x2FT	Epitaxial growth of III-V (arsenide, phosphide and antimonide based materials) 2D and 3D semiconductor structures.	2013	MOCVD CCS (Close-Coupled Showerhead) system for growth of III-V (III-As, III-P, III-Sb) semiconductor structures	Metal-Organic Chemical Vapour Deposition (MOCVD)	Deposition	Chemical Vapour Deposition (CVD)	MOCVD is a chemical vapour deposition technique that uses metal-organic precursors to enable the growth of III-V semiconductors in two and three dimensions.
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Aixtron 3x2FT (ANU)	Aixtron	3x2FT	Epitaxial growth of III-N (nitride based materials) 2D and 3D semiconductor structures.	2013	MOCVD CCS (Close-Coupled Showerhead) system for growth of III-nitride semiconductor structures	Metal-Organic Chemical Vapour Deposition (MOCVD)	Deposition	Chemical Vapour Deposition (CVD)	MOCVD is a chemical vapour deposition technique that uses metal-organic precursors to enable the growth of III-V semiconductors in two and three dimensions.
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Finetech Fineplacer Lambda (ANU)	Finetech	Fineplacer Lambda	Used to align and place/bond chips on PCB or larger chips using metal bonding	2012	Flip chip bonder	Wafer bonding	Packaging	Bonding	Bonding a wafer to another wafer is a step commonly used when packaging components in an micro or nanoelectrical device. It can help a form new functions in a device, or can ensure mechanical and hermetic encapsulation of devices and electronics. The result is irreversible. Common bonding methods include using heat or with an adhesive for thermally sensitive samples.
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Low Energy Ion Implanter (ANU)		Low Energy Ion Implanter	Ion implantation for materials modification and research	1992					
ACT Node	Next generation semiconductor opto-electronic devices	ANU	High Energy Ion Implanter (ANU)		High Energy Ion Implanter	Ion implantation for materials modification and research	1988					
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Rutherford Back-Scattering Spectroscopy (ANU)	Rutherford	Back-Scattering Spectroscopy	Materials Composition Analysis	2000					
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Aixtron 200/4 (ANU)	Aixtron	200/4	Epitaxial growth of III-V (arsenide, phosphide and antimonide based materials) 2D and 3D semiconductor structures.	2000	MOCVD (horizontal flow) system for epitaxial growth of III-V semiconductor structures.	Metal-Organic Chemical Vapour Deposition (MOCVD)	Deposition	Chemical Vapour Deposition (CVD)	MOCVD is a chemical vapour deposition technique that uses metal-organic precursors to enable the growth of III-V semiconductors in two and three dimensions.
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Fabrication and characterisation Facility (ANU)		Fabrication and characterisation Facility	Ovens, mask aligner, PL, micro-PL, PLD, RTA, FTIR	Various					
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Oxford Instruments Plasmalab 100 (ANU)	Oxford Instruments	Plasmalab 100	Deposit dielectrics SiOx, SiNx and amorphous Si	2009	Plasma enhanced chemical vapour deposition system (PECVD) for depositing SiOx, SiNx, a-Si	Plasma Enhanced Chemical Vapour Deposition (PECVD)	Deposition	Chemical Vapour Deposition (CVD)	Plasma Enhanced Chemical Vapour Deposition (PECVD) uses a plasma to deposit a thin film of silicon dioxide or silicon nitrate onto a substrate. PECVD uses lower temperatures than the furnace systems to achieve an insulating layer on a variety of materials. PECVD is used in optics, microelectronics, energy applications, packaging and chemistry for the deposition of anti-reflective coatings, scratch resistant transparent coatings, electronically active layers, passivation layers, dielectric layers, isolating layers, etch stop layers, encapsulation and chemical protective coatings.
ACT Node	Next generation semiconductor opto-electronic devices	ANU	EVG 620 (ANU)	EVG	620	Standard optical lithography and Nano-Imprint UV Lithography	2010	UV lithography and NIL exposure	Nano Imprint Lithography	Lithography	Photolithography	Nanoimprint lithography uses a transparent mould to deform a layer of photoresist into a desired topography. Light is then passed through the clear mould to cure the resist and make these deformations permanent. This technique relies on the accuracy of the mould but can be used to create many identical versions of the same structure.
ACT Node	Next generation semiconductor opto-electronic devices	ANU	Picosun Sunale (ANU)	Picosun	Sunale	Load-locked ALD system with thermal and plasma ALD processes	2012	Atomic layer deposition (ALD) system for depositing Al, Zn, Ti, Hf, Ta, Si oxides and TiN	Atomic Layer Deposition (ALD)	Deposition	Atomic Layer Deposition (ALD)	Atomic Layer Deposition (ALD) involves the deposition of materials one atomic monolayer at a time. It forms extremely uniform, conformal, pin-hole-free coatings even on high-aspect-ratio structures. This is achieved by pulsing a chemical precursor onto a hydroxylated substrate surface which reacts, resulting in a monolayer of material to be formed. The unused precursor is purged from the chamber and then the surface is again hydroxylated with water vapour or oxygen, followed by another purge. These steps are then repeated until the desired thickness of material is achieved. ALD has a vast array of applications from semiconductors, MEMS, nanostructures and optics through to wear-resistant coatings.

ACT Node	Next generation semiconductor opto-electronic devices	ANU	Kurt Lesker Nano36 (ANU)	Kurt Lesker	Nano36	Thermal deposition of various materials.	2013	Thermal evaporator for depositing Au, Cu, Zn, etc.	Thermal evaporation	Deposition	Physical Vapour Deposition (PVD)	Thermal Evaporation is one of the simplest forms of physical vapor deposition (PVD). It uses heat to evaporate a high purity source material that moves through a vacuum chamber and deposits a thin film on a substrate. Thermal evaporation can be used to deposit metals, organic, and inorganic polymers. In this method, electrical energy is used to heat a filament which in turn heats a deposition material to the point of evaporation. The process can be performed at very high levels of vacuum to eliminate collisions with foreign particles and therefore fewer tendencies to introduce film impurities. High deposition rates can be achieved and lower energy particles can reduce substrate damage. Thermal evaporation is widely used when creating polymer solar cells and flexible electronics.
ACT Node	Next generation semiconductor opto-electronic devices	ANU	J. A. Woollam M-2000-DI (ANU)	J. A. Woollam	M-2000-DI	Fully automated spectral ellipsometer to measure refractive index and thickness of materials.	2013	Spectral Ellipsometer	Spectroscopic ellipsometry	Testing and validation	Thin film characterisation	Spectroscopic ellipsometry is an optical characterisation technique which provides a highly sensitive, contactless method for thin film measurements. Multiple light wavelengths and variable angles of polarised light are reflected off the surface of a sample. As this light reflects, its characteristics change depending on a number of the sample's properties – it can therefore be used to characterise film thickness as well as composition such as roughness, crystalline nature, electrical conductivity and doping concentration.
ACT Node	Nanophotonics and integrated optics	ANU	FEI Verios SEM-CL (ANU)	FEI	Verios SEM-CL	The FEI Verios 460L has a field emission gun and a monochromator suitable for ultra high resolution imaging. Attached to the instrument are a Gatan MonoCL4 Elite system which enables cathodoluminescence mapping and spectroscopic studies, and an Oxford electron dispersive X-ray (EDX) spectrometer for elemental analysis.	2014	Cathodoluminescence Analysis and Scanning Electron Microscopy (SEM-CL)	Scanning Electron Microscopy (SEM)	Testing and validation	Scanning Electron Microscopy (SEM)	Scanning Electron Microscopy (SEM) is the process whereby a tightly focused electron beam is scanned onto the surface to be imaged. As the primary electrons hit the atoms in the surface, a number of secondary electrons are emitted, and collected by the instrument's detector, which assigns a level of grey accordingly, thereby creating a pixel for a digital image. The machines can routinely image features down to about 10nm, and in some special cases down to several nm in size. SEM is a key tool for process characterisation of surface topography. Most samples fabricated in the cleanroom undergoes at least one round of SEM imaging, in order to assess the quality of the fabrication and its defects. This information is fed into the process optimisation loop until a satisfying sample is produced. The tool is also used to image samples such as fixated cells and failed components.
ACT Node	Nanophotonics and integrated optics	ANU	AJA International ATC-2400 V (ANU)	AJA International	ATC-2400 V	Magnetron sputter system with three DC sources and three RF sources	2005	Sputtering system	Sputtering	Deposition	Physical Vapour Deposition (PVD)	Sputtering is a physical vapour deposition method that involves depositing thin films in a vacuum environment. During this process, a solid material and substrate are positioned separately within a vacuum system. A high-energy argon ion plasma stream is targeted at the material, resulting in the subject material being ejected and deposited onto the substrate, creating a thin film. As this is not an evaporative process, the temperatures required for sputtering are lower than evaporation methods. This makes it one of the most flexible deposition processes and it is particularly useful for depositing materials with a high melting point or a mixture of materials, as compounds that may evaporate at different rates, can be sputtered at the same rate. Certain processes will benefit from improved film adhesion due to higher impact energy. The sputtering process is used extensively in the semiconductor industry, screen displays, photovoltaics and magnetic data storage. Sputtering can be used to deposit a wide variety of thin films including metals, oxides, nitrides and alloys.
ACT Node	Nanophotonics and integrated optics	ANU	Raith 150 (ANU)	Raith	150	Electron-beam lithography tool for sub-µm features, accurate positioning	2007	Electron beam lithography (EBL) system	Electron Beam Lithography (EBL)	Lithography	Direct Write Lithography	Electron Beam Lithography (EBL) allows users to write patterns with extremely high resolution, smaller than 10nm in size. It makes use of a highly energetic, tightly focused electron beam, which is scanned over a sample coated with an electron-sensitive resist. The electron beam scans the image according to a pattern defined on a CAD file. The sample is then developed in an appropriate solvent which reveals the structures defined into the resist. This acts as a mould for subsequent pattern transfer techniques such as dry etching or metal lift-off. Due to the high-resolution nature of the technique, EBL has a vast range of applications including nano-electronics, photonics, plasmonics, nano-fluidics, MEMS, x-ray and neutron optics.
ACT Node	Nanophotonics and integrated optics	ANU	PlasmaTherm ICP-RIE Versaline Plasma Therm (ANU)	PlasmaTherm	ICP-RIE Versaline Plasma Therm	Cl- and F- based RIE for etching SiOx, SiNx, Si, III-V	2009					
ACT Node	Nanophotonics and integrated optics	ANU	Temescal BJD2000 (ANU)	Temescal	BJD2000	Equipment provides E-beam evaporation of metals and also features a thermal evaporation source for gold.	2009	Electron beam evaporator for depositing metals including Au, Pt, Ti, Al, Cr, Ge, Ni, Mo, Nb	Electron Beam Evaporation (E-Beam Evaporation)	Deposition	Physical Vapour Deposition (PVD)	Electron-beam evaporation is a physical vapour deposition method for depositing thin films of metals, oxides and semiconductors in a high vacuum environment. Ultra high purity coating material is placed inside a vacuum chamber, typically as pellets in a crucible. Electron energy is used to heat these pellets, causing the coating material to enter the gas phase. Due to the vacuum environment, the evaporated particles can travel to the substrate without colliding with foreign particles, where they then condense on the substrate surface in a thin film. Electron beam evaporation is used to deposit electronic and optical films for the semiconductor industry and has applications in displays and photovoltaics. High melting point materials can be deposited at high deposition rates, making this a preferred process for refractory metal and ceramic films.
ACT Node	Nanophotonics and integrated optics	ANU	FEI Helios NanoLab 600 Dual Beam SEM/FIB (ANU)	FEI	Helios NanoLab 600 Dual Beam SEM/FIB	A multifunction system for nanofabrication, characterisation, and high-resolution imaging	2010	Scanning electron microscope with focused ion beam for milling (FIB-SEM)	Focused Ion Beam (FIB) milling	Lithography	Direct Write Lithography	Focused Ion Beam (FIB) milling provides significant advantages as a single-step, nanoscale prototyping method that doesn't require a mask or resist. It is capable of performing: subtractive lithography in which atoms are locally milled away by physical sputtering with sub-10nm resolution; additive lithography in which materials are locally deposited with sub-10nm resolution; local ion implantation for fabrication of an etching mask for subsequent pattern transfer; and direct material modification by ion-induced mixing. FIB milling is a versatile technique with a wide range of applications including advanced materials development/characterisation; resist-free, high-resolution patterning of nanostructures; cross-sectional analysis of samples; sample preparation for transmission electron microscopy (TEM) and for atom probe analysis.
Optofab Node	Nano, Micro, Macro Optics fabrication	ANU	Canon MPA500-FAB (ANU)	Canon	MPA500-FAB	1x projection lith tool 100mm wafers	1981					
Optofab Node	Nano, Micro, Macro Optics fabrication	ANU	Veeco Spector (ANU)	Veeco	Spector	Ion Beam sputter system	2000					
Optofab Node	Nano, Micro, Macro Optics fabrication	ANU	Oxford Instruments ICP-100 (ANU)	Oxford	Instruments ICP-100	ICP Etcher, 3KW ICP source, 8 gasses, interferometric etch rate monitor, up to 150mm wafers	2000					
Optofab Node	Nano, Micro, Macro Optics fabrication	ANU	SCI Filmtek 4000 (ANU)	SCI	Filmtek 4000	Mapping thin film thickness/index measurement system	2000					
Optofab Node	Nano, Micro, Macro Optics fabrication	ANU	K&S and others (ANU)		K&S and others	Dicing saw, wafer mounter, and cleaner	2000					

ACT Node		ANU	SAMCO ICP-RIE 400iP (ANU)	SAMCO ICP-RIE	400iP	Inductively Coupled plasma etch tool for etching III-V semiconductors, no metals etching		Cl- ICP-RIE for etching III-V semiconductors	Reactive Ion Etching (RIE)	Etching	Dry Etching	Reactive Ion Etching (RIE) is a method that combines both chemical and physical etching to allow isotropic and anisotropic material removal. The etching process is carried out in a chemically reactive plasma containing positively and negatively charged ions generated from gases that are pumped into the reaction chamber. A mask on top of the substrate is used to protect designated areas from etching, exposing only the areas to be etched. Dry etching offers excellent process control for cleanliness, homogeneity, etch-rate, etch-profile, selectivity and run-to-run consistency, which is critical for high-fidelity pattern-transfer in micro- and nano-system technologies. RIE is extensively used in the field of displays & lighting (LEDs), semiconductors, electronics, MEMS, communication technology, microfluidics, optoelectronics and photovoltaics.
ACT Node		ANU	SAMCO ICP-RIE 400iP (ANU)	SAMCO ICP-RIE	400iP	Inductively Coupled plasma etch tool for etching SiOx, SiNx, Si, Ge, etc		F-based ICP-RIE for etching SiOx, SiNx, Si	Reactive Ion Etching (RIE)	Etching	Dry Etching	Reactive Ion Etching (RIE) is a method that combines both chemical and physical etching to allow isotropic and anisotropic material removal. The etching process is carried out in a chemically reactive plasma containing positively and negatively charged ions generated from gases that are pumped into the reaction chamber. A mask on top of the substrate is used to protect designated areas from etching, exposing only the areas to be etched. Dry etching offers excellent process control for cleanliness, homogeneity, etch-rate, etch-profile, selectivity and run-to-run consistency, which is critical for high-fidelity pattern-transfer in micro- and nano-system technologies. RIE is extensively used in the field of displays & lighting (LEDs), semiconductors, electronics, MEMS, communication technology, microfluidics, optoelectronics and photovoltaics.
ACT Node		ANU	EVG 520 (ANU)	EVG	520	Hot Embossing, Nanoimpint lithography, and wafer bonding		Hot embossing and wafer bonding	Hot embossing	Lithography	Embossing	Hot embossing is a pattern-transfer technique, involving the application of pressure and heat to a polymeric or resist-coated substrate, placed in contact with a master mould. This allows the relief features on the mould to be transferred faithfully. Hot embossing achieves fast patterning at a resolution of 50nm. This technique addresses a wide range of applications, from polymer-based lab-on-chip systems, where imprinting is performed on thick polymers substrates, for the fabrication of sub 50nm features for bio-sensing or data recording applications, as well as microfluidics, MEMS, optoelectronics, packaging and SOI production.
Victorian Node	Advanced nanofiber-derived materials and fabrication	Deakin	Electrospinning instrument (Deakin)		Electrospinning instrument	upgrade 1.1: chamber enviro and drum heater upgrade	2011					
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	Flinders	Angstrom Covap II (Flinders)	Angstrom	Covap II	Thermal evaporator housed in an inert atmosphere glovebox.	2013	Thermal evaporator	Thermal evaporation	Deposition	Physical Vapour Deposition (PVD)	Thermal Evaporation is one of the simplest forms of physical vapor deposition (PVD). It uses heat to evaporate a high purity source material that moves through a vacuum chamber and deposits a thin film on a substrate. Thermal evaporation can be used to deposit metals, organic, and inorganic polymers. In this method, electrical energy is used to heat a filament which in turn heats a deposition material to the point of evaporation. The process can be performed at very high levels of vacuum to eliminate collisions with foreign particles and therefore fewer tendencies to introduce film impurities. High deposition rates can be achieved and lower energy particles can reduce substrate damage. Thermal evaporation is widely used when creating polymer solar cells and flexible electronics.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	Flinders	Labec / MKS HTF40/12 / Various (Flinders)	Labec / MKS	HTF40/12 / Various	High temperature furnace with a programmable gas flow system.	2012	Tube furnace and chemical vapour deposition system (CVD)	Plasma Enhanced Chemical Vapour Deposition (PECVD)	Deposition	Chemical Vapour Deposition (CVD)	Plasma Enhanced Chemical Vapour Deposition (PECVD) uses a plasma to deposit a thin film of silicon dioxide or silicon nitrate onto a substrate. PECVD uses lower temperatures than the furnace systems to achieve an insulating layer on a variety of materials. PECVD is used in optics, microelectronics, energy applications, packaging and chemistry for the deposition of anti-reflective coatings, scratch resistant transparent coatings, electronically active layers, passivation layers, dielectric layers, isolating layers, etch stop layers, encapsulation and chemical protective coatings.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	Flinders	MIESS (Flinders)		MIESS	Nanocluster sputtering source	2012					
South Australian Node	3D Imaging, surface profiling and CT Characterisation	Flinders	Horiba / Nanonics XploRA / MultiView 4000 (Flinders)	Horiba / Nanonics	XploRA / MultiView 4000	Raman spectroscopy system, including a confocal microscope and an atomic force microscope which can perform tip enhanced Raman spectroscopy (TERS)	2011	Raman confocal microscope and atomic force microscope (AFM) with tip-enhanced Raman spectroscopy (TERS) capability	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
South Australian Node		Flinders	Innovative Technology PL-HE-xGB (Flinders)	Innovative Technology	PL-HE-xGB	Inert atmosphere four and two glove gloveboxes for undertaking oxygen and moisture sensitive processes.		Inert atmosphere gloveboxes	Gloveboxes	Laboratory infrastructure	Specialised environments	Gloveboxes provide an encapsulated environment to either protect a sample from the atmosphere, or to protect the cleanroom from a sample.
South Australian Node		Flinders	Flinders Custom Specs (Flinders)	Flinders Custom	Specs	Electron and ion spectrometer used to characterise the electronic structure of surfaces. The instrument also houses a deposition source to make nanoclusters/nanocatalysts.		Metastable induced electron spectrometer (MIES) and Nanocluster deposition chamber	Other spectroscopy	Testing and validation	Spectroscopy	Variations on the theme of spectroscopy provide specific advantages for a range of uses – tweaking of the principle of observing the spectral output of materials in a variety of conditions can provide incredible amounts of information about the composition of a sample.
South Australian Node		Flinders	Flinders Custom Specs (Flinders)	Flinders Custom	Specs	Ion spectroscopy instrument used to directly measure the elemental composition of interfaces.		Neutral impact collision ion scattering spectroscopy (NICISS)	Other spectroscopy	Testing and validation	Spectroscopy	Variations on the theme of spectroscopy provide specific advantages for a range of uses – tweaking of the principle of observing the spectral output of materials in a variety of conditions can provide incredible amounts of information about the composition of a sample.

Queensland Node	Device Fabrication	Griffith	Unknown Prog 200 RIE (Griffith)	Unknown	Prog 200 RIE	Used to etch various materials, such as silicon dioxide, silicon nitride and polymers	2008	Reactive ion etcher (RIE)	Reactive Ion Etching (RIE)	Etching	Dry Etching	Reactive Ion Etching (RIE) is a method that combines both chemical and physical etching to allow isotropic and anisotropic material removal. The etching process is carried out in a chemically reactive plasma containing positively and negatively charged ions generated from gases that are pumped into the reaction chamber. A mask on top of the substrate is used to protect designated areas from etching, exposing only the areas to be etched. Dry etching offers excellent process control for cleanliness, homogeneity, etch-rate, etch-profile, selectivity and run-to-run consistency, which is critical for high-fidelity pattern-transfer in micro- and nano-system technologies. RIE is extensively used in the field of displays & lighting (LEDs), semiconductors, electronics, MEMS, communication technology, microfluidics, optoelectronics and photovoltaics.
Queensland Node	Device Fabrication	Griffith	Ultratech 602 (Griffith)	Ultratech	602	Mask Cleaner	1990					
Queensland Node	Device Fabrication	Griffith	Neutronix Quintel XXXX (Griffith)	Neutronix Quintel	XXXX	Creates structures of down to 1µm and perform front side alignment on both 4 and 6 inch wafers.	2008	Mask aligner and resist exposure system	Multiple mask lithography	Lithography	Photolithography	Photolithography is used to create a pattern on a substrate by shining light from a light source onto a photoresist that coats the surface of the substrate through a photomask and is followed by a development phase. Depending on the complexity of a device's design, various deposition, etching and lithography processes can be cycled through many times. This could mean that more than one photolithography stage is required, potentially dozens, and each iteration could require a new mask. Each mask used has to be aligned perfectly to the previously processed layer if the final device is to operate as desired. To do this, photomasks are often made to feature alignment marks, but to assist with accuracy, mask aligners are commonly used to ensure things line up. These mask aligning systems also offer a great deal of control over the exposure settings and conditions in which the photolithography process takes place.
Queensland Node	Device Fabrication	Griffith	SSE SSE OPTIcoat ST22+ (Griffith)	SSE	SSE OPTIcoat ST22+	Resist coater + hot plate	2007					
Queensland Node	Device Fabrication	Griffith	Neutronix Quintel Ultra µ line7000 (Griffith)	Neutronix Quintel	Ultra µ line7000	Front side mask aligner	1997					
Queensland Node	Device Fabrication	Griffith	LAM Autoetch 480 (Griffith)	LAM	Autoetch 480	Plasma etching of 6 inch wafers using a semi-isotropic dry etch process. Can produce features of 3µm.	1980	Plasma Asher	Plasma etching	Etching	Dry Etching	Plasma etching uses a finely controlled plasma to selectively remove material from a substrate.
Queensland Node	Device Fabrication	Griffith	Neutronix Quintel Ultra µ line7000 (Griffith)	Neutronix Quintel	Ultra µ line7000	Front side mask aligner	2000					
Queensland Node	Metrology	Griffith	Renishaw InVia (Griffith)	Renishaw	InVia	XXXX Exclude	2011	Combined Raman/AFM system				
Queensland Node	Metrology	Griffith	NT-MDT NTEGRA (Griffith)	NT-MDT	NTEGRA	This tool provides chemical plus spatial mapping of a sample, and can perform AFM on the same area. It is used to capture spectroscopic analysis of materials, mapping, imaging and to observe in situ reactions under electrochemical control synthesis.	2011	AFM/Raman with NeXT filter	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
Queensland Node	Metrology	Griffith	Nanoline CD 50/51 (Griffith)	Nanoline	CD 50/51	Optical line measurement	1990					
Queensland Node	Metrology	Griffith	Nanospec AFT 180 (Griffith)	Nanospec	AFT 180	Optical film measurement	1985	Microspectrophotometer	Spectrophotometry	Testing and validation	Spectroscopy	Spectrophotometry is a method that measures the amount of light that is absorbed or transmitted by a sample as a function of the wavelength of that light. This measurement is a basic characterisation of the optical properties and can be applied to various forms of sample, such as thin film and liquids.
Queensland Node	Metrology	Griffith	NT-MDT AFM NTEGRA Microspectrometer (Griffith)	NT-MDT	AFM NTEGRA Microspectrometer	AFM/Raman with NeXT filter	2006					
Queensland Node	Epitaxy	Griffith	Atlas Copco ZT22 (Griffith)	Atlas Copco	ZT22	Air compressor	2013					
Queensland Node	Epitaxy	Griffith	Atlas Copco NG27 (Griffith)	Atlas Copco	NG27	99.9% N2 gas generator ~270L/min	2013					
Queensland Node	Epitaxy	Griffith	Atlas copco NG15 (Griffith)	Atlas copco	NG15	99.999% N2 gas generator - 30L/min	2013					
Queensland Node	Epitaxy	Griffith	KLA Surfscan 7700 (Griffith)	KLA	Surfscan 7700	Fast, fully automatic, jig to jig, non-contact surface measurement. Particle Sensitivity 150nm. Processes Si wafers of 150mm - 675µm	1997	Wafer inspection system	Other spectroscopy	Testing and validation	Spectroscopy	Variations on the theme of spectroscopy provide specific advantages for a range of uses – tweaking of the principle of observing the spectral output of materials in a variety of conditions can provide incredible amounts of information about the composition of a sample.
Queensland Node	Epitaxy	Griffith	Custom SPT Micro EpiFlx (Griffith)	Custom SPT Micro	EpiFlx	Global standard for thin epitaxial thin films of SiC. Can process wafers of up to 300mm Si wafers with a uniformity of sub-1%.	2012	Large batch production reactor for SiC Deposition	Reactor	Materials synthesis and modification	Material synthesis	Reactors provide controllable environments in which to produce new materials.
Queensland Node	Epitaxy	Griffith	Edwards iQDP80/QMB250 (Griffith)	Edwards	iQDP80/QMB250	Vacuum pumps	2000					
Queensland Node	Epitaxy	Griffith	Adixen 15 (Griffith)		Adixen 15	Vacuum pumps	2005					
Queensland Node	Epitaxy	Griffith	Millipore Elix (Griffith)	Millipore	Elix	Complex class 2 DI water generator max 70L/hr	2006					
Queensland Node	Epitaxy	Griffith	Peak NG10 (Griffith)		Peak NG10	99.9995 N2 generator 8L/min	2009					
Queensland Node	Epitaxy	Griffith	Peak NG10 (Griffith)		Peak NG10	99.9995 N2 generator 8L/min	2009					
Queensland Node	Epitaxy	Griffith	Edwards Edwards IPX (Griffith)	Edwards	Edwards IPX	Vacuum pumps	2000					
Queensland Node	Epitaxy	Griffith	Adixen 28 (Griffith)		Adixen 28	Vacuum pumps	2008					
Queensland Node	Epitaxy	Griffith	Genius 6 (Griffith)		Genius 6	99.5% N2 generator 300L/min	2014					
Queensland Node	Epitaxy	Griffith	Boge C30FD (Griffith)		Boge C30FD	Air compressor	2014					
Queensland Node	Epitaxy	Griffith	various (Griffith)		various	distribution for UHP process gases	from 1990 ...					
Queensland Node	Epitaxy	Griffith	Millipore Super Q (Griffith)	Millipore	Super Q	Polisher to produce class 1 water	2006					

Queensland Node	Device Fabrication	Griffith	Yield Engineering Systems (YES) 310TA (Griffith)	Yield Engineering Systems (YES)	310TA	A HMDS vapour is heated to 150°C in a vacuum chamber and modifies the surface of the substrate in a controlled and reproducible manner.	1995	HDMS oven	Silanisation	Materials synthesis and modification	Surface treatment	The alteration of the surface chemistry of a substrate using an organofunctional alkoxysilane to make a sample hydrophobic. The process works on mineral components such as glass and metal oxides as they have hydroxyl groups which attach to and displace the alkoxy groups on the silane forming a covalent O-Si bond.
Queensland Node	Device Fabrication	Griffith	SSE OPTIcoat ST22 (Griffith)	SSE	OPTIcoat ST22	Uses a vacuum chuck to spin the wafer whilst a specific amount of photoresist is deposited on the surface of the substrate. Spin speeds and volumes are variable to allow for different thickness and uniformity requirements.	2007	Resist developer	Spin coating and wafer development	Lithography	Support systems	Spin coaters are capable of applying uniform thickness polymer films, such as a resist to substrates. Resist is essential for many types of lithography, such as UV lithography. Resists are termed either positive or negative -- this denotes whether, when cured, chemical bonds are made or broken, and therefore whether the sections of resist that remain are either the true pattern, or it's inverse. This selection must be considering etching or deposition stages that may follow as it will help to make.
Queensland Node	Epitaxy	Griffith	DomnickHunter H2 generator (Griffith)	DomnickHunter	H2 generator	99.99995 H2 1.1L/min	2012					
Queensland Node	Epitaxy	Griffith	DomnickHunter H2 generator (Griffith)	DomnickHunter	H2 generator	99.99995 H2 1.1L/min	2012					
Queensland Node	Epitaxy	Griffith	Edwards GRC (Griffith)	Edwards	GRC	Gas abatement systems	1999					
Queensland Node	Epitaxy	Griffith	Edwards iQDP80/QMB250 (Griffith)	Edwards	iQDP80/QMB250	Vacuum pumps	2012					
Queensland Node	Epitaxy	Griffith	Edwards IPX (Griffith)	Edwards	IPX	Vacuum pumps	2013					
Queensland Node	Epitaxy	Griffith	Edwards iQDP80 (Griffith)	Edwards	iQDP80	Vacuum pumps	2005					
Queensland Node	Epitaxy	Griffith	Edwards iQDP81 (Griffith)	Edwards	iQDP81	Vacuum pumps	2006					
Queensland Node	Epitaxy	Griffith	Edwards TPU (Griffith)	Edwards	TPU	Gas abatement systems	1990+WRU 2007					
Queensland Node	Epitaxy	Griffith	Edwards GRC (Griffith)	Edwards	GRC	Gas abatement systems	1999					
Queensland Node	Epitaxy	Griffith	Edwards GRC (Griffith)	Edwards	GRC	Gas abatement systems	2000					
Queensland Node	Epitaxy	Griffith	Edwards GRC (Griffith)	Edwards	GRC	Gas abatement systems	2000					
Queensland Node	Epitaxy	Griffith	Edwards IPX (Griffith)	Edwards	IPX	Vacuum pumps	1999					
Queensland Node	Epitaxy	Griffith	Dowdens RO water (Griffith)	Dowdens	RO water	RO system	2016					
Queensland Node	Epitaxy	Griffith	Edwards iQDP80/QMB250 (Griffith)	Edwards	iQDP80/QMB250	Vacuum pumps	2014					
Victorian Node	Advanced material and surface analysis	La Trobe	Asylum Research MFP3D-BIO (La Trobe)	Asylum Research	MFP3D-BIO	General use Atomic Force Microscope (AFM) built on a Nikon inverted microscope base for integrated scanning-probe and optical microscopy. Modes available; Kelvin force probe/adhesion and stiffness maps, conductivity maps and single molecule spectroscopy, viscoelastic mapping, magnetic force mapping.	2007	Atomic force microscope (AFM) with inverted optical microscope	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
Victorian Node	Advanced material and surface analysis	La Trobe	Asylum Research MFP3D-SA (La Trobe)	Asylum Research	MFP3D-SA	A versatile AFM mounted on an active-damping vibration-isolation table in an acoustic-isolation enclosure to improve resolution. Operating Modes: contact and non-contact (AC) AFM, EFM, MFM, lateral force microscopy (LFM), conductive AFM, KPFM, and nanolithography.	2007	Atomic force microscope (AFM)	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
Victorian Node	Advanced material and surface analysis	La Trobe	DataPhysics Optical Contact Angle Analysis (DataPhysics OCA20) (La Trobe)	DataPhysics	Optical Contact Angle Analysis (DataPhysics OCA20)	Optical Contact Angle Analysis	2002					
Victorian Node	Advanced material and surface analysis	La Trobe	Kratos Analytical XPS Nova instrument (Kratos Analytical) (La Trobe)	Kratos Analytical	XPS Nova instrument (Kratos Analytical)	X-ray photoelectron spectroscopy (NOVA DSU)	2009					
Victorian Node	Advanced material and surface analysis	La Trobe	Kratos Analytical XPS Ultra instrument (Kratos Analytical) (La Trobe)	Kratos Analytical	XPS Ultra instrument (Kratos Analytical)	X-ray photoelectron spectroscopy (ULTRA DSU)	2008					
Victorian Node	Advanced material and surface analysis	La Trobe	Physical Electronics Scanning Auger nanoprobe (Physical Electronics 710) (La Trobe)	Physical Electronics	Scanning Auger nanoprobe (Physical Electronics 710)	Scanning auger nanoprobe MFC	2014					
Victorian Node	Advanced material and surface analysis	La Trobe	Physical Electronics Scanning Auger nanoprobe 710 (La Trobe)	Physical Electronics	Scanning Auger nanoprobe 710	Scanning auger nanoprobe EDX	2014					
Victorian Node	Advanced material and surface analysis	La Trobe	Sample preparation laboratory - physical sciences sample prep (La Trobe)		Sample preparation laboratory - physical sciences sample prep	Sample cutting, polishing, embedding, sections	various (mostly > 20 yrs old)					
Victorian Node	Advanced material and surface analysis	La Trobe	TOF - SIMS DSC (Ion-ToF ToF-SIMS 5-100P) (La Trobe)		TOF - SIMS DSC (Ion-ToF ToF-SIMS 5-100P)	Time-of-flight secondary ion mass spectrometers	2014					

Victorian Node	Advanced material and surface analysis	La Trobe	TOF - SIMS GCIS (Ion-ToF ToF-SIMS 5-100P) (La Trobe)		TOF - SIMS GCIS (Ion-ToF ToF-SIMS 5-100P)	Time-of-flight secondary ion mass spectrometers in situ fib	2014					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	ABM Stand Alone UV Exposure System (MCN)	ABM	Stand Alone UV Exposure System	A versatile system that floods the exposure chamber with UV light.	2010	UV flood exposure source	UV Flood Exposure	Lithography	Photolithography	UV flood exposure sources provide quick, non discriminant processing of UV-sensitive materials and substrates. This can be incredibly useful when a sample doesn't require more than one mask, or it's an abnormal shape or size.
Victorian Node		MCN	Agilent Cary 60 (MCN)	Agilent	Cary 60	Agilent UV VIS Cary 60 Spectrophoto	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Ambius XP200 profilometer (MCN)	Ambius	XP200 profilometer	Ambios stylus profilometer	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Amerimade Automated Wetbench Suite (MCN)	Amerimade	Automated Wetbench Suite	The automated wet-bench suite is comprised of three custom made instruments – a manual wet processing deck, a semi-automated chemical cleaning station and an IPA aerosol vapour dryer. All three wetbench instruments are designed to accommodate 25 wafers processing at a time resulting in high throughput and large volume of chemical ensure repeatable results. The wetbench suite significantly reduces the risk of using dangerous chemical by eliminating beakers and safe waste management systems.	2012	Set of wet benches for wet processing	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Anatech Hummer BC-20 (MCN)	Anatech Hummer	BC-20	Manual tool which can be used to deposit a wide variety of conductive and non-conductive thin films including metals, oxides, nitrides and alloys. The system allows for up to two materials to be co-deposited at once, with the option to vary the composition over time.	2006	RF/DC sputtering system	Sputtering	Deposition	Physical Vapour Deposition (PVD)	Sputtering is a physical vapour deposition method that involves depositing thin films in a vacuum environment. During this process, a solid material and substrate are positioned separately within a vacuum system. A high-energy argon ion plasma stream is targeted at the material, resulting in the subject material being ejected and deposited onto the substrate, creating a thin film. As this is not an evaporative process, the temperatures required for sputtering are lower than evaporation methods. This makes it one of the most flexible deposition processes and it is particularly useful for depositing materials with a high melting point or a mixture of materials, as compounds that may evaporate at different rates, can be sputtered at the same rate. Certain processes will benefit from improved film adhesion due to higher impact energy. The sputtering process is used extensively in the semiconductor industry, screen displays, photovoltaics and magnetic data storage. Sputtering can be used to deposit a wide variety of thin films including metals, oxides, nitrides and alloys.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Anton Paar Zeta Potential Analyser (MCN)	Anton Paar	Zeta Potential Analyser	Surface potential analyser Anton Parr	2010					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Arrayit NanoPrint LM60 (MCN)	Arrayit	NanoPrint LM60	NanoprintTM LM60	2011					
Victorian Node		MCN	Artec Spyder (MCN)	Artec	Spyder	A versatile handheld scanner that is used for product design and quality control applications.		Handheld 3D scanner	Laser scanning	Modelling and device design	3D Modelling	Laser scanning can be used to record a three-dimensional computer model of an object, often for CAD modelling, but also for part inspection or defect monitoring. A laser is used to take spot measurements in three dimensional space of an object. This can be done using a handheld or mounted scanner that revolves around the object while it is stationary. Once scanned, a computer file is created that can be used for 3D printing, further CAD work, or other digital steps.
Victorian Node		MCN	Autodesk Ember (MCN)	Autodesk	Ember	A 3D Printer capable of printing structures that measure 50 microns on the X and Y axes, and approximately to 10-100 microns on the Z axis. Commonly used for non-functional prototypes, dental applications, and to create parts that will undergo high temperatures.		Desktop 3D printer	Plastic printing	Manufacturing and machining	3D printing	3D printing involves taking a model and slicing into layers, then printing these layers on top of one another to recreate a 3D component. It's an incredibly quick way to produce unique parts, or for small production runs, and is massively useful when wanting to quickly create prototypes. A variety of materials can be printed, such as metals and biological materials – however, desktop 3D printers tend to use plastics.
Victorian Node		MCN	BioTek Instruments Synergy MX Multidetection Plate Reader (MCN)	BioTek Instruments	Synergy MX Multidetection Plate Reader	Synergy MX Multi-Detection Micropla	2011					
Victorian Node		MCN	Bruker Contour GT-1 (MCN)	Bruker	Contour GT-1	Optical profiler - Brucker contour	2014					

Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Bruker Dimension Icon (MCN)	Bruker	Dimension Icon	The Dimension Icon AFM features a number of application modules such as ScanAsyst, Peak Force QNMTM (PFQNM), electrical materials characterisation and heating and cooling studies. The ScanAsyst imaging mode performs automatic image optimisation by controlling the tip-sample interaction force for faster and more consistent imaging results. The PFQNM mode analyses tip-sample interaction forces and generates quantitative nanoscale maps of mechanical properties, including modulus, adhesion, deformation, and dissipation. PFQNM operates over an extremely wide range to characterise a large variety of sample types. The AFM executes temperature control and thermal analysis on	2010	Atomic force microscope (AFM) with various condition control and usability modules	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Cambridge NanoTech Fiji 200 (MCN)	Cambridge NanoTech	Fiji 200	The Fiji F200 is capable of both thermal and Plasma Assisted ALD (PA-ALD). PA-ALD expands the window for materials by decreasing activation energy and allows for deposition at lower temperatures to reduce precursor decomposition, deposition times and film contaminations. This tool is equipped to enable Cambridge Nanotech's unique Exposure Mode™ for thin film deposition on ultra high aspect ratio substrates. In-situ film growth can be monitored using a spectroscopic ellipsometry.	2011	Plasma assisted atomic layer deposition (PA-ALD) System	Atomic Layer Deposition (ALD)	Deposition	Atomic Layer Deposition (ALD)	Atomic Layer Deposition (ALD) involves the deposition of materials one atomic monolayer at a time. It forms extremely uniform, conformal, pin-hole-free coatings even on high-aspect-ratio structures. This is achieved by pulsing a chemical precursor onto a hydroxylated substrate surface which reacts, resulting in a monolayer of material to be formed. The unused precursor is purged from the chamber and then the surface is again hydroxylated with water vapour or oxygen, followed by another purge. These steps are then repeated until the desired thickness of material is achieved. ALD has a vast array of applications from semiconductors, MEMS, nanostructures and optics through to wear-resistant coatings.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Cambridge NanoTech Savannah S100 (MCN)	Cambridge NanoTech	Savannah S100	This glovebox-integrated thermal ALD system allows the user to deposit materials in controlled environments.	2009	Atomic layer deposition (ALD) system in a glovebox	Atomic Layer Deposition (ALD)	Deposition	Atomic Layer Deposition (ALD)	Atomic Layer Deposition (ALD) involves the deposition of materials one atomic monolayer at a time. It forms extremely uniform, conformal, pin-hole-free coatings even on high-aspect-ratio structures. This is achieved by pulsing a chemical precursor onto a hydroxylated substrate surface which reacts, resulting in a monolayer of material to be formed. The unused precursor is purged from the chamber and then the surface is again hydroxylated with water vapour or oxygen, followed by another purge. These steps are then repeated until the desired thickness of material is achieved. ALD has a vast array of applications from semiconductors, MEMS, nanostructures and optics through to wear-resistant coatings.
Victorian Node		MCN	Cell incubator (38 degree C, CO2) (MCN)		Cell incubator (38 degree C, CO2)	Various steromicroscopes and lab equipment	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Coherent Confocal Microscope (MCN)	Coherent	Confocal Microscope	Multi laser excitation laser imaging microscope	2010					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Coherent Total Internal eflection Microscope (TIRF) (MCN)	Coherent	Total Internal eflection Microscope (TIRF)	Fluorescence imaging microscope	2010					
Victorian Node	ANFF Design House	MCN	Design House licences/upkeep (MCN)		Design House licences/upkeep	Coventor, Synopsis, L-Edit, Intellisense						
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Digital Matrix SA1000 (MCN)	Digital Matrix	SA1000	Can fabricate Ni master mould from patterned (photolithography, EBL) substrates to be used in hot embossing and nano-imprint lithography for mass production	2011	Nickel electroplating system	Electroplating	Deposition	Other deposition capabilities	Electroplating uses electrical current to reduce dissolved metal ions from an electrolyte to form a coherent metal coating on a material. The cathode, or part to be plated, and plating metal are immersed in an electrolyte containing dissolved metal salts as well as other ions that permit the flow of electricity. When a current is applied to the electrolyte, the free metal ions move through the solution to the cathode and are reduced to metal, creating a thin metal covering the surface. Electroplating is a common process in the jewellery, automotive, and food industries but it is also highly useful in the production of semi-conducting electronics and optics. Different metals can also be used to grow shims for use in hot embossing and nano-imprint lithography, while they can also help to protect surfaces from aggressive etching processes. Nickel electroplating can also be used to cast PDMS in the creation of fluidic cells.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Disco Disco 321 DAD (MCN)	Disco	Disco 321 DAD	Wafer dicer, 6" capability	2006					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Dynatex Dynatex Scribe wafer dicer (MCN)	Dynatex	Dynatex Scribe wafer dicer	DTX-150-MDB DYNATEX DTX STREET SMAR	2006					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Eppendorf Centrifuge (MCN)	Eppendorf	Centrifuge	Eppendorf Refrigerated centrifuge 5804	2012					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	EVG 520 (MCN)	EVG	520	Can emboss wafers and perform bonding such as anodic bonding, fusion bonding, eutectic bonding and epoxy bonding.	2010	Hot embossing tool	Hot embossing	Lithography	Embossing	Hot embossing is a pattern-transfer technique, involving the application of pressure and heat to a polymeric or resist-coated substrate, placed in contact with a master mould. This allows the relief features on the mould to be transferred faithfully. Hot embossing achieves fast patterning at a resolution of 50nm. This technique addresses a wide range of applications, from polymer-based lab-on-chip systems, where imprinting is performed on thick polymers substrates, for the fabrication of sub 50nm features for bio-sensing or data recording applications, as well as microfluidics, MEMS, optoelectronics, packaging and SOI production.

Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	EVG 620 (MCN)	EVG	620	A high-resolution mask aligner with split-field microscopes that is capable of handling multiple wafer sizes with quick change-over time. Features back side alignment capability for mask aligning.	2009	Mask aligner and resist exposure system with NIL capability	Nano Imprint Lithography	Lithography	Photolithography	Nanoimprint lithography uses a transparent mould to deform a layer of photoresist into a desired topography. Light is then passed through the clear mould to cure the resist and make these deformations permanent. This technique relies on the accuracy of the mould but can be used to create many identical versions of the same structure.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	F&S Bondtec Deep-access 5832 (MCN)	F&S Bondtec	Deep-access 5832	Deep access wire bonder suitable for wedge bonding.. Deep access wedge allows for the bonding of devices with tight and constricted geometries.	2016	Wire bonder with pull head and general upgrades	Wire bonding	Packaging	Bonding	Wire bonding is the part of the fabrication that allows an electrical component to communicate with the outside world. A thin electrically conductive wire – typically gold, aluminium, copper or silver – is used to allow electricity to flow from contacts on the component to, or from, its packaging. There are two commonly used types of wire bonding – wedge and ball. Which one is more suitable depends on the substrate, the contact material, the bonding material, and a number of other physical factors. Bonders can be manual or automated, and some can feature pattern recognition software to help speed the bonding process up.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	FEI FIB/SEM (MCN)	FEI	FIB/SEM	EDX detector upgrade	2009					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	FEI Helios NanoLab 600 Dual Beam (MCN)	FEI	Helios NanoLab 600 Dual Beam	Ultra-high resolution three dimensional imaging for topography, surface morphology and maskless ion beam direct lithography.	2009	Scanning electron microscope with focused ion beam for milling (FIB-SEM)	Focused Ion Beam (FIB) milling	Lithography	Direct Write Lithography	Focused Ion Beam (FIB) milling provides significant advantages as a single-step, nanoscale prototyping method that doesn't require a mask or resist. It is capable of performing: subtractive lithography in which atoms are locally milled away by physical sputtering with sub-10nm resolution; additive lithography in which materials are locally deposited with sub-10nm resolution; local ion implantation for fabrication of an etching mask for subsequent pattern transfer; and direct material modification by ion-induced mixing. FIB milling is a versatile technique with a wide range of applications including advanced materials development/characterisation; resist-free, high-resolution patterning of nanostructures; cross-sectional analysis of samples; sample preparation for transmission electron microscopy (TEM) and for atom probe analysis.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	FEI NovaNanoSEM 430 (MCN)	FEI	NovaNanoSEM 430	Ultra-high resolution three dimensional imaging for topography, surface morphology and metrology purposes in order to assess the quality of fabrication of devices and any defects.	2010	Field Emission Gun Scanning Electron Microscope (FEG-SEM)	Scanning Electron Microscopy (SEM)	Testing and validation	Scanning Electron Microscopy (SEM)	Scanning Electron Microscopy (SEM) is the process whereby a tightly focused electron beam is scanned onto the surface to be imaged. As the primary electrons hit the atoms in the surface, a number of secondary electrons are emitted, and collected by the instrument's detector, which assigns a level of grey accordingly, thereby creating a pixel for a digital image. The machines can routinely image features down to about 10nm, and in some special cases down to several nm in size. SEM is a key tool for process characterisation of surface topography. Most samples fabricated in the cleanroom undergoes at least one round of SEM imaging, in order to assess the quality of the fabrication and its defects. This information is fed into the process optimisation loop until a satisfying sample is produced. The tool is also used to image samples such as fixated cells and failed components.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Fridges (Various) (MCN)		Fridges (Various)	Fridges (Various)	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Fumehoods Biological Safety Cabinets (MCN)	Fumehoods	Biological Safety Cabinets	A recirculating fume cupboard with a spin coater and a hot plate.	2010	Topsafe Class II	Fumehoods	Laboratory infrastructure	Specialised environments	Fumehoods offer a safe space to process materials that may produce harmful gases.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	General Purpose spin coaters (MCN)		General Purpose spin coaters	6" capability general purpose spin coaters	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Gold electroplating bath (MCN)		Gold electroplating bath	automated gold electroplating tool	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Harrick Plasma asher (2) (MCN)	Harrick	Plasma asher (2)	Harrick plasma etcher / asher	2011					
Victorian Node		MCN	HEPA Filters (MCN)		HEPA Filters	Filtration units for cleanroom operation	2010					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	High speed camera (MCN)		High speed camera	Screening and integration camera	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Hitachi Desktop SEM (MCN)	Hitachi	Desktop SEM	motorized stage upgrade	2014					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Hitech CTF/150/3Z/1200C (MCN)	Hitech	CTF/150/3Z/1200C	Allows for the wet or dry oxidation of up to 25 wafers in one run. SiO2 growth up to 4µm possible via wet oxidation.	2011	Wet/dry oxidation furnace	Furnaces	Materials synthesis and modification	Material modification	High temperature furnaces used to melt materials to create glass fibre fabrication.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Holographic microscopy suite (MCN)		Holographic microscopy suite	Non-contact reflectometers (3 tools)	2012					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Intelligent Micropatterning SF100 XPRESS (MCN)	Intelligent Micropatterning	SF100 XPRESS	A maskless photolithography system capable of writing features down to 1 µm, that offers speed and cost benefits over masked systems.	2012	Maskless micropatterning system	Maskless lithography	Lithography	Photolithography	Maskless lithography can be used to speed up the lithography process, and to save money by negating the need to fabricate steps required. Micropatterning is a lithography process that involves an image being projected directly onto a photoresist without the use of a mask.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Intlvac Intlvac E-Beam evaporator (MCN)	Intlvac	Intlvac E-Beam evaporator	GLAD and substrate heater upgrade	2010					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Intlvac Nanochrome (MCN)	Intlvac	Nanochrome	An automated tool which can be used to deposit a wide variety of conductive thin films including metals, oxides, nitrides and alloys. The system allows for up to three materials to be co-deposited at once, with the option to vary the composition over time.	2010	AC/DC Sputtering system with co-deposition	Sputtering	Deposition	Physical Vapour Deposition (PVD)	Sputtering is a physical vapour deposition method that involves depositing thin films in a vacuum environment. During this process, a solid material and substrate are positioned separately within a vacuum system. A high-energy argon ion plasma stream is targeted at the material, resulting in the subject material being ejected and deposited onto the substrate, creating a thin film. As this is not an evaporative process, the temperatures required for sputtering are lower than evaporation methods. This makes it one of the most flexible deposition processes and it is particularly useful for depositing materials with a high melting point or a mixture of materials, as compounds that may evaporate at different rates, can be sputtered at the same rate. Certain processes will benefit from improved film adhesion due to higher impact energy. The sputtering process is used extensively in the semiconductor industry, screen displays, photovoltaics and magnetic data storage. Sputtering can be used to deposit a wide variety of thin films including metals, oxides, nitrides and alloys.

Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Intlvac Nanochrome II (MCN)	Intlvac	Nanochrome II	Single films or multi-material stacks are easily created using simple layer definitions. Features ion-beam pre-cleaning and sample heating capabilities.	2010	Electron beam evaporator	Electron Beam Evaporation (E-Beam Evaporation)	Deposition	Physical Vapour Deposition (PVD)	Electron-beam evaporation is a physical vapour deposition method for depositing thin films of metals, oxides and semiconductors in a high vacuum environment. Ultra high purity coating material is placed inside a vacuum chamber, typically as pellets in a crucible. Electron energy is used to heat these pellets, causing the coating material to enter the gas phase. Due to the vacuum environment, the evaporated particles can travel to the substrate without colliding with foreign particles, where they then condense on the substrate surface in a thin film. Electron beam evaporation is used to deposit electronic and optical films for the semiconductor industry and has applications in displays and photovoltaics. High melting point materials can be deposited at high deposition rates, making this a preferred process for refractory metal and ceramic films.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	JPK NanoWizard II (MCN)	JPK	NanoWizard II	AFM with cell adhesion module, suitable for live cell imaging built on a Zeiss inverted microscope base.	2010	Atomic force microscope (AFM) for biological samples	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	K550X Gold sputter coater (MCN)		K550X Gold sputter coater	Gold sputter coating unit for the FIB/SEM	2010					
Victorian Node		MCN	Labtec -20 Degree Freezer (MCN)	Labtec	-20 Degree Freezer	Labtec -20 degree freezer	2010					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Laminar Flow Hoods - HEPA replacement (MCN)		Laminar Flow Hoods - HEPA replacement	Biosafety cabinet	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Malvern Malvern Nanosizer (Dynamic Light Scattering) (MCN)	Malvern	Malvern Nanosizer (Dynamic Light Scattering)	Particle characterisation	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	MBraun MB200 (MCN)	MBraun	MB200	A glovebox facility with ALD and Savannah S100 electron beam evaporator.	2010	Glovebox for solar cells with ALD and electron beam evaporator	Gloveboxes	Laboratory infrastructure	Specialised environments	Gloveboxes provide an encapsulated environment to either protect a sample from the atmosphere, or to protect the cleanroom from a sample.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Mettler Toledo XS105DU Balance (MCN)	Mettler Toledo	XS105DU Balance	high resolution balance	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Millipore Elix 100 (MCN)	Millipore	Elix 100	100 l/Hr water purification plant	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	neaSNOM AFM IR system (MCN)		neaSNOM AFM IR system	Laser upgrades (broadband IR for spectral mapping)	2016					
Victorian Node		MCN	Network analyser (MCN)		Network analyser	network analsyer	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Nikon Instruments A1Rsi (MCN)	Nikon Instruments	A1Rsi	Features a laser light source, galvanal scanner, high-speed resonant scanner and 32 channel PMT spectral detectors to rapidly produce confocal images of cells or thin metal films.	2011	Measurement Microscope with camera	Optical microscopy	Testing and validation	Microscopy	A fundamental form of sample analysis, optical microscopy uses a series of lenses to focus light that is reflected from or passed through a sample. Various forms of light and magnification can be used to visualise the sample.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Nikon Instruments Ti-U (MCN)	Nikon Instruments	Ti-U	UV/VIS/NIS Spectrophotometer is combined with a Princeton Instrument Isoplane 320 High performance Spectrograph as well as a Deep Cooled EMCCD camera. It offers transmitted and reflected brightfield illumination and transmitted darkfield illumination. Choice of three gratings to cater for long range or high resolution spectral imaging. Can provides transmission, reflection and darkfield images of samples.	2011	Highly sensitive spectral imaging with a mechanical slit down to 1µm.	Spectrophotometry	Testing and validation	Spectroscopy	Spectrophotometry is a method that measures the amount of light that is absorbed or transmitted by a sample as a function of the wavelength of that light. This measurement is a basic characterisation of the optical properties and can be applied to various forms of sample, such as thin film and liquids.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Objet EDEN260 (MCN)	Objet	EDEN260	General use polyjet polymer 3D printer.	2011	Desktop 3D printer	Plastic printing	Manufacturing and machining	3D printing	3D printing involves taking a model and slicing into layers, then printing these layers on top of one another to recreate a 3D component. It's an incredibly quick way to produce unique parts, or for small production runs, and is massively useful when wanting to quickly create prototypes. A variety of materials can be printed, such as metals and biological materials – however, desktop 3D printers tend to use plastics.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Optical Microscopes (MCN)		Optical Microscopes	Various Nikon microscopes	2010					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Oxford Instruments Plasmalab 100 ICP380 (MCN)	Oxford Instruments	Plasmalab 100 ICP380	Silicon-specific dry etching with good control over feature size and Bosch process capability for high aspect ratio structures.	2010	Deep reactive ion etcher (DRIE) capable of Bosch process	Deep Reactive Ion Etching (DRIE)	Etching	Dry Etching	Deep Reactive Ion Etching (DRIE) is effectively an extension of the Reactive Ion Etching (RIE) process, but can provide higher aspect ratio structures. The DRIE process alternates between etch and passivation cycles to allow patterns to be cut deeper into a substrate. Etch channels or other feature geometries with extremely high uniformity into glass, plastic or silicon substrates

Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Oxford Instruments Plasmalab 100 ICP380 (MCN)	Oxford Instruments	Plasmalab 100 ICP380	Offers fast, affordable deposition at relatively low temperatures.	2010	Plasma enhanced chemical vapour deposition system (PECVD) for depositing SiOx and SiN	Plasma Enhanced Chemical Vapour Deposition (PECVD)	Deposition	Chemical Vapour Deposition (CVD)	Plasma Enhanced Chemical Vapour Deposition (PECVD) uses a plasma to deposit a thin film of silicon dioxide or silicon nitrate onto a substrate. PECVD uses lower temperatures than the furnace systems to achieve an insulating layer on a variety of materials. PECVD is used in optics, microelectronics, energy applications, packaging and chemistry for the deposition of anti-reflective coatings, scratch resistant transparent coatings, electronically active layers, passivation layers, dielectric layers, isolating layers, etch stop layers, encapsulation and chemical protective coatings.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Oxford Instruments Plasmalab 100 ICP380 (MCN)	Oxford Instruments	Plasmalab 100 ICP380	General dry reactive etching of wide range of materials.	2010	Deep reactive ion etcher (DRIE)	Deep Reactive Ion Etching (DRIE)	Etching	Dry Etching	Deep Reactive Ion Etching (DRIE) is effectively an extension of the Reactive Ion Etching (RIE) process, but can provide higher aspect ratio structures. The DRIE process alternates between etch and passivation cycles to allow patterns to be cut deeper into a substrate. Etch channels or other feature geometries with extremely high uniformity into glass, plastic or silicon substrates
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Oxford Systems Cryo-Swapover (MCN)	Oxford	Systems Cryo-Swapover	RIE/DRIE support	2010					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Ozone cleaner (MCN)		Ozone cleaner	UV-OZONE DRY CLEANER	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	pH and Conducvity meter (MCN)		pH and Conducvity meter	pH and Conducvity meter	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	PicoTRACK PCT-150RRE (MCN)	PicoTRACK	PCT-150RRE	A fully automated system for wafer processing which includes spin coating, HMDS application, baking, and development. The system is well suited to batch scale production, providing high process performance and consistency in coating and development.	2015	Automated spin-coating and wafer developing system	Spin coating and wafer development	Lithography	Support systems	Spin coaters are capable of applying uniform thickness polymer films, such as a resist to substrates. Resist is essential for many types of lithography, such as UV lithography. Resists are termed either positive or negative -- this denotes whether, when cured, chemical bonds are made or broken, and therefore whether the sections of resist that remain are either the true pattern, or it's inverse. This selection must be considering etching or deposition stages that may follow as it will help to make.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Plasma Asher (MCN)		Plasma Asher	Barrel asher	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Polos & Others Hot Plates (MCN)	Polos & Others	Hot Plates	6" capabilities but some burnt out and require replacement	2010					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Polytec MSA-400 (MCN)	Polytec	MSA-400	The Micro System Analyser (MSA)-400 is a Laser doppler vibrometer that allows the researcher to analyse and visualise structural vibrations in MEMS devices.	2006	Laser Doppler Vibrometer (LDV) with stroboscopic and planar motion analysis	Laser Doppler Vibrometry (LDV)	Testing and validation	Vibrometry	Laser Doppler Vibrometry (LDV) measures the high frequency vibrations of surfaces by focusing a laser onto a sample and observing the reflected light. As the surface of a sample oscillates, it causes the wavelength of incident laser light to lengthen or shorten. Comparing this Doppler shifted reflected light to a reference beam provides information on the velocity, displacement, and phase of the surface vibrations. LDV is useful in the characterisation of MEMS devices, as well as piezoelectrics and surface acoustic wave devices.
Victorian Node		MCN	Sanyo -80 Freezer (MCN)	Sanyo	-80 Freezer	-80 Freezer	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Seki AX6300 (MCN)	Seki	AX6300	Used to coat seeded samples of any shape with boron-doped diamond.	2012	MPCVD system for deposition of boron-doped diamond	Microwave Plasma-enhanced Chemical Vapour Deposition (MPCVD)	Deposition	Chemical Vapour Deposition (CVD)	MPCVD is a chemical vapour deposition process which uses a continuous microwave source to create and help to maintain a highly reactive plasma made up of the reacting chemicals and necessary catalysts. MPCVD is heavily used in the ANFF network to deposit layers of diamond – methane and hydrogen are introduced and used to grow new diamond on a diamond-seeded substrate. ANFF equipment can introduce dopants to the carbon structure while its being grown. These include boron which can create superconducting diamond, and nitrogen vacancies which can produce interesting photo-luminescence properties that are being exploited for quantum information systems.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Shakers and vortexers (MCN)		Shakers and vortexers	Shakers and vortexers	2011					
Victorian Node		MCN	Spectroscopic Ellipsometer (MCN)		Spectroscopic Ellipsometer	Ellipsometric thin film characterisation	2012					
Victorian Node		MCN	Spectroscopic Ellipsometer (MCN)		Spectroscopic Ellipsometer	Ellipsometric thin film characterisation	2012					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Spin / cleaner / developer (MCN)		Spin / cleaner / developer	Spin / cleaner / developer	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Stereomicroscopes (MCN)		Stereomicroscopes	Various steromicroscopes and lab equipment	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Subtractive Miller (MCN)		Subtractive Miller	CNC maching centre	2012					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Suss Delta RC80+ (MCN)	Suss	Delta RC80+	Spin coater set up to process 4-inch wafers and also features a hot plate.	2010	Spin coater	Spin coating and wafer development	Lithography	Support systems	Spin coaters are capable of applying uniform thickness polymer films, such as a resist to substrates. Resist is essential for many types of lithography, such as UV lithography. Resists are termed either positive or negative -- this denotes whether, when cured, chemical bonds are made or broken, and therefore whether the sections of resist that remain are either the true pattern, or it's inverse. This selection must be considering etching or deposition stages that may follow as it will help to make.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Suss Suss MA6 Mask Aligner (MCN)	Suss	Suss MA6 Mask Aligner	6" topside general purpose aligner	2007					

Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	SVCS SVSFUR-FP (MCN)	SVCS	SVSFUR-FP	The SVCS four-stack horizontal furnace system with a HEPA controlled loading station with small batch processing options. The four processing tubes cater for atmospheric pressure diffusion, atmospheric pressure annealing and the low-pressure chemical vapour deposition of low strain and stoichiometric silicon nitride.	2013	Furnace for atmospheric pressure diffusion, annealing, and LPCVD	Annealing	Materials synthesis and modification	Material modification	Annealing is a process that can reduce residual stress in a substrate that has accumulated during prior processes such as deposition. The material is heated to high temperatures and allowed to cool at a controlled rate. This allows the material's crystal structure to relax into a less intrinsically stressed state, and to settle into a more desirable microstructure as it cools.
Victorian Node		MCN	SwissLitho NanoFrazor (MCN)	SwissLitho	NanoFrazor	Operates at ambient temperature, pressure, low voltage, and under N2 atmosphere. Not reliant on ion gun or electron beam which is good when processing sensitive materials and devices.		Thermal Scanning Probe Lithography (t-SPL) system	Thermal Scanning Probe Lithography (t-SPL)	Lithography	Direct Write Lithography	Thermal Scanning Probe Lithography (t-SPL) is a 3D direct-write lithography technique that provides sub-10nm resolution with sub-2nm vertical accuracy in ambient conditions. A 1,000°C cantilevered tip sublimates PPA resist as it scans over a sample, before the tip quickly cools to provide real-time topological AFM-type characterisation. The process isn't reliant on an ion gun or electron beam (helpful when processing sensitive materials); it operates at ambient temperature, pressure, low voltage, and under N2 atmosphere instead of requiring a specialist environment. The ease of use and high resolution means it is ideal for rapid fabrication of three-dimensional nanostructures including the fabrication of novel devices and components for nanophotonics, nanooptics, nanoelectronics, and plasmonics applications.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Tomy Autoclave (MCN)	Tomy	Autoclave	Tomy Autoclave	2010					
Victorian Node		MCN	Vacuum oven (MCN)		Vacuum oven	vac oven	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Various incubators and misc equipment (MCN)		Various incubators and misc equipment	Various incubators and misc equipment	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Various steromicroscopes and lab equipment (MCN)		Various steromicroscopes and lab equipment	Various steromicroscopes and lab equipment	2011					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Vistec EBL 5000 (MCN)	Vistec	EBL 5000	EBL that is capable of exposing thick layers of e-beam resist of up to several micrometres with small forward scattering. Fully automated equipment features a laser height measurement for automatic focus adjustment.	2010	Electron beam lithography (EBL) system	Electron Beam Lithography (EBL)	Lithography	Direct Write Lithography	Electron Beam Lithography (EBL) allows users to write patterns with extremely high resolution, smaller than 10nm in size. It makes use of a highly energetic, tightly focused electron beam, which is scanned over a sample coated with an electron-sensitive resist. The electron beam scans the image according to a pattern defined on a CAD file. The sample is then developed in an appropriate solvent which reveals the structures defined into the resist. This acts as a mould for subsequent pattern transfer techniques such as dry etching or metal lift-off. Due to the high-resolution nature of the technique, EBL has a vast range of applications including nano-electronics, photonics, plasmonics, nano-fluidics, MEMS, x-ray and neutron optics.
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	MCN	Water Bath (MCN)		Water Bath	Various steromicroscopes and lab equipment	2011					
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Coherent SuperRapidHE Lumera/Coherent (MQ)	Coherent	SuperRapidHE Lumera/Coherent	Picosecond laser facility - Laser	2013					
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	3DMicroMac Picosecond micromachining facility (MQ)	3DMicroMac	Picosecond micromachining facility	Picosecond laser machining facility using a SuperRapidHE laser and galvo scanners. 266nm, 532nm, 1064nm.	2013	Picosecond laser system	Laser engraving and cutting	Manufacturing and machining	Laser processing	Subtractive processes that use of lasers to create patterns on a substrate or to cut through a material.
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Jeol IB (MQ)	Jeol	IB	Prepares smooth facets using argon ion bombardment for sample preparation and analysis	2010	Crossectional polisher	Glass working	Manufacturing and machining	Optical fibre pulling and processing	Once a bulk glass material has been produced, it has to be made into something useful. If the aim is to produce some sort of fibre optic, draw towers are used to create glass fibres by heating and stretching a bulk material (or preform) to create long strands. The design and composition of this preform results in different abilities of the fibres once drawn out, such as stronger fibres, more efficient data transmission, or a broader available bandwidths for carrying information. Polishing involves reducing the surface roughness of a substrate by physical means. In the micro and nano worlds this is typically done to alter a surfaces optical properties, making it more reflective or transparent depending on the substrate.
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	3D Micromac - Microstruct-c (MQ)		3D Micromac - Microstruct-c	Picosecond laser facility - chasis and motion	2013					
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Aerotech Aerotech ABL1500 + Z + Theta (MQ)	Aerotech	Aerotech ABL1500 + Z + Theta	RegA 100kHz ultrafast laser facility - Motion	2010					
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Custom Ultrafast laser facility (MQ)	Custom	Ultrafast laser facility	Ti:Sapphire laser writing system (In-Kind facility)	2010	Ultrafast laser writing system	Laser engraving and cutting	Manufacturing and machining	Laser processing	Subtractive processes that use of lasers to create patterns on a substrate or to cut through a material.
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Nikon Nexiv (MQ)	Nikon	Nexiv	Quality Control CNC microscope	2014					
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Hitachi TM3030 (MQ)	Hitachi	TM3030	Benchtop SEM with Qantax EDS. Practical inspection and EDS up to 2000x mag.	2013	Desktop Scanning Electron Microscope (SEM)	Scanning Electron Microscopy (SEM)	Testing and validation	Scanning Electron Microscopy (SEM)	Scanning Electron Microscopy (SEM) is the process whereby a tightly focused electron beam is scanned onto the surface to be imaged. As the primary electrons hit the atoms in the surface, a number of secondary electrons are emitted, and collected by the instrument's detector, which assigns a level of grey accordingly, thereby creating a pixel for a digital image. The machines can routinely image features down to about 10nm, and in some special cases down to several nm in size. SEM is a key tool for process characterisation of surface topography. Most samples fabricated in the cleanroom undergoes at least one round of SEM imaging, in order to assess the quality of the fabrication and its defects. This information is fed into the process optimisation loop until a satisfying sample is produced. The tool is also used to image samples such as fixated cells and failed components.
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	LWE Q201 532nm Laser (MQ)		LWE Q201 532nm Laser	Nanosecond micromachining facility- laser	2003					
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Custom Nanosecond micromachining facility (MQ)	Custom	Nanosecond micromachining facility	532nm, 2mJ, nanosecond laser, Stages and Drilling optics. 266nm option available.	2003	532nm nanosecond laser with trepanning head	Laser engraving and cutting	Manufacturing and machining	Laser processing	Subtractive processes that use of lasers to create patterns on a substrate or to cut through a material.
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Spectra Physics Spectra Physics Hurricane (MQ)	Spectra Physics	Spectra Physics Hurricane	Femtosecond writing facility - Motion	2003					

Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Custom Femtosecond micromachining facility (MQ)	Custom	Femtosecond micromachining facility	800nm, 1030nm, 515nm, 257nm femtosecond laser sources, precision stages, objective lens delivery.	2011	Femtosecond laser writing system	Laser engraving and cutting	Manufacturing and machining	Laser processing	Subtractive processes that use of lasers to create patterns on a substrate or to cut through a material.
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Aerotech Aerotech ABL1000 + ANT50 (MQ)	Aerotech	Aerotech ABL1000 + ANT50	Femtosecond writing facility - Laser						
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Olympus BH DIC microscope (MQ)	Olympus	BH DIC microscope	Characterisation Facility - DIC Microscope	2003					
Optofab Node	Nano, Micro, Macro Optics fabrication	MQ	Seki AX6300 (MQ)	Seki	AX6300	CVD reactor for growing polydiamond films from methane/hydrogen chemistries.	2011	MPCVD system for deposition of diamond	Microwave Plasma-enhanced Chemical Vapour Deposition (MPCVD)	Deposition	Chemical Vapour Deposition (CVD)	MPCVD is a chemical vapour deposition process which uses a continuous microwave source to create and help to maintain a highly reactive plasma made up of the reacting chemicals and necessary catalysts. MPCVD is heavily used in the ANFF network to deposit layers of diamond – methane and hydrogen are introduced and used to grow new diamond on a diamond-seeded substrate. ANFF equipment can introduce dopants to the carbon structure while its being grown. These include boron which can create superconducting diamond, and nitrogen vacancies which can produce interesting photo-luminescence properties that are being exploited for quantum information systems.
Optofab Node	Nano, Micro, Macro Optics fabrication	MQ	Coherent Chameleon (MQ)	Coherent	Chameleon	Tuneable Ti:Saphire laser for optical charactersation and laser development tasks.	2008	Femtosecond laser source	Laser engraving and cutting	Manufacturing and machining	Laser processing	Subtractive processes that use of lasers to create patterns on a substrate or to cut through a material.
Optofab Node	Nano, Micro, Macro Optics fabrication	MQ	Fritch Ball Mill (MQ)	Fritch	Ball Mill	Mechanical ball mill for make micro/nano particle solutions. Zirconia and Tungsten Carbide grinding media in use	2012	Ball mill	Other milling	Manufacturing and machining	Milling	Various milling processes
Optofab Node	Integrated systems fabrication	MQ	NKT Photonics SuperK Super Continuum (MQ)	NKT Photonics	SuperK Super Continuum	Super continuum source for optical characterisation.	2011	Photonics Characterisation Suite - Source	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.
Optofab Node	Integrated systems fabrication	MQ	MTI Wafer Saw (MQ)	MTI	Wafer Saw	Polishing facilities - Wafer Saw						
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Hammatsu/Olympus RegA 100kHz ultrafast laser facility - ancillary optics (MQ)	Hammatsu/Olympus	RegA 100kHz ultrafast laser facility - ancillary optics	RegA 100kHz ultrafast laser facility - ancillary optics	2010					
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Aerotech ATS100 Stages (MQ)	Aerotech	ATS100 Stages	Nanosecond micromachining facility- Motion	2001					
Optofab Node	Additive and Subtractive 3d manufacturing?	MQ	Aerotech/Oxford Trepanning head (MQ)	Aerotech/Oxford	Trepanning head	Nanosecond micromachining facility- Motion	2009					
Optofab Node	Nano, Micro, Macro Optics fabrication	MQ	Jeol JSM 7100F (MQ)	Jeol	JSM 7100F	FESEM with cancellation cage and Kliendieck mounting plate available	2013	Field Emission Scanning Electron Microscope (FE-SEM)	Scanning Electron Microscopy (SEM)	Testing and validation	Scanning Electron Microscopy (SEM)	Scanning Electron Microscopy (SEM) is the process whereby a tightly focused electron beam is scanned onto the surface to be imaged. As the primary electrons hit the atoms in the surface, a number of secondary electrons are emitted, and collected by the instrument's detector, which assigns a level of grey accordingly, thereby creating a pixel for a digital image. The machines can routinely image features down to about 10nm, and in some special cases down to several nm in size. SEM is a key tool for process characterisation of surface topography. Most samples fabricated in the cleanroom undergoes at least one round of SEM imaging, in order to assess the quality of the fabrication and its defects. This information is fed into the process optimisation loop until a satisfying sample is produced. The tool is also used to image samples such as fixated cells and failed components.
Optofab Node	Nano, Micro, Macro Optics fabrication	MQ	Kleindieck MM3A (MQ)	Kleindieck	MM3A	Micro Manipulators	2013	Micro Manipulators	Scanning Electron Microscopy (SEM)	Testing and validation	Scanning Electron Microscopy (SEM)	Scanning Electron Microscopy (SEM) is the process whereby a tightly focused electron beam is scanned onto the surface to be imaged. As the primary electrons hit the atoms in the surface, a number of secondary electrons are emitted, and collected by the instrument's detector, which assigns a level of grey accordingly, thereby creating a pixel for a digital image. The machines can routinely image features down to about 10nm, and in some special cases down to several nm in size. SEM is a key tool for process characterisation of surface topography. Most samples fabricated in the cleanroom undergoes at least one round of SEM imaging, in order to assess the quality of the fabrication and its defects. This information is fed into the process optimisation loop until a satisfying sample is produced. The tool is also used to image samples such as fixated cells and failed components.
Optofab Node	Integrated systems fabrication	MQ	Various Thorlabs laser sources (MQ)		Various Thorlabs laser sources	Photonics Characterisation Suite - sources	2011					
Optofab Node	Integrated systems fabrication	MQ	MTI Saw (MQ)	MTI	Saw	Diamond wire saw and Wafer Saw for preparing small samples of glass from ingots or wafers	2012	Diamond wire saw and Wafer Saw	Wafer dicing	Packaging	Wafer processing	Nanofabricated devices are generally made in batches on wafers and need to be separated or packaged before use. This separation can be achieved through wet or dry dicing. In a wet dicing operation, a precision, high-speed, diamond impregnated blade is used to mill narrow grooves between the devices either partially or completely through the wafer. During this process, water is circulated over the cutting surface to cool the blade and prevent the liberation of dangerous particulates into the air. Materials which would be damaged by water are diced using a dry process known as scribing. Scribing utilises a diamond tipped stylus which is drawn across the wafer surface creating lines of high-stress which are later broken over precision fulcrum.
Optofab Node	Integrated systems fabrication	MQ	Nanomax Positioners x2, racks (MQ)	Nanomax	Positioners x2, racks	Photonics Characterisation Suite - positioners	2011					
Optofab Node	Integrated systems fabrication	MQ	Logitech PM5 Auto-lap (MQ)	Logitech	PM5 Auto-lap	Optical polishing for end faces and small surfaces of glass devices	2011	Optical polishing	Glass working	Manufacturing and machining	Optical fibre pulling and processing	Once a bulk glass material has been produced, it has to be made into something useful. If the aim is to produce some sort of fibre optic, draw towers are used to create glass fibres by heating and stretching a bulk material (or preform) to create long strands. The design and composition of this preform results in different abilities of the fibres once drawn out, such as stronger fibres, more efficient data transmission, or a broader available bandwidths for carrying information. Polishing involves reducing the surface roughness of a substrate by physical means. In the micro and nano worlds this is typically done to alter a surfaces optical properties, making it more reflective or transparent depending on the substrate.
Optofab Node	Integrated systems fabrication	MQ	Nanomax Positioners (MQ)	Nanomax	Positioners	Photonics Characterisation Suite - Manual	2011					
Victorian Node	Device/systems integration and packaging	RMIT	Ceramic Materials Characterisation (RMIT)		Ceramic Materials Characterisation	Various tools for Rheology and dielectric characterisation						
Victorian Node	Biointerface engineering	Swinburne	Dip Coater (Swinburne)		Dip Coater	Thin film preparation	2011					
Victorian Node	Biointerface engineering	Swinburne	Expanded Plasma Polymersiation Facilities (Swinburne)		Expanded Plasma Polymersiation Facilities	Surface teatment facility	2011					
Victorian Node	Biointerface engineering	Swinburne	IR Spectrometer (Swinburne)		IR Spectrometer	Optical characterisation	2011					

Victorian Node	Biointerface engineering	Swinburne	Langmuir Blodgett (Swinburne)		Langmuir Blodgett	Thin film preparation	2012					
Victorian Node	Biointerface engineering	Swinburne	Spectroscopic Ellipsometer (Swinburne)		Spectroscopic Ellipsometer	Ellipsometric thin film characterisation	2012					
Victorian Node	High-throughput, multi-scale, precision micro and nanodevice fabrication	UniMelb	DataPhysics OCA-20 (UniMelb)	DataPhysics	OCA-20	Video-based contact angle measurement.	2006	Optical contact angle analyser	Contact angle analysis	Testing and validation	Topological analysis and surface profiling	Observing the contact angle of a liquid on a samples surface can be a simple way of determining a samples hydrophobicity. To measure this many contact angle analysers use a high resolution camera to take an image, then use specific software to interpret the photo and provide the angle of contact. It is often used in conjunction with other surface analysis techniques to paint a complete picture of surface behaviour based on a sample's surface chemistry and roughness.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	Dell Precision 7910 (UniSA)	Dell	Precision 7910	Computer suite with access to an extensive suite of advanced software tools including Synopsys, Intellisense, Coventor, TannerEDA Solidworks, Inventor, AutoCAD and Computational Fluid Dynamics simulation using ANSYS	2014	Advanced design and modelling capability suite	Software packages	Modelling and device design	CAD	Through ANFF, users can access software packages for designing new devices, simulating complex systems, producing 3D or virtual reality models, or a number of other purposes.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	Lyncee Tec T1001 (UniSA)	Lyncee Tec	T1001	Widely used for imaging of channel geometries in microfluidic devices for process control quality assurance and product validation. It can be used to assist in the static and dynamic 3D characterisation of samples and quantitative characterisation of cells (including live cells). Gives information on specimen surface, shape, material and internal structure or defects. Other applications include: defect inspection, MEMS measurement, surface topography, surface finish and structured thin films.	2011	Digital holographic microscope	Digital holographic microscopy	Testing and validation	Microscopy	DHM relies on computing power to interpret an interference pattern produced by shining a laser onto a sample to produce a three dimensional image.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	Disco DAD 321 (UniSA)	Disco	DAD 321	Wafer dicer capable of dicing 6-inch wafers	2001	Wafer dicer	Wafer dicing	Packaging	Wafer processing	Nanofabricated devices are generally made in batches on wafers and need to be separated or packaged before use. This separation can be achieved through wet or dry dicing. In a wet dicing operation, a precision, high-speed, diamond impregnated blade is used to mill narrow grooves between the devices either partially or completely through the wafer. During this process, water is circulated over the cutting surface to cool the blade and prevent the liberation of dangerous particulates into the air. Materials which would be damaged by water are diced using a dry process known as scribing. Scribing utilises a diamond tipped stylus which is drawn across the wafer surface creating lines of high-stress which are later broken over precision fulcrum.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	ASPEX PSEM eXpress (UniSA)	ASPEX	PSEM eXpress	A simple to operate SEM with an intuitive user interface. No special sample preparation required, it operates in both low and high vacuum modes and has four settings for accelerating voltage. Suitable for a variety of applications depending upon material. Features a large stage allows travel of up to 80 mm x 120 mm and a magnification of up to 40,000 times is possible.	2010	Desktop Scanning Electron Microscope (SEM)	Scanning Electron Microscopy (SEM)	Testing and validation	Scanning Electron Microscopy (SEM)	Scanning Electron Microscopy (SEM) is the process whereby a tightly focused electron beam is scanned onto the surface to be imaged. As the primary electrons hit the atoms in the surface, a number of secondary electrons are emitted, and collected by the instrument's detector, which assigns a level of grey accordingly, thereby creating a pixel for a digital image. The machines can routinely image features down to about 10nm, and in some special cases down to several nm in size. SEM is a key tool for process characterisation of surface topography. Most samples fabricated in the cleanroom undergoes at least one round of SEM imaging, in order to assess the quality of the fabrication and its defects. This information is fed into the process optimisation loop until a satisfying sample is produced. The tool is also used to image samples such as fixated cells and failed components.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	HHV TF500 (UniSA)	HHV	TF500	A 3 magnetron sputtering system for the deposition of high quality (pinhole free) metal layers. Able to accommodate up to 6 inch diameter substrates. Fitted with three sputter sources with a switching system to select from DC or RF power supplies. Multilayer deposition can be performed without breaking vacuum.	2012	Sputtering system	Sputtering	Deposition	Physical Vapour Deposition (PVD)	Sputtering is a physical vapour deposition method that involves depositing thin films in a vacuum environment. During this process, a solid material and substrate are positioned separately within a vacuum system. A high-energy argon ion plasma stream is targeted at the material, resulting in the subject material being ejected and deposited onto the substrate, creating a thin film. As this is not an evaporative process, the temperatures required for sputtering are lower than evaporation methods. This makes it one of the most flexible deposition processes and it is particularly useful for depositing materials with a high melting point or a mixture of materials, as compounds that may evaporate at different rates, can be sputtered at the same rate. Certain processes will benefit from improved film adhesion due to higher impact energy. The sputtering process is used extensively in the semiconductor industry, screen displays, photovoltaics and magnetic data storage. Sputtering can be used to deposit a wide variety of thin films including metals, oxides, nitrides and alloys.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	R.D. Webb Red Devil (UniSA)	R.D. Webb	Red Devil	High temperature (1,200°C) vacuum or inert gas furnace for bonding and heat treatments.	2011	Vacuum Furnace	Annealing	Materials synthesis and modification	Material modification	Annealing is a process that can reduce residual stress in a substrate that has accumulated during prior processes such as deposition. The material is heated to high temperatures and allowed to cool at a controlled rate. This allows the material's crystal structure to relax into a less intrinsically stressed state, and to settle into a more desirable microstructure as it cools.

South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	EVG 620 (UniSA)	EVG	620	High resolution double side mask aligner with split-field microscopes which is capable of handling multiple wafer sizes with quick change-over time. Capable of processing ceramics, glasses, metals, polymers and semiconductors	2009	Mask aligner and resist exposure system with NIL capability	Multiple mask lithography	Lithography	Photolithography	Photolithography is used to create a pattern on a substrate by shining light from a light source onto a photoresist that coats the surface of the substrate through a photomask and is followed by a development phase. Depending on the complexity of a device's design, various deposition, etching and lithography processes can be cycled through many times. This could mean that more than one photolithography stage is required, potentially dozens, and each iteration could require a new mask. Each mask used has to be aligned perfectly to the previously processed layer if the final device is to operate as desired. To do this, photomasks are often made to feature alignment marks, but to assist with accuracy, mask aligners are commonly used to ensure things line up. These mask aligning systems also offer a great deal of control over the exposure settings and conditions in which the photolithography process takes place.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	EVG 520 (UniSA)	EVG	520	Designed for bonding, embossing and nanoimprinting applications the system can thermally bond glass substrates and emboss channel geometries into substrates.	2009	Substrate bonder	Wafer bonding	Packaging	Bonding	Bonding a wafer to another wafer is a step commonly used when packaging components in an micro or nanoelectrical device. It can help a form new functions in a device, or can ensure mechanical and hermetic encapsulation of devices and electronics. The result is irreversible. Common bonding methods include using heat or with an adhesive for thermally sensitive samples.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	Ulvac NLD-570 (UniSA)	Ulvac	NLD-570	Capable of deep etching features from the nano to micron scale.	2009	Deep reactive ion etcher (DRIE)	Deep Reactive Ion Etching (DRIE)	Etching	Dry Etching	Deep Reactive Ion Etching (DRIE) is effectively an extension of the Reactive Ion Etching (RIE) process, but can provide higher aspect ratio structures. The DRIE process alternates between etch and passivation cycles to allow patterns to be cut deeper into a substrate. Etch channels or other feature geometries with extremely high uniformity into glass, plastic or silicon substrates
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	Dilase 650 (UniSA)	Dilase	650	This equipment offers you the possibility to work with one or two writing lasers, to be focused into one to two beam sizes ranging from 1µm to 50 µm. Writes over a surface area as large as 6 x 6 inches.	2014	Direct laser lithography system	Direct laser lithography	Lithography	Direct Write Lithography	Laser processing uses a highly controlled and focused beam of high-energy photons of the same wavelength to burn away material. These processes are repeatable, scalable and cheap, but can induce thermal stresses on the substrate, and resolutions tend to be in the micrometre regime. Laser processing is often used within ANFF to create masks for later lithography steps, but it can also be used to create patterns directly into the substrate itself, skipping several ordinary fabrication steps.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	Suss Delta 80 (UniSA)	Suss	Delta 80	Used to evenly and repeatably coat substrates with polymer films	2009	Spin coater	Spin coating and wafer development	Lithography	Support systems	Spin coaters are capable of applying uniform thickness polymer films, such as a resist to substrates. Resist is essential for many types of lithography, such as UV lithography. Resists are termed either positive or negative -- this denotes whether, when cured, chemical bonds are made or broken, and therefore whether the sections of resist that remain are either the true pattern, or it's inverse. This selection must be considering etching or deposition stages that may follow as it will help to make.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	Emitech 975K MVD (UniSA)	Emitech	975K MVD	A thermal evaporator with two evaporation sources	2007	Thermal evaporator	Thermal evaporation	Deposition	Physical Vapour Deposition (PVD)	Thermal Evaporation is one of the simplest forms of physical vapor deposition (PVD). It uses heat to evaporate a high purity source material that moves through a vacuum chamber and deposits a thin film on a substrate. Thermal evaporation can be used to deposit metals, organic, and inorganic polymers. In this method, electrical energy is used to heat a filament which in turn heats a deposition material to the point of evaporation. The process can be performed at very high levels of vacuum to eliminate collisions with foreign particles and therefore fewer tendencies to introduce film impurities. High deposition rates can be achieved and lower energy particles can reduce substrate damage. Thermal evaporation is widely used when creating polymer solar cells and flexible electronics.
South Australian Node	Lab-on-a-chip, Microfluidic chip fabrication, integration and interfacing	UniSA	Cleanroom Class 1,000 (UniSA)	Cleanroom	Class 1,000	Controlled 28m2 cleanroom environment	2008	Class 1,000 cleanroom space	Cleanroom spaces	Laboratory infrastructure	Specialised environments	A cleanroom is a highly purified environment, containing as few as 100 "dirty" particles in one cubic foot of air -- a cubic foot of air on a typical street can contain approximately 350 million of dirty particles. Cleanrooms are essential to creating micro and nanotechnologies. Considering that the scale of most of the structures and devices made using micro or nanofabrication processes is 10's of thousands times smaller than a human hair, dust and dirt can ruin a sample. cleanroom suits are required for entry into these controlled spaces, not to protect the user from the samples, but rather to protect the samples from the user. However, temperature changes and lighting conditions can also ruin these delicate structures as they are being made. Cleanrooms are engineered to force potential contaminants from the local atmosphere, also maintaining consistent temperatures, and controlling lighting conditions.
South Australian Node	Chip prototyping and pre-manufacturing capability (prototype to production)	UniSA	Kira SuperMill 2M (UniSA)	Kira	SuperMill 2M	The system provides true simultaneous 3-dimensional interpretation of structures, 10nm precision on its dual spindles, a 50,000rpm main spindle and a 120,000rpm finishing spindle in a +/- 1 degree Celsius temperature controlled environment.	2009	MicroCNC Mill	Computer Numerical Control (CNC) milling	Manufacturing and machining	Milling	CNC milling is a conventional manufacturing technique that uses a computer to control a milling cutter. It can be used to precisely machine geometries and features into a substrate, or to mill hot embossing stamps and jigs that may be used to fabricate microstructured features in devices. The equipment typically mills material in either two or three axes, processing wood, metal, ceramics or plastics depending on the cutter that is used.
South Australian Node	Chip prototyping and pre-manufacturing capability (prototype to production)	UniSA	Juken JMW-027S-20t (UniSA)	Juken	JMW-027S-20t	Capable of batch scale production of macro and micro featured plastic components. Used when manufacturing a wide variety of precision plastic components that require a high degree of accuracy and durability.	2017	Micro-injection moulder	Microinjection moulding	Manufacturing and machining	Injection moulding	Injection moulding is an incredibly repeatable production technique, with parts being made by pouring molten material into a mould and letting it set. Microinjection moulding has taken this practice and reduces the scale by an order of magnitude to reliably create parts that feature structures that measure micrometres in size. The resolution of this process makes it ideal for the batch production and scale up of microfluidic devices for prototyping and testing purposes. Making injection moulding microscale requires intense control of injection pressure, temperature, and the ability to fabricate intricate moulds.
South Australian Node	Chip prototyping and pre-manufacturing capability (prototype to production)	UniSA	Zeiss Xradia MicroXCT 400 (UniSA)	Zeiss	Xradia MicroXCT 400	Ultra-high resolution CT scanner for 3D visualisation of microscopic sample volumes. A fully automated non-destructive technique with 3D resolution down to 1µm.	2017	Micron-scale 3D x-ray tomography system	X-ray scanning	Modelling and device design	3D modelling	X-ray scanning provides non-destructive imaging of complex internal structures, offering insight into deeply buried micro and nanostructures that may be unobservable with 2D imaging techniques such as optical microscopy, SEM and AFM. These capabilities, in particular micro and nanotomography, enable highly efficient examination of components during development or when analysing a fault. For life sciences, the equipment can be used to inspect the internal structure of biological specimens, such as bone, soft tissue, and biomedical devices with resolution down to 50 nm on some tools.

South Australian Node	3D Imaging, surface profiling and CT Characterisation	UniSA	Zeiss Xradia NanoXCT 200 (UniSA)	Zeiss	Xradia NanoXCT 200	Ultra-high resolution CT scanner for 3D visualisation of microscopic sample volumes with down to 50nm resolution. Outstanding images can be obtained from both low and high atomic number materials, composites, polymers and biological samples without the addition of contrasting agents. The associated software allows calculation of pore size, continuity calculations, density and standard surface metrology evaluation.	2011	Nanometre-scale 3D x-ray tomography system	X-ray scanning	Modelling and device design	3D modelling	X-ray scanning provides non-destructive imaging of complex internal structures, offering insight into deeply buried micro and nanostructures that may be unobservable with 2D imaging techniques such as optical microscopy, SEM and AFM. These capabilities, in particular micro and nanotomography, enable highly efficient examination of components during development or when analysing a fault. For life sciences, the equipment can be used to inspect the internal structure of biological specimens, such as bone, soft tissue, and biomedical devices with resolution down to 50 nm on some tools.
South Australian Node	3D Imaging, surface profiling and CT Characterisation	UniSA	Veeco Wyko NT9100 (UniSA)	Veeco	Wyko NT9100	Provides 3D imaging of channel geometries for process control quality assurance and product validation. Capable of taking sub-nanometre to millimetre-high steps in the z dimension.	2009	Optical profilometer	Optical profilometry	Testing and validation	Profilometry	Optical profilometry is a non-contact form of profilometry that can be used to characterise the surface steps and the roughness of a material. Optical profilometry employs phase-shifting and/or vertical scanning interferometry to resolve the topology of complex 3D structures. The technique marries precision z-axis control with interference-based techniques to resolve features from the angstrom to millimetre scale. The technique lends itself well to die-based measurements for ISO/QA and large area mapping. Profilometry is useful in process control steps such as measuring etch depth and lithography patterns.
South Australian Node	3D Imaging, surface profiling and CT Characterisation	UniSA	Nikon Instruments Ti-U (UniSA)	Nikon Instruments	Ti-U	Inverted microscope with reflected and transmitted light source	2012	Optical microscope	Optical microscopy	Testing and validation	Microscopy	A fundamental form of sample analysis, optical microscopy uses a series of lenses to focus light that is reflected from or passed through a sample. Various forms of light and magnification can be used to visualise the sample.
South Australian Node	3D Imaging, surface profiling and CT Characterisation	UniSA	PlasmaTech V50 (UniSA)	PlasmaTech	V50	Used primarily for ashing photoresist materials from substrates.	2003	Plasma asher	Cleaning	Lithography	Support systems	Cleaning, an essential step when operating on the micro and nanoscale, is used to remove contaminants from the surface of the substrate before it is used in another fabrication process. This sometimes means simply burning away material, often using an asher to do this. Ashers use heat to remove unwanted material, such as photoresist. They are often used to clean a wafer, although they can sometimes be used to selectively etch away material as well.
New South Wales Node	Advanced Lithography	UNSW	FEI Sirion (UNSW)	FEI	Sirion	EBL system, NPGS pattern generator, small write fields	2003	Electron beam lithography (EBL) system	Electron Beam Lithography (EBL)	Lithography	Direct Write Lithography	Electron Beam Lithography (EBL) allows users to write patterns with extremely high resolution, smaller than 10nm in size. It makes use of a highly energetic, tightly focused electron beam, which is scanned over a sample coated with an electron-sensitive resist. The electron beam scans the image according to a pattern defined on a CAD file. The sample is then developed in an appropriate solvent which reveals the structures defined into the resist. This acts as a mould for subsequent pattern transfer techniques such as dry etching or metal lift-off. Due to the high-resolution nature of the technique, EBL has a vast range of applications including nano-electronics, photonics, plasmonics, nano-fluidics, MEMS, x-ray and neutron optics.
New South Wales Node	Advanced Lithography	UNSW	Cleanroom ISO 5 (UNSW)	Cleanroom	ISO 5	West infrastructure	2009	Class 100 cleanroom space	Cleanroom spaces	Laboratory infrastructure	Specialised environments	A cleanroom is a highly purified environment, containing as few as 100 "dirty" particles in one cubic foot of air -- a cubic foot of air on a typical street can contain approximately 350 million of dirty particles. Cleanrooms are essential to creating micro and nanotechnologies. Considering that the scale of most of the structures and devices made using micro or nanofabrication processes is 10's of thousands times smaller than a human hair, dust and dirt can ruin a sample. cleanroom suits are required for entry into these controlled spaces, not to protect the user from the samples, but rather to protect the samples from the user. However, temperature changes and lighting conditions can also ruin these delicate structures as they are being made. Cleanrooms are engineered to force potential contaminants from the local atmosphere, also maintaining consistent temperatures, and controlling lighting conditions.
New South Wales Node	MOS Process line	UNSW	Oxford Instruments Plasmalab 100 (UNSW)	Oxford Instruments	Plasmalab 100	RIE, 'clean' Si processes	2014	Reactive ion etcher (RIE)	Reactive Ion Etching (RIE)	Etching	Dry Etching	Reactive Ion Etching (RIE) is a method that combines both chemical and physical etching to allow isotropic and anisotropic material removal. The etching process is carried out in a chemically reactive plasma containing positively and negatively charged ions generated from gases that are pumped into the reaction chamber. A mask on top of the substrate is used to protect designated areas from etching, exposing only the areas to be etched. Dry etching offers excellent process control for cleanliness, homogeneity, etch-rate, etch-profile, selectivity and run-to-run consistency, which is critical for high-fidelity pattern-transfer in micro- and nano-system technologies. RIE is extensively used in the field of displays & lighting (LEDs), semiconductors, electronics, MEMS, communication technology, microfluidics, optoelectronics and photovoltaics.
New South Wales Node	MOS Process line	UNSW	IBS IMC-200 (UNSW)	IBS	IMC-200	ion implanter	2016	Ion implanter	Ion implantation, doping and diffusion	Materials synthesis and modification	Material modification	Incorporating a dopant can allow a material to take on novel features – this could include changing a material's hardness, reactivity, optical and electrical properties, or any number of other adjustments. To introduce the impurity, the substrate is typically heated, or the new material is propelled into the sample.
New South Wales Node	MOS Process line	UNSW	Cleanroom ISO 5 (UNSW)	Cleanroom	ISO 5	East infrastructure	2009	Class 100 cleanroom space	Cleanroom spaces	Laboratory infrastructure	Specialised environments	A cleanroom is a highly purified environment, containing as few as 100 "dirty" particles in one cubic foot of air -- a cubic foot of air on a typical street can contain approximately 350 million of dirty particles. Cleanrooms are essential to creating micro and nanotechnologies. Considering that the scale of most of the structures and devices made using micro or nanofabrication processes is 10's of thousands times smaller than a human hair, dust and dirt can ruin a sample. cleanroom suits are required for entry into these controlled spaces, not to protect the user from the samples, but rather to protect the samples from the user. However, temperature changes and lighting conditions can also ruin these delicate structures as they are being made. Cleanrooms are engineered to force potential contaminants from the local atmosphere, also maintaining consistent temperatures, and controlling lighting conditions.
New South Wales Node	MOS Process line	UNSW	Thermco UDOX (UNSW)	Thermco	UDOX	UDOX ultra-clean Si oxidation furnace (MOS)	<1995	Ultra dry oxidation (UDOX) furnace for Si only	Furnaces	Materials synthesis and modification	Material modification	High temperature furnaces used to melt materials to create glass fibre fabrication.
New South Wales Node	MOS Process line	UNSW	Thermco oxidation furnace (UNSW)	Thermco	oxidation furnace	clean Si oxidation furnace	<1995	Oxidation furnace for Si only	Furnaces	Materials synthesis and modification	Material modification	High temperature furnaces used to melt materials to create glass fibre fabrication.

New South Wales Node	MOS Process line	UNSW	Thermco boron diffusion (UNSW)	Thermco	boron diffusion	boron diffusion furnace	<1995	Furnace for diffusion of boron	Ion implantation, doping and diffusion	Materials synthesis and modification	Material modification	Incorporating a dopant can allow a material to take on novel features – this could include changing a material's hardness, reactivity, optical and electrical properties, or any number of other adjustments. To introduce the impurity, the substrate is typically heated, or the new material is propelled into the sample.
New South Wales Node	MOS Process line	UNSW	Thermco phosphorus diffusion (UNSW)	Thermco	phosphorus diffusion	phosphorus diffusion furnace	<1995	Furnace for diffusion of phosphorus	Ion implantation, doping and diffusion	Materials synthesis and modification	Material modification	Incorporating a dopant can allow a material to take on novel features – this could include changing a material's hardness, reactivity, optical and electrical properties, or any number of other adjustments. To introduce the impurity, the substrate is typically heated, or the new material is propelled into the sample.
New South Wales Node	MOS Process line	UNSW	Thermco GP annealing (UNSW)	Thermco	GP annealing	general purpose anneal furnace	<1995	General purpose furnace	Annealing	Materials synthesis and modification	Material modification	Annealing is a process that can reduce residual stress in a substrate that has accumulated during prior processes such as deposition. The material is heated to high temperatures and allowed to cool at a controlled rate. This allows the material's crystal structure to relax into a less intrinsically stressed state, and to settle into a more desirable microstructure as it cools.
New South Wales Node	MOS Process line	UNSW	Thermco clean silicon annealing (UNSW)	Thermco	clean silicon annealing	clean anneal furnace (MOS)	<1995	Furnace	Annealing	Materials synthesis and modification	Material modification	Annealing is a process that can reduce residual stress in a substrate that has accumulated during prior processes such as deposition. The material is heated to high temperatures and allowed to cool at a controlled rate. This allows the material's crystal structure to relax into a less intrinsically stressed state, and to settle into a more desirable microstructure as it cools.
New South Wales Node	MOS Process line	UNSW	Neutronix Quintel Q6000 (UNSW)	Neutronix Quintel	Q6000	UV mask aligner	<1995	Mask aligner and resist exposure system	Multiple mask lithography	Lithography	Photolithography	Photolithography is used to create a pattern on a substrate by shining light from a light source onto a photoresist that coats the surface of the substrate through a photomask and is followed by a development phase. Depending on the complexity of a device's design, various deposition, etching and lithography processes can be cycled through many times. This could mean that more than one photolithography stage is required, potentially dozens, and each iteration could require a new mask. Each mask used has to be aligned perfectly to the previously processed layer if the final device is to operate as desired. To do this, photomasks are often made to feature alignment marks, but to assist with accuracy, mask aligners are commonly used to ensure things line up. These mask aligning systems also offer a great deal of control over the exposure settings and conditions in which the photolithography process takes place.
New South Wales Node	MOS Process line	UNSW	Digital Instruments DI3000 (UNSW)	Digital Instruments	DI3000	More information to come	2001	Atomic force microscope (AFM)	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
New South Wales Node	MOS Process line	UNSW	Jipelec Jetfirst (UNSW)	Jipelec	Jetfirst	rapid thermal annealer	2002	Rapid thermal annealer	Annealing	Materials synthesis and modification	Material modification	Annealing is a process that can reduce residual stress in a substrate that has accumulated during prior processes such as deposition. The material is heated to high temperatures and allowed to cool at a controlled rate. This allows the material's crystal structure to relax into a less intrinsically stressed state, and to settle into a more desirable microstructure as it cools.
New South Wales Node	MOS Process line	UNSW	STS ICP-DRIE (UNSW)	STS	ICP-DRIE	ICP-RIE	2007	Inductively coupled plasma (ICP) reactive ion etcher	Reactive Ion Etching (RIE)	Etching	Dry Etching	Reactive Ion Etching (RIE) is a method that combines both chemical and physical etching to allow isotropic and anisotropic material removal. The etching process is carried out in a chemically reactive plasma containing positively and negatively charged ions generated from gases that are pumped into the reaction chamber. A mask on top of the substrate is used to protect designated areas from etching, exposing only the areas to be etched. Dry etching offers excellent process control for cleanliness, homogeneity, etch-rate, etch-profile, selectivity and run-to-run consistency, which is critical for high-fidelity pattern-transfer in micro- and nano-system technologies. RIE is extensively used in the field of displays & lighting (LEDs), semiconductors, electronics, MEMS, communication technology, microfluidics, optoelectronics and photovoltaics.
New South Wales Node	Device packaging and integration	UNSW	Kulicke & Soffa 4523 (UNSW)	Kulicke & Soffa	4523	Al wedge bonder	<1995	Wedge bonder	Wire bonding	Packaging	Bonding	Wire bonding is the part of the fabrication that allows an electrical component to communicate with the outside world. A thin electrically conductive wire – typically gold, aluminium, copper or silver – is used to allow electricity to flow from contacts on the component to, or from, its packaging. There are two commonly used types of wire bonding – wedge and ball. Which one is more suitable depends on the substrate, the contact material, the bonding material, and a number of other physical factors. Bonders can be manual or automated, and some can feature pattern recognition software to help speed the bonding process up.
New South Wales Node	Materials-specific etch & depo	UNSW	Oxford Instruments Plasmalab 100 (UNSW)	Oxford Instruments	Plasmalab 100	PECVD	2014	Plasma enhanced chemical vapour deposition system (PECVD)	Plasma Enhanced Chemical Vapour Deposition (PECVD)	Deposition	Chemical Vapour Deposition (CVD)	Plasma Enhanced Chemical Vapour Deposition (PECVD) uses a plasma to deposit a thin film of silicon dioxide or silicon nitrate onto a substrate. PECVD uses lower temperatures than the furnace systems to achieve an insulating layer on a variety of materials. PECVD is used in optics, microelectronics, energy applications, packaging and chemistry for the deposition of anti-reflective coatings, scratch resistant transparent coatings, electronically active layers, passivation layers, dielectric layers, isolating layers, etch stop layers, encapsulation and chemical protective coatings.
New South Wales Node	Materials-specific etch & depo	UNSW	Cambridge NanoTech Savannah S200 (UNSW)	Cambridge NanoTech	Savannah S200	ALD system, two precursor sources	2011	Atomic layer deposition (ALD) system with two precursor sources	Atomic Layer Deposition (ALD)	Deposition	Atomic Layer Deposition (ALD)	Atomic Layer Deposition (ALD) involves the deposition of materials one atomic monolayer at a time. It forms extremely uniform, conformal, pin-hole-free coatings even on high-aspect-ratio structures. This is achieved by pulsing a chemical precursor onto a hydroxylated substrate surface which reacts, resulting in a monolayer of material to be formed. The unused precursor is purged from the chamber and then the surface is again hydroxylated with water vapour or oxygen, followed by another purge. These steps are then repeated until the desired thickness of material is achieved. ALD has a vast array of applications from semiconductors, MEMS, nanostructures and optics through to wear-resistant coatings.

New South Wales Node	Materials-specific etch & depo	UNSW	HHV TF600 (UNSW)	HHV	TF600	sputtering system, 8" capability, multi-target, co-sputtering	2011	Sputtering system	Sputtering	Deposition	Physical Vapour Deposition (PVD)	Sputtering is a physical vapour deposition method that involves depositing thin films in a vacuum environment. During this process, a solid material and substrate are positioned separately within a vacuum system. A high-energy argon ion plasma stream is targeted at the material, resulting in the subject material being ejected and deposited onto the substrate, creating a thin film. As this is not an evaporative process, the temperatures required for sputtering are lower than evaporation methods. This makes it one of the most flexible deposition processes and it is particularly useful for depositing materials with a high melting point or a mixture of materials, as compounds that may evaporate at different rates, can be sputtered at the same rate. Certain processes will benefit from improved film adhesion due to higher impact energy. The sputtering process is used extensively in the semiconductor industry, screen displays, photovoltaics and magnetic data storage. Sputtering can be used to deposit a wide variety of thin films including metals, oxides, nitrides and alloys.
New South Wales Node	Materials-specific etch & depo	UNSW	Lesker thermal evaporator (UNSW)	Lesker	thermal evaporator	thermal evaporator, general purpose	<1995	Thermal evaporator	Thermal evaporation	Deposition	Physical Vapour Deposition (PVD)	Thermal Evaporation is one of the simplest forms of physical vapor deposition (PVD). It uses heat to evaporate a high purity source material that moves through a vacuum chamber and deposits a thin film on a substrate. Thermal evaporation can be used to deposit metals, organic, and inorganic polymers. In this method, electrical energy is used to heat a filament which in turn heats a deposition material to the point of evaporation. The process can be performed at very high levels of vacuum to eliminate collisions with foreign particles and therefore fewer tendencies to introduce film impurities. High deposition rates can be achieved and lower energy particles can reduce substrate damage. Thermal evaporation is widely used when creating polymer solar cells and flexible electronics.
New South Wales Node	Materials-specific etch & depo	UNSW	Edwards 306 thermal evaporator (UNSW)	Edwards	306 thermal evaporator	thermal evaporator, angled evaporation stage, cold evaporation stage	2003	Thermal evaporator with angled and cold evaporation stages	Thermal evaporation	Deposition	Physical Vapour Deposition (PVD)	Thermal Evaporation is one of the simplest forms of physical vapor deposition (PVD). It uses heat to evaporate a high purity source material that moves through a vacuum chamber and deposits a thin film on a substrate. Thermal evaporation can be used to deposit metals, organic, and inorganic polymers. In this method, electrical energy is used to heat a filament which in turn heats a deposition material to the point of evaporation. The process can be performed at very high levels of vacuum to eliminate collisions with foreign particles and therefore fewer tendencies to introduce film impurities. High deposition rates can be achieved and lower energy particles can reduce substrate damage. Thermal evaporation is widely used when creating polymer solar cells and flexible electronics.
New South Wales Node	Materials-specific etch & depo	UNSW	Custom Reactive Ion Etcher (UNSW)	Custom	Reactive Ion Etcher	hollow-cathode RIE, general purpose	<1995	Hollow-cathode RIE	Reactive Ion Etching (RIE)	Etching	Dry Etching	Reactive Ion Etching (RIE) is a method that combines both chemical and physical etching to allow isotropic and anisotropic material removal. The etching process is carried out in a chemically reactive plasma containing positively and negatively charged ions generated from gases that are pumped into the reaction chamber. A mask on top of the substrate is used to protect designated areas from etching, exposing only the areas to be etched. Dry etching offers excellent process control for cleanliness, homogeneity, etch-rate, etch-profile, selectivity and run-to-run consistency, which is critical for high-fidelity pattern-transfer in micro- and nano-system technologies. RIE is extensively used in the field of displays & lighting (LEDs), semiconductors, electronics, MEMS, communication technology, microfluidics, optoelectronics and photovoltaics.
New South Wales Node	Materials-specific etch & depo	UNSW	Edwards sputterer (UNSW)	Edwards	sputterer	sputtering system, short throw (thick depositions)	<1995	Sputtering system	Sputtering	Deposition	Physical Vapour Deposition (PVD)	Sputtering is a physical vapour deposition method that involves depositing thin films in a vacuum environment. During this process, a solid material and substrate are positioned separately within a vacuum system. A high-energy argon ion plasma stream is targeted at the material, resulting in the subject material being ejected and deposited onto the substrate, creating a thin film. As this is not an evaporative process, the temperatures required for sputtering are lower than evaporation methods. This makes it one of the most flexible deposition processes and it is particularly useful for depositing materials with a high melting point or a mixture of materials, as compounds that may evaporate at different rates, can be sputtered at the same rate. Certain processes will benefit from improved film adhesion due to higher impact energy. The sputtering process is used extensively in the semiconductor industry, screen displays, photovoltaics and magnetic data storage. Sputtering can be used to deposit a wide variety of thin films including metals, oxides, nitrides and alloys.
New South Wales Node	Advanced materials growth	UNSW	Veeco Gen930 (UNSW)	Veeco	Gen930	III-V MBE system	2014	Molecular Beam Epitaxy (MBE) system for III-V materials	Molecular Beam Epitaxy (MBE)	Deposition	Physical Vapour Deposition (PVD)	Molecular Beam Epitaxy is a deposition technique that allows for crystals to be grown with extremely high purity. The process allows for subnanometre control over the structure of the crystal as it's grown and positioning of dopants within the material, as well as film thickness. A series of molecular beams are directed onto a heated crystalline substrate. Upon collision with the substrate, the molecules in the beam bind, forming a new crystal layer. The entire growth occurs in an ultra high vacuum and there is no chemical mixing before the beams reach the substrate surface.
New South Wales Node	Advanced materials growth	UNSW	Pascal Laser MBE (UNSW)	Pascal	Laser MBE	dual chamber laser-MBE system	2014	dual chamber laser-MBE system	Molecular Beam Epitaxy (MBE)	Deposition	Physical Vapour Deposition (PVD)	Molecular Beam Epitaxy is a deposition technique that allows for crystals to be grown with extremely high purity. The process allows for subnanometre control over the structure of the crystal as it's grown and positioning of dopants within the material, as well as film thickness. A series of molecular beams are directed onto a heated crystalline substrate. Upon collision with the substrate, the molecules in the beam bind, forming a new crystal layer. The entire growth occurs in an ultra high vacuum and there is no chemical mixing before the beams reach the substrate surface.
New South Wales Node	Advanced Lithography	UNSW	Denton Asher (UNSW)	Denton	Asher	O2 plasma asher	<1995	Plasma asher	Cleaning	Lithography	Support systems	Cleaning, an essential step when operating on the micro and nanoscale, is used to remove contaminants from the surface of the substrate before it is used in another fabrication process. This sometimes means simply burning away material, often using an asher to do this. Ashers use heat to remove unwanted material, such as photoresist. They are often used to clean a wafer, although they can sometimes be used to selectively etch away material as well.
New South Wales Node	Advanced Lithography	UNSW	Custom Asher (UNSW)	Custom	Asher	O2 plasma asher	<1995	Plasma asher	Cleaning	Lithography	Support systems	Cleaning, an essential step when operating on the micro and nanoscale, is used to remove contaminants from the surface of the substrate before it is used in another fabrication process. This sometimes means simply burning away material, often using an asher to do this. Ashers use heat to remove unwanted material, such as photoresist. They are often used to clean a wafer, although they can sometimes be used to selectively etch away material as well.
New South Wales Node	MOS Process line	UNSW	Custom Probe Station (UNSW)	Custom	Probe Station	four point probe	<1995	Four point probe	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.

New South Wales Node	Device packaging and integration	UNSW	Suss scriber (UNSW)	Suss	scriber	wafer scriber	<1995	Wafer scriber	Wafer dicing	Packaging	Wafer processing	Nanofabricated devices are generally made in batches on wafers and need to be separated or packaged before use. This separation can be achieved through wet or dry dicing. In a wet dicing operation, a precision, high-speed, diamond impregnated blade is used to mill narrow grooves between the devices either partially or completely through the wafer. During this process, water is circulated over the cutting surface to cool the blade and prevent the liberation of dangerous particulates into the air. Materials which would be damaged by water are diced using a dry process known as scribing. Scribing utilises a diamond tipped stylus which is drawn across the wafer surface creating lines of high-stress which are later broken over precision fulcrum.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	CEM Liberty 1 (UoA)	CEM	Liberty 1	Microwave peptide synthesiser	2010	Microwave peptide synthesiser	Peptide synthesis	Materials synthesis and modification	Biological materials	A technique to combine amino acids into peptide chains in a pre-determined order. This is useful to create peptide chains that mimic biologically relevant peptide or protein fragments. Created peptides can also be used in biological assays, detections systems, sensors and as biological medicines.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Agilent Technologies 1260 Infinity (UoA)	Agilent Technologies	1260 Infinity	Identify, and quantify components in a liquid mixture	2011	High performance liquid chromatography (HPLC) system	Liquid Chromatography (LC)	Materials synthesis and modification	Chromatography	Chromatography involves separating a mixture by passing it through a separation medium that gradually traps solutes due to their size – in liquid chromatography (LC) a sample is dissolved in suitable solvent and passed through a separation medium as a liquid. This could be done immediately ahead of analysis step, perhaps to see how much of a specific protein is within a sample, or it could be done to synthesise a highly purified material for later fabrication steps. LC is commonly performed at high pressure (high-performance liquid chromatography (HPLC)), which his able to resolve to a higher degree, or in conjunction with a mass spectrometer (LC-MS) for immediate analysis.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Gilson GX-271 (UoA)	Gilson	GX-271	Unit has automated sampling and fraction collection functions.	2012	Semi-preparative HPLC	Liquid Chromatography (LC)	Materials synthesis and modification	Chromatography	Chromatography involves separating a mixture by passing it through a separation medium that gradually traps solutes due to their size – in liquid chromatography (LC) a sample is dissolved in suitable solvent and passed through a separation medium as a liquid. This could be done immediately ahead of analysis step, perhaps to see how much of a specific protein is within a sample, or it could be done to synthesise a highly purified material for later fabrication steps. LC is commonly performed at high pressure (high-performance liquid chromatography (HPLC)), which his able to resolve to a higher degree, or in conjunction with a mass spectrometer (LC-MS) for immediate analysis.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Innovative Technology Pure Lab GP-1 SR (UoA)	Innovative Technology	Pure Lab GP-1 SR	This glovebox is designated for performing air or moisture sensitive reactions.	2013	Glovebox	Gloveboxes	Laboratory infrastructure	Specialised environments	Gloveboxes provide an encapsulated environment to either protect a sample from the atmosphere, or to protect the cleanroom from a sample.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	BioTek Instruments Synergy H4 (UoA)	BioTek Instruments	Synergy H4	Detection modes include fluorescence Intensity, luminescence and UV/Vis absorbance.	2013	Multi-mode microplate reader used to detect biological, chemical or physical events of samples in microtiter plates.	Photometric readers	Testing and validation	Biological analysis	Photometric readers collect a variety of responses to different forms of light. They can measure colour intensity at a particular wavelength, the fluorescence of a samples at a set of excitation and emission wavelengths or even inherent sample luminescence.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	NT-MDT Ntegra Solaris (UoA)	NT-MDT	Ntegra Solaris	The Atomic Force Microscope (AFM) is primarily used to measure and analyse surface topography and morphology, providing nanoscale height measurements.	2009	Scanning Near-Field Optical Microscope (SNOM) and Atomic Force Microscope (AFM)	Scanning Near-field Optical Microscopy (SNOM)	Testing and validation	Microscopy	Scanning Near-field Optical Microscopy (SNOM) combines imaging and spectroscopy in the VIS, IR and THz spectral regions at 10 nm spatial resolution. It is used during plasmonic analysis, nanoscale stress and strain testing, and observations of free charge carrier distribution.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	High Temperature Extrusion Chamber Furnace (Furnace Engineering) (UoA)		High Temperature Extrusion Chamber Furnace (Furnace Engineering)	Silica glass extruder - furnace	2014					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Tetlow Vertical Tube Furnace 1500oC (UoA)	Tetlow	Vertical Tube Furnace 1500oC	Hard glass extruder furnace	2011					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Custom Hard glass extruder (UoA)	Custom	Hard glass extruder	Manufacture hard glass type preforms for drawing to fibre.	2011	Hard glass extrusion facility up to 1,700oC and 250kN	Extrusion systems	Manufacturing and machining	Optical fibre pulling and processing	The ability to create objects of a fixed cross-sectional profile by pushing material through a die of the desired cross-section. Extrusion systems are used to create optical fibres.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Tower Control System (UoA)		Tower Control System	Silica glass draw tower - control system	2012					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Custom Glass melter (UoA)	Custom	Glass melter	Facility consisting of a 6-port Heraeus glovebox with integrated furnaces	2014	Controlled atmosphere oxide glass melting facilities.	Furnaces	Materials synthesis and modification	Material modification	High temperature furnaces used to melt materials to create glass fibre fabrication.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Lathe Control System (UoA)		Lathe Control System	Silica preform manufacturing - control cabinet	2005					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Astro Furnace (UoA)	Astro	Furnace	Silica glass draw tower - furnace	2005					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	4m Drawing Tower (UoA)		4m Drawing Tower	Soft glass draw tower - RF furnace	2006					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Heathway/Controls Interface 4m Drawing Tower (UoA)	Heathway/Controls Interface	4m Drawing Tower	Soft glass and polymer draw tower	2006	4m Fibre Draw Tower	Draw towers	Manufacturing and machining	Optical fibre pulling and processing	Draw towers are used to create fibres, such as optical fibres, by heating and stretching a bulk material (or preform) to create long strands. The design and composition of this preform results in different abilities of the fibres once drawn out, such as stronger fibres, more efficient data transmission, or a broader available bandwidths for carrying information.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Custom Glass melting - fluoride (UoA)	Custom	Glass melting - fluoride	Facility consisting of a 5-port Mbraun glovebox with integrated furnaces	2005	Fluoride glass melting facility	Gloveboxes	Laboratory infrastructure	Specialised environments	Gloveboxes provide an encapsulated environment to either protect a sample from the atmosphere, or to protect the cleanroom from a sample.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	MCVD Chemical Cabinet (UoA)		MCVD Chemical Cabinet	MCVD preform manufacturing - chemical cabinet	2005					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	MCVD Control System (UoA)		MCVD Control System	MCVD preform manufacturing - control system	2005					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	4m Drawing Tower (UoA)		4m Drawing Tower	Soft glass draw tower - 4m tower	2006					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	6m Drawing Tower (UoA)		6m Drawing Tower	Silica glass draw tower - laser gauge	2005					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Zwick Zwick 100kN Testing Machine (UoA)	Zwick	Zwick 100kN Testing Machine	Soft glass extruder - machine and furnace1	2005					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Photon Kinetics Photon Kinetics PK2600 (UoA)	Photon Kinetics	Photon Kinetics PK2600	Preform profiler	2005					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	MBraun MBraun Glove Box 6-port (UoA)	MBraun	MBraun Glove Box 6-port	Controlled atmosphere oxide glass melting facility - glovebox	2010					

Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Preform Lathe (UoA)		Preform Lathe	Silica preform manufacturing - lathe	2005					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	6m Drawing Tower (UoA)		6m Drawing Tower	Silica glass draw tower - 6m tower	2005					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Zwick Zwick 100kN Testing Machine large width (UoA)	Zwick	Zwick 100kN Testing Machine large width	Hard glass extruder machine	2016					
Optofab Node	Additive and Subtractive 3d manufacturing?	UoA	3D Systems ProX200 (UoA)	3D Systems	ProX200	3D printing facilitates rapid prototyping and manufacturing, allowing for the fast availability of functional prototypes for product development, as well as on demand manufacturing for research and industry requirements.	2014	Selective laser meting metal 3D printer.	Metal printing	Manufacturing and machining	3D Printing	3D Metal Printing creates a three-dimensional metal structure by building metal layers upon metal layers, much like conventional 3D printing with plastics. 3D printing with metals has open the door to rapidly-produced, customised parts that can be incredibly durable. For applications such as
Optofab Node	Additive and Subtractive 3d manufacturing?	UoA	DMG Mori DMU 20 linear Ultrasonic (UoA)	DMG Mori	DMU 20 linear Ultrasonic	Kinematic superposition of the tool rotation with an additional oscillation, traditionally difficult to machine high-performance materials can now be machined with excellent results.	2013	Ultrasonic simultaneous 5-axis machining.	Ultrasonic milling	Manufacturing and machining	Milling	Ultrasonic milling is a subtractive process that uses focused sound waves and an abrasive agent to remove materials. An oscillating part is used to vibrate small particles suspended in a fluid to gradually scratch away at a highly specific part of a substrate. This technique is well suited to milling brittle materials that would likely crack when milled using conventional mechanisms.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Innovative Technology Pure Solv PS-Micro (UoA)	Innovative Technology	Pure Solv PS-Micro	Purification system to remove water from solvent.	2013	Solvent purifier	Purification and drying	Materials synthesis and modification	Support systems	Removing contaminants from a sample is vital to ensuring uniformity and reproducibility of a sample. It is also required to enable certain chemical reactions that would not be possible with even trace amounts of contaminants, such as water – high purity solvents are a good example of this. Producing high purity samples requires specialist equipment that is typically located in specialised environments.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Hamamatsu H10330A-75 Pmt Assy (UoA)	Hamamatsu	H10330A-75 Pmt Assy	Scanning Near-Field Optical Microscope - lasers	2009					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Tetlow/Ceramic Engineering Glass melting - open air (UoA)	Tetlow/Ceramic Engineering	Glass melting - open air	The open-air melting capability consists of a melting furnace with maximum temperature of 1200oC and two annealing furnaces with a maximum temperature of 500oC.	2015	Open air glass melting furnaces	Glass fabrication	Materials synthesis and modification	Material synthesis	Glass fabrication requires incredible temperatures and pressures, but can be harnessed to produce materials that are functionalised towards a large range of applications. Concocting different mixtures or introducing nanoparticles can result in glass with novel properties – these are then typically used in light-based applications like sensing, communications, or advanced optics.
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Optical Sensor Interrogator (UoA)		Optical Sensor Interrogator	Soft glass draw tower - interrogator	2014					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Touch Screen PC (UoA)		Touch Screen PC	Soft glass draw tower - touch screen	2015					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Enclosure for Research Equipment (UoA)		Enclosure for Research Equipment	Silica glass extruder - enclosure	2012					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Snorkel TM12 Lift (UoA)	Snorkel	TM12 Lift	Silica glass draw tower - snorkel lift	2012					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Vertical Tube Furnace 1000oC (UoA)		Vertical Tube Furnace 1000oC	Controlled atmosphere fluoride glass melting facility - melting furnace	2007					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Tegramin Polishing Machine Tegramin-30 (UoA)	Tegramin	Polishing Machine Tegramin-30	Glass polishing machine	2011					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Tetlow Vertical Tube Furnace 1200oC (UoA)	Tetlow	Vertical Tube Furnace 1200oC	Soft glass extruder - furnace2	2015					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Optical Microscope (UoA)		Optical Microscope	Optical Microscope for fibre inspection	2005					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Tetlow Vertical Tube Furnace 1800oC (UoA)	Tetlow	Vertical Tube Furnace 1800oC	Controlled atmosphere oxide glass melting facility - melting furnace	2011					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Servo Drive System (UoA)		Servo Drive System	Soft glass extruder - guiding system part1	2013					
Optofab Node	Optical Fibres and speciality glass synthesis	UoA	Servo Drive System (UoA)		Servo Drive System	Soft glass extruder - guiding system part2	2013					
Optofab Node		UoA	CEM Discover and explorer SP (UoA)	CEM	Discover and explorer SP	Microwave synthesiser - with compressed air cooling system		Microwave synthesiser for general organic synthesis	Peptide synthesis	Materials synthesis and modification	Biological materials	A technique to combine amino acids into peptide chains in a pre-determined order. This is useful to create peptide chains that mimic biologically relevant peptide or protein fragments. Created peptides can also be used in biological assays, detections systems, sensors and as biological medicines.
Optofab Node		UoA	Custom Soft glass and polymer extruder #1 (UoA)	Custom	Soft glass and polymer extruder #1	Manufacture soft glass and polymer preforms for drawing to fibre. Extrudes at up to 700 degrees C and 100kN.		Soft glass and polymer extrusion facility	Extrusion systems	Manufacturing and machining	Optical fibre pulling and processing	The ability to create objects of a fixed cross-sectional profile by pushing material through a die of the desired cross-section. Extrusion systems are used to create optical fibres.
Optofab Node		UoA	Custom Soft glass and polymer extruder #2 (UoA)	Custom	Soft glass and polymer extruder #2	Manufacture soft glass and polymer preforms for drawing to fibre. Extrudes at up to 1400 degrees C and 100kN.		Soft glass and polymer extrusion facility	Extrusion systems	Manufacturing and machining	Optical fibre pulling and processing	The ability to create objects of a fixed cross-sectional profile by pushing material through a die of the desired cross-section. Extrusion systems are used to create optical fibres.
Optofab Node		UoA	Heathway/Controls Interface 6m Drawing Tower (UoA)	Heathway/Controls Interface	6m Drawing Tower	Silica type glass draw tower .		Hard glass draw tower	Draw towers	Manufacturing and machining	Optical fibre pulling and processing	Draw towers are used to create fibres, such as optical fibres, by heating and stretching a bulk material (or preform) to create long strands. The design and composition of this preform results in different abilities of the fibres once drawn out, such as stronger fibres, more efficient data transmission, or a broader available bandwidths for carrying information.
Optofab Node		UoA	Heathway/Controls Interface Glass working lathe (UoA)	Heathway/Controls Interface	Glass working lathe	Glass working lathe with hydrogen torch capability.		Glass working lathe	Glass working	Manufacturing and machining	Optical fibre pulling and processing	Once a bulk glass material has been produced, it has to be made into something useful. If the aim is to produce some sort of fibre optic, draw towers are used to create glass fibres by heating and stretching a bulk material (or preform) to create long strands. The design and composition of this preform results in different abilities of the fibres once drawn out, such as stronger fibres, more efficient data transmission, or a broader available bandwidths for carrying information. Polishing involves reducing the surface roughness of a substrate by physical means. In the micro and nano worlds this is typically done to alter a surfaces optical properties, making it more reflective or transparent depending on the substrate.

Optofab Node	UoA	Custom HF etching (UoA)	Custom	HF etching	Hydrofluoric acid etching facilities.	HF etching facilities	Vapour phase etching	Etching	Dry etching	Vapour phase etching involves exposing a substrate to a corrosive chemical in vapour form which will remove material that it comes into contact with. The sections of material that are removed can be selected by protecting parts of the substrate that are desired to be kept with a mask or coating.
Optofab Node	UoA	Struers Accutom-100 (UoA)	Struers	Accutom-100	Precision cut-off and grinding machine with variable speed (300 - 5000 rpm).	High precision glass saw	Glass working	Manufacturing and machining	Optical fibre pulling and processing	Once a bulk glass material has been produced, it has to be made into something useful. If the aim is to produce some sort of fibre optic, draw towers are used to create glass fibres by heating and stretching a bulk material (or preform) to create long strands. The design and composition of this preform results in different abilities of the fibres once drawn out, such as stronger fibres, more efficient data transmission, or a broader available bandwidths for carrying information. Polishing involves reducing the surface roughness of a substrate by physical means. In the micro and nano worlds this is typically done to alter a surfaces optical properties, making it more reflective or transparent depending on the substrate.
Optofab Node	UoA	Metkon Forcipol 1V (UoA)	Metkon	Forcipol 1V	Manual polisher.	Polisher/grinder	Glass working	Manufacturing and machining	Optical fibre pulling and processing	Once a bulk glass material has been produced, it has to be made into something useful. If the aim is to produce some sort of fibre optic, draw towers are used to create glass fibres by heating and stretching a bulk material (or preform) to create long strands. The design and composition of this preform results in different abilities of the fibres once drawn out, such as stronger fibres, more efficient data transmission, or a broader available bandwidths for carrying information. Polishing involves reducing the surface roughness of a substrate by physical means. In the micro and nano worlds this is typically done to alter a surfaces optical properties, making it more reflective or transparent depending on the substrate.
Optofab Node	UoA	Struers Tegramin-30 (UoA)	Struers	Tegramin-30	Automatic precision polisher.	High precision polisher	Glass working	Manufacturing and machining	Optical fibre pulling and processing	Once a bulk glass material has been produced, it has to be made into something useful. If the aim is to produce some sort of fibre optic, draw towers are used to create glass fibres by heating and stretching a bulk material (or preform) to create long strands. The design and composition of this preform results in different abilities of the fibres once drawn out, such as stronger fibres, more efficient data transmission, or a broader available bandwidths for carrying information. Polishing involves reducing the surface roughness of a substrate by physical means. In the micro and nano worlds this is typically done to alter a surfaces optical properties, making it more reflective or transparent depending on the substrate.
Optofab Node	UoA	Bruker ContourGT-K (UoA)	Bruker	ContourGT-K	This instrument performs non-contact 3D surface metrology measurements for laboratory research and production process control.	High precision surface profiler	Stylus profilometry	Testing and validation	Profilometry	Stylus profilometry is a direct form of profilometry that can be used to characterise the surface steps and the roughness of a material. A stylus profilometer drags a metal tip along the surface of a sample and measuring the distance traced by the stylus tip and its deflection along the vertical axis to register slight changes in the surface height of a material. This measurement is then converted into a cross-sectional plot and can be used to resolve steps as small as 10nm. Optical profilometry employs phase-shifting and/or vertical scanning interferometry to resolve the topology of complex 3D structures. The technique marries precision z-axis control with interference based techniques to resolve features from the angstrom to millimetre scale. The technique lends itself well to die-based measurements for ISO/QA and large area mapping.
Optofab Node	UoA	J.A. Woollam IR-VASE (UoA)	J.A. Woollam	IR-VASE	Common measurements include coating thickness, IR refractive indices and molecular bond vibrations.	Measuring complex refractive index or dielectric function of thin films.	Spectroscopic ellipsometry	Testing and validation	Thin film characterisation	Spectroscopic ellipsometry is an optical characterisation technique which provides a highly sensitive, contactless method for thin film measurements. Multiple light wavelengths and variable angles of polarised light are reflected off the surface of a sample. As this light reflects, its characteristics change depending on a number of the sample's properties – it can therefore be used to characterise film thickness as well as composition such as roughness, crystalline nature, electrical conductivity and doping concentration.
Optofab Node	UoA	Micro-VU Vertex 312UC (UoA)	Micro-VU	Vertex 312UC	A coordinate measuring machine with camera and touch probes.	Coordinate measuring machine	Physical property analysis	Testing and validation	Material characterisation	When a material is developed, there are key properties that can be determined to define the materials. These can include the temperature profile of the material, the physical strength, the hardness, the colour or the size of the material. One important technique is differential scanning calorimetry (DSC), a thermoanalytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference is measured as a function of temperature. It can be used to determine the phase transitions of a material.
Optofab Node	UoA	Perkin Elmer Spectrum 400 (UoA)	Perkin Elmer	Spectrum 400	This instrument can be purged with nitrogen. Optimum Wavelength range: 7800 to 400 cm-1 (TGS), 7800 to 450 cm-1(MCT).	Fourier transform infrared spectrophotometer (FTIR)	Fourier Transform Infrared (FTIR) Spectroscopy	Testing and validation	Spectroscopy	Fourier-transform infrared (FTIR) spectroscopy is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. It is a technique used to examine chemical composition using the infrared (IR) part of the electromagnetic spectrum. FTIR spectroscopy flashes a sample with a series of broadband light of varying IR wavelengths. The resulting collection of spectra are then interpreted using the Fourier transform algorithm to indicate which parts of the spectrum were absorbed, and therefore, the chemical composition of the sample.
Optofab Node	UoA	Perkin Elmer STA 6000 (UoA)	Perkin Elmer	STA 6000	STA simultaneously combines differential thermal analysis (DSC and DTA) with thermo-gravimetric analysis (TGA). STA is commonly used for measuring melting/crystallisation temperature, reaction enthalpies, quantity of volatile content in materials and thermal stabilities	Simultaneous thermal analyser (STA)	Physical property analysis	Testing and validation	Material characterisation	When a material is developed, there are key properties that can be determined to define the materials. These can include the temperature profile of the material, the physical strength, the hardness, the colour or the size of the material. One important technique is differential scanning calorimetry (DSC), a thermoanalytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference is measured as a function of temperature. It can be used to determine the phase transitions of a material.
Optofab Node	UoA	Agilent Technologies Cary 5000 (UoA)	Agilent Technologies	Cary 5000	The Cary 5000 is a high performance UV-Vis-NIR spectrophotometer with photometric performance in the 175-3300 nm range.	UV-VIS-NIR spectrophotometer	Spectrophotometry	Testing and validation	Spectroscopy	Spectrophotometry is a method that measures the amount of light that is absorbed or transmitted by a sample as a function of the wavelength of that light. This measurement is a basic characterisation of the optical properties and can be applied to various forms of sample, such as thin film and liquids.

Materials Node	Materials for bio-med and bio device fab	UoN	Omnivac Surface Analysis System (UoN)	Omnivac	Surface Analysis System	The Omnivac X-ray photoelectron spectrometer (XPS) is a glovebox-attached system that allows for samples to be fabricated, transported and analysed without ever being exposed to the atmosphere. XPS can be used to determine the elemental and molecular composition of the surface of a sample - especially useful for characterising the fabrication of thin films and semiconductor technologies.	2009	X-ray photoelectron spectroscope (XPS) with evaporation and sputtering options	X-ray Photoelectron Spectroscopy (XPS)	Testing and validation	Spectroscopy	X-ray photoelectron spectroscopy (XPS) is a quantitative technique that measures the composition and electronic state of the elements are on the surface of a sample. Spectra are obtained by irradiating a sample with a beam of X-rays while measuring the number of electrons of a specific energy that escape from the top 1 to 10 nm of the surface. XPS requires that the sample is exposed to ultra-high vacuum (UHV) conditions. Detection limits for most of the elements are in the range of parts per thousand. The analyser can also be used to check the uniformity of elemental composition across the top surface (line profiling or mapping) and as a function of depth into the sample (by ion beam etching). A number of additional film preparation tools are available within the same vacuum system.
Materials Node	Flexible printed electronics (UNC)	UoN	Semicore R2R Sputter Coater (UoN)	Semicore	R2R Sputter Coater	The Semicore roll-to-roll sputter coater is a large-scale vacuum metalliser, capable of putting down metallic layers (such as aluminium) on plastic sheet (such as PET).	2013	Roll-to-roll sputter coater for flexible electronics	Roll-to-roll printing	Manufacturing and machining	2D Printing	Roll-to-roll printing is a technique that is widely used to print newspapers, magazines and many other conventional printed products that are required in large quantities. The ANFF equipment is based on this principle but allows for the user to print functionalised inks onto novel materials – it's already enabling the creation of printable solar panels that can be created at incredibly high speeds. A roll of substrate (traditionally paper, but now polymers substrates for flexible electronics) is fed through a series of printing steps, until it is collated on a new roll at the other end.
Materials Node	Flexible printed electronics (UNC)	UoN	GM Laminator Unit (UoN)	GM	Laminator Unit	A roll to roll lamination system providing a method for UV cured epoxy glues to be applied and cured to seal multiple layers of plastic together. The system enables the application of high performance barrier films to flexible printed electronics.	2013	Roll-to-roll laminator	Roll-to-roll printing	Manufacturing and machining	2D Printing	Roll-to-roll printing is a technique that is widely used to print newspapers, magazines and many other conventional printed products that are required in large quantities. The ANFF equipment is based on this principle but allows for the user to print functionalised inks onto novel materials – it's already enabling the creation of printable solar panels that can be created at incredibly high speeds. A roll of substrate (traditionally paper, but now polymers substrates for flexible electronics) is fed through a series of printing steps, until it is collated on a new roll at the other end.
Materials Node	Flexible printed electronics (UNC)	UoN	GM Solar 1 (UoN)	GM	Solar 1	A printing and coating line more commonly used for producing stickers and wine labels, this system is now used to produce functional printed devices such as bio-sensors, OLEDs, and solar cells. Able to take a roll of plastic up to a kilometre long, the coating line includes stations for various types of coating such as Gravure, Flexographic, Slot-die, and Screen printing. Two metres of heating also allow for the drying of wet-ink layers into thin-films.	2013	Roll-to-roll organic coater	Roll-to-roll printing	Manufacturing and machining	2D Printing	Roll-to-roll printing is a technique that is widely used to print newspapers, magazines and many other conventional printed products that are required in large quantities. The ANFF equipment is based on this principle but allows for the user to print functionalised inks onto novel materials – it's already enabling the creation of printable solar panels that can be created at incredibly high speeds. A roll of substrate (traditionally paper, but now polymers substrates for flexible electronics) is fed through a series of printing steps, until it is collated on a new roll at the other end.
Materials Node	Flexible printed electronics (UNC)	UoN	Atomate CVD (UoN)	Atomate	CVD	Chemical Vapour Deposition specifically to fabricate materials such as carbon nanotubes or graphene by exposing a substrate to reactive precursors.	2006	Chemical vapour deposition (CVD) system for carbon nanotube and graphene growth	Plasma Enhanced Chemical Vapour Deposition (PECVD)	Deposition	Chemical Vapour Deposition (CVD)	Plasma Enhanced Chemical Vapour Deposition (PECVD) uses a plasma to deposit a thin film of silicon dioxide or silicon nitrate onto a substrate. PECVD uses lower temperatures than the furnace systems to achieve an insulating layer on a variety of materials. PECVD is used in optics, microelectronics, energy applications, packaging and chemistry for the deposition of anti-reflective coatings, scratch resistant transparent coatings, electronically active layers, passivation layers, dielectric layers, isolating layers, etch stop layers, encapsulation and chemical protective coatings.
Materials Node	Flexible printed electronics (UNC)	UoN	Nanonics Nanonics Multiview 1000 (UoN)	Nanonics	Nanonics Multiview 1000	Current mapping for organic flexible electronics	2002					
Materials Node	Flexible printed electronics (UNC)	UoN	Asylum Research Cypher ES (UoN)	Asylum Research	Cypher ES	An atomic force microscope which performs very high resolution probing of surfaces. The ES model of the Cypher has an environmental chamber, allowing for the control of temperature and the atmosphere around the sample. Dry and liquid AFM is possible with this system.	2011	Atomic force microscope (AFM) for polymer film analysis	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
Materials Node	Flexible printed electronics (UNC)	UoN	Custom EQE (UoN)	Custom	EQE	A measurement system to determine the ability of a solar cell to convert incident photons into electrons at varying wavelengths. Designed to integrate with lab scale devices, this custom system scans from 300 to 1,100 nm and has capacity to extend further in the spectrum.	2004	External quantum efficiency (EQE) measurement system	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.
Materials Node	Flexible printed electronics (UNC)	UoN	XPS (UoN)		XPS	XPS system for surface analysis	1995					

Materials Node	Flexible printed electronics (UNC)	UoN	Bruker Dektak XT-S (UoN)	Bruker	Dektak XT-S	Used to measure the surface roughness of samples or to determine film thickness.	2004	Stylus profilometer	Stylus profilometry	Testing and validation	Profilometry	Stylus profilometry is a direct form of profilometry that can be used to characterise the surface steps and the roughness of a material. A stylus profilometer drags a metal tip along the surface of a sample and measuring the distance traced by the stylus tip and its deflection along the vertical axis to register slight changes in the surface height of a material. This measurement is then converted into a cross-sectional plot and can be used to resolve steps as small as 10nm. Optical profilometry employs phase-shifting and/or vertical scanning interferometry to resolve the topology of complex 3D structures. The technique marries precision z-axis control with interference based techniques to resolve features from the angstrom to millimetre scale. The technique lends itself well to die-based measurements for ISO/QA and large area mapping.
Materials Node	Flexible printed electronics (UNC)	UoN	Agilent Technologies Cary 6000i (UoN)	Agilent Technologies	Cary 6000i	Reflection, absorption, and transmission measurements are possible with this tool on both liquid and film samples. A large array of attachments allows for a wide variety of UV-Vis techniques to be performed.	2007	UV-Vis-NIR spectrophotometer	Spectrophotometry	Testing and validation	Spectroscopy	Spectrophotometry is a method that measures the amount of light that is absorbed or transmitted by a sample as a function of the wavelength of that light. This measurement is a basic characterisation of the optical properties and can be applied to various forms of sample, such as thin film and liquids.
Materials Node	Flexible printed electronics (UNC)	UoN	Fujifilm Dimatix (UoN)	Fujifilm	Dimatix	This system enables benchtop inkjet printing of novel, electroactive inks. Operating in a similar way to an office printer, a design created on a computer is simply printed using this equipment. Functional devices such as solar cells, fuses, bio-sensors, and other electronic components can be printed using a range of inks.	2010	Desktop inkjet printer printing system	Inkjet printing	Manufacturing and machining	2D Printing	Inkjet printing is similar to the process conducted in most offices across the world, but instead of using conventional inks, researchers are beginning to use conductive liquids, or even photovoltaic ones, to give a printed product far greater functionality.
Materials Node	Flexible printed electronics (UNC)	UoN	Newport Oriel (UoN)	Newport	Oriel	Tool for comparing the performance of solar cells under standardised conditions	2006	Solar simulator	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.
Materials Node	Flexible printed electronics (UNC)	UoN	Custom Scanning Helium Microscope (SHeM) (UoN)	Custom	Scanning Helium Microscope (SHeM)	A custom built highly surface-sensitive imaging system	2013	Scanning Helium Microscope (SHeM)	Scanning Helium Microscopy (SHeM)	Testing and validation	Microscopy	Developed by the University of Newcastle in collaboration with researchers from Cambridge University, the Newcastle Scanning Helium Microscope (SHeM) is an extremely surface-sensitive imaging technique. The tool, one of only three in the world, probes samples using neutral helium atoms instead of the more traditional light or electrons. Advantages include minimal sample preparation requirements (no charge reducing coatings required), a complete lack of sample damage as can occur under beams of electrons or laser light, and no penetration of the probe into the surface at all (extreme sensitivity to thin, transparent films).
Materials Node	Flexible printed electronics (UNC)	UoN	Shimadzu RF-6000 (UoN)	Shimadzu	RF-6000	Fluorescence measurements of both film and solution samples.	2016	Spectrofluorophotometer	Spectrophotometry	Testing and validation	Spectroscopy	Spectrophotometry is a method that measures the amount of light that is absorbed or transmitted by a sample as a function of the wavelength of that light. This measurement is a basic characterisation of the optical properties and can be applied to various forms of sample, such as thin film and liquids.
Materials Node	Flexible printed electronics (UNC)	UoN	Cleanroom Class 1,000 (UoN)	Cleanroom	Class 1,000	A general purpose clean room including two glovebox systems for environmentally sensitive work.	2007	Class 1,000 cleanroom space	Cleanroom spaces	Laboratory infrastructure	Specialised environments	A cleanroom is a highly purified environment, containing as few as 100 "dirty" particles in one cubic foot of air -- a cubic foot of air on a typical street can contain approximately 350 million of dirty particles. Cleanrooms are essential to creating micro and nanotechnologies. Considering that the scale of most of the structures and devices made using micro or nanofabrication processes is 10's of thousands times smaller than a human hair, dust and dirt can ruin a sample. cleanroom suits are required for entry into these controlled spaces, not to protect the user from the samples, but rather to protect the samples from the user. However, temperature changes and lighting conditions can also ruin these delicate structures as they are being made. Cleanrooms are engineered to force potential contaminants from the local atmosphere, also maintaining consistent temperatures, and controlling lighting conditions.
Materials Node	Flexible printed electronics (UNC)	UoN	Glovebox Nitrogen environment (UoN)	Glovebox	Nitrogen environment	A combined glovebox/thermal evaporator that allows for the fabrication of samples without the need to expose said samples to the atmosphere. The evaporator offers up 3 boat and 3 crucible sources, allowing for relatively complex, automated recipes to be performed. This equipment is very useful for fabricating solar cells.	2009	Glovebox with thermal evaporator system	Gloveboxes	Laboratory infrastructure	Specialised environments	Gloveboxes provide an encapsulated environment to either protect a sample from the atmosphere, or to protect the cleanroom from a sample.
Materials Node	Flexible printed electronics (UNC)	UoN	Zeiss XXXX (UoN)	Zeiss	XXXX	Thin film quality and uniformity measurements	2004					
Materials Node	Flexible printed electronics (UNC)	UoN	Keithley 2400 (UoN)	Keithley	2400	Used for measuring organic transistors, solar cells and other flexible electronic structures	2009					
Materials Node	Flexible printed electronics (UNC)	UoN	Ink Synthesis Suite (UoN)	Ink Synthesis	Suite	The nanoparticulate synthesis suite allows the production of surfactant based nanoparticles. Using a series of ultrasonic horns, a centrifuge and heating elements polymeric materials are combined using surfactants to produce nanoparticles of varying size, shape, and performance.	2015	Nanoparticulate ink synthesis suite	Centrifuge	Materials synthesis and modification	Separation techniques	Centrifuges provide a simple way to separate materials that are suspended in a liquid. By spinning samples at high speeds, materials with different densities are separated from one another by centrifugal forces. This technique is often used in biological applications for, say, separating the constituent parts of blood.
Materials Node	Flexible printed electronics (UNC)	UoN	Hielscher UP400S (UoN)	Hielscher	UP400S	Small batch (4 mL) nanoparticulate synthesis	2015					

Materials Node	Flexible printed electronics (UNC)	UoN	Hielscher UP1000 (UoN)	Hielscher	UP1000	Large batch (1 L) nanoparticulate synthesis	2015					
Materials Node	Flexible printed electronics (UNC)	UoN	Sartorius Vivaflow 200 system (UoN)	Sartorius	Vivaflow 200 system	Surfactant removal system for nanoparticulate inks	2015					
Materials Node	Flexible printed electronics (UNC)	UoN	Laurell WS-400A (UoN)	Laurell	WS-400A	Used to produce thin films on small substrates. The sample is placed onto a vacuum chuck and rotated at thousands of revolutions per minute whilst ink is deposited onto the surface. The majority of the ink is removed due to the rotation but what's left is an extremely thin, uniform film.	2006	Spin coater for ink coatings	Spin coating and wafer development	Lithography	Support systems	Spin coaters are capable of applying uniform thickness polymer films, such as a resist to substrates. Resist is essential for many types of lithography, such as UV lithography. Resists are termed either positive or negative -- this denotes whether, when cured, chemical bonds are made or broken, and therefore whether the sections of resist that remain are either the true pattern, or it's inverse. This selection must be considering etching or deposition stages that may follow as it will help to make.
Materials Node	Flexible printed electronics (UNC)	UoN	BioForce Nanosciences UV Ozone Cleaner - ProCleaner (UoN)	BioForce	Nanosciences UV Ozone Cleaner - ProCleaner	150 mm x 150 mm UV exposure unit, for cleaning ITO samples	2011					
Materials Node	Flexible printed electronics (UNC)	UoN	Keysight E4980A (UoN)	Keysight	E4980A	LCR meter for inductance spectroscopy measurements	2016					
Materials Node	3D Bio-fab	UoW	MECC Nanon (UoW)	MECC	Nanon	Fibre electrospinning system	2012	Electrospinner	Fibre processing	Materials synthesis and modification	Fibres and textiles	Traditional techniques such as spinning, weaving and knitting are being scaled down to create and handle novel fibres that are vital to new materials, flexible electronics, wearable technologies, as well as new applications in medical and defence sectors.
Materials Node	3D Bio-fab	UoW	Speciality Coating Systems (SCS) PDS 2010 (UoW)	Speciality Coating Systems (SCS)	PDS 2010	Parylene coating system	2012	Parylene deposition system	Coatings	Deposition	Other deposition capabilities	A frequent step in producing a device is to coat a substrate in order to make its surface behave differently in some way. This could be to make it biocompatible, harder, hydrophobic, or to gain any number of other characteristics. Coatings are also widely used as a preparation step for another fabrication process.
Materials Node	3D Bio-fab	UoW	Objet Connex 350 (UoW)	Objet	Connex 350	Polyjet printer for multi-colour, multi-material printing	2010	Polyjet 3D printer	Plastic printing	Manufacturing and machining	3D printing	3D printing involves taking a model and slicing into layers, then printing these layers on top of one another to recreate a 3D component. It's an incredibly quick way to produce unique parts, or for small production runs, and is massively useful when wanting to quickly create prototypes. A variety of materials can be printed, such as metals and biological materials – however, desktop 3D printers tend to use plastics.
Materials Node	3D Bio-fab	UoW	Realizer SLM 50 (UoW)	Realizer	SLM 50	Selective laser melting (SLM) system and water stage vacuum cleaner	2011	Metal SLM 3D printer	Metal printing	Manufacturing and machining	3D Printing	3D Metal Printing creates a three-dimensional metal structure by building metal layers upon metal layers, much like conventional 3D printing with plastics. 3D printing with metals has open the door to rapidly-produced, customised parts that can be incredibly durable. For applications such as
Materials Node	3D Bio-fab	UoW	Harry Lucas R1-S (UoW)	Harry Lucas	R1-S	Tubular knitting	2012	Knitting machine	Fibre processing	Materials synthesis and modification	Fibres and textiles	Traditional techniques such as spinning, weaving and knitting are being scaled down to create and handle novel fibres that are vital to new materials, flexible electronics, wearable technologies, as well as new applications in medical and defence sectors.
Materials Node	3D Bio-fab	UoW	Trenz Export Lab Scale Braiding Machine (UoW)	Trenz Export	Lab Scale Braiding Machine	Multi-filament/yarn braiding.	2010	Braiding machine	Fibre processing	Materials synthesis and modification	Fibres and textiles	Traditional techniques such as spinning, weaving and knitting are being scaled down to create and handle novel fibres that are vital to new materials, flexible electronics, wearable technologies, as well as new applications in medical and defence sectors.
Materials Node	3D Bio-fab	UoW	EnvisonTEC 3D-Bioplotter (UoW)	EnvisonTEC	3D-Bioplotter	3D bioplotter	2012	Bioscaffold printer with walk-in biosafety cabinet (PCII) and thermal control system	3D additive biofabrication	Manufacturing and machining	3D Printing	3D additive biofabrication reapplies the layer-by-layer method of 3D printing to produce living tissues. One prominent technique involves printing layers of a biocompatible substance called a hydrogel that has been infused with a patients stem cells. Once a 3D structure has been printed, stem cells can proliferate across this hydrogel scaffold until a biomedical part is complete, ready for implantation.
Materials Node	3D Bio-fab	UoW	Customised bioextruder platform Mechatronics 4 Technology - SPS-1000 KIMM (UoW)	Customised bioextruder platform	Mechatronics 4 Technology - SPS-1000 KIMM	3D printer with pneumatic thermoplastic extruder capabilities	2012	Pneumatic extrusion printer	Plastic printing	Manufacturing and machining	3D printing	3D printing involves taking a model and slicing into layers, then printing these layers on top of one another to recreate a 3D component. It's an incredibly quick way to produce unique parts, or for small production runs, and is massively useful when wanting to quickly create prototypes. A variety of materials can be printed, such as metals and biological materials – however, desktop 3D printers tend to use plastics.
Materials Node	3D Bio-fab	UoW	Universal Laser Systems PLS6MW (UoW)	Universal Laser Systems	PLS6MW	Laser cutter	2012	Laser cutter	Laser engraving and cutting	Manufacturing and machining	Laser processing	Subtractive processes that use of lasers to create patterns on a substrate or to cut through a material.
Materials Node	3D Bio-fab	UoW	LP50 Pixdro LP50 (UoW)	LP50	Pixdro LP50	Desktop R&D inkjet printer for functional printing applications	2012	Inkjet printing system	Inkjet printing	Manufacturing and machining	2D Printing	Inkjet printing is similar to the process conducted in most offices across the world, but instead of using conventional inks, researchers are beginning to use conductive liquids, or even photovoltaic ones, to give a printed product far greater functionality.
Materials Node	3D Bio-fab	UoW	Sono-Tek Spray Coater (UoW)	Sono-Tek	Spray Coater	Ultrasonic spray coating system	2012	Spray Coater	Coatings	Deposition	Other deposition capabilities	A frequent step in producing a device is to coat a substrate in order to make its surface behave differently in some way. This could be to make it biocompatible, harder, hydrophobic, or to gain any number of other characteristics. Coatings are also widely used as a preparation step for another fabrication process.
Materials Node	3D Bio-fab	UoW	Coatema Smart Coater Reel-2-reel coating system (UoW)	Coatema Smart Coater	Reel-2-reel coating system	Roll-to-roll coating system, offers dip, blade and gravure with corona substrate treatment capabilities.	2012	Roll-to-roll coating system	Roll-to-roll printing	Manufacturing and machining	2D Printing	Roll-to-roll printing is a technique that is widely used to print newspapers, magazines and many other conventional printed products that are required in large quantities. The ANFF equipment is based on this principle but allows for the user to print functionalised inks onto novel materials – it's already enabling the creation of printable solar panels that can be created at incredibly high speeds. A roll of substrate (traditionally paper, but now polymers substrates for flexible electronics) is fed through a series of printing steps, until it is collated on a new roll at the other end.
Materials Node	3D Bio-fab	UoW	Barrell Melt extrusion pot (UoW)	Barrell	Melt extrusion pot	Pneumatic melt pot extruder	2012	Polymer melting pot	Furnaces	Materials synthesis and modification	Material modification	High temperature furnaces used to melt materials to create glass fibre fabrication.
Materials Node	3D Bio-fab	UoW	Barrell Twin Screw Extruder (UoW)	Barrell	Twin Screw Extruder	Bench top twin screw extrusion system	2014	Twin screw extrusion system	Extrusion systems	Manufacturing and machining	Optical fibre pulling and processing	The ability to create objects of a fixed cross-sectional profile by pushing material through a die of the desired cross-section. Extrusion systems are used to create optical fibres.
Materials Node	Materials for bio-med and bio device fab	UoW	Heidolph Laborota 4000 Efficient (UoW)	Heidolph	Laborota 4000 Efficient	4xHeidolph laborota 4000 efficient rotavap VBeco	2011	Rotary Evaporator	Purification and drying	Materials synthesis and modification	Support systems	Removing contaminants from a sample is vital to ensuring uniformity and reproducibility of a sample. It is also required to enable certain chemical reactions that would not be possible with even trace amounts of contaminants, such as water – high purity solvents are a good example of this. Producing high purity samples requires specialist equipment that is typically located in specialised environments.
Materials Node	Materials for bio-med and bio device fab	UoW	Jobin Yvon HR800 (UoW)	Jobin Yvon	HR800	Capable of high speed Raman mapping	2006	Raman spectrometer	Other spectroscopy	Testing and validation	Spectroscopy	Variations on the theme of spectroscopy provide specific advantages for a range of uses – tweaking of the principle of observing the spectral output of materials in a variety of conditions can provide incredible amounts of information about the composition of a sample.
Materials Node	Materials for bio-med and bio device fab	UoW	Uniqsis FlowSyn (UoW)	Uniqsis	FlowSyn	Continuous flow reactor for organic synthesis	2012	Flow reactor for continuous flow reactions	Reactor	Materials synthesis and modification	Material synthesis	Reactors provide controllable environments in which to produce new materials.

Materials Node	Materials for bio-med and bio device fab	UoW	Bruker Avance III NMR (UoW)	Bruker	Avance III NMR	High performance nuclear magnetic resonance system	2008 + 2013 upgrade ($90K)	Nuclear magnetic resonance (NMR) spectroscopy	Other spectroscopy	Testing and validation	Spectroscopy	Variations on the theme of spectroscopy provide specific advantages for a range of uses – tweaking of the principle of observing the spectral output of materials in a variety of conditions can provide incredible amounts of information about the composition of a sample.
Materials Node	Materials for bio-med and bio device fab	UoW	Bruker ESR Spectrophotometer (UoW)	Bruker	ESR Spectrophotometer	Bruker ESR Spectrometer	2006					
Materials Node	Materials for bio-med and bio device fab	UoW	Sartojet Sartorius Stedim Biotech – Sartojet (UoW)	Sartojet	Sartorius Stedim Biotech – Sartojet		2008	Pump for large scale purification of organic compounds				
Materials Node	Materials for bio-med and bio device fab	UoW	Sartorius Stedim Biotech Sartorius Stedim Ultrafiltration system and Sartojet pump for large scale purification of organic compounds (UoW)	Sartorius Stedim Biotech	Sartorius Stedim Ultrafiltration system and Sartojet pump for large scale purification of organic compounds	Tangential cross-flow dialysis system		Large-scale purifier of organic compounds	Purification and drying	Materials synthesis and modification	Support systems	Removing contaminants from a sample is vital to ensuring uniformity and reproducibility of a sample. It is also required to enable certain chemical reactions that would not be possible with even trace amounts of contaminants, such as water – high purity solvents are a good example of this. Producing high purity samples requires specialist equipment that is typically located in specialised environments.
Materials Node	Materials for bio-med and bio device fab	UoW	Malvern Instruments Zetasizer (UoW)	Malvern Instruments	Zetasizer	Particle sizing and zeta potential measurements in solution.	2006	Photon correlation spectrometer	Particle sizing	Testing and validation	Particle characterisation	Measuring of the average size and the size distribution of particles within a sample. The result is provided as a size distribution. Different instrument can measure different size ranges and handle vastly different sample volumes.
Materials Node	Materials for bio-med and bio device fab	UoW	Shimadzu UV-3600 (UoW)	Shimadzu	UV-3600	UV-Vis spectrophotometer with dispersive and specular reflectance integration sphere capabilities for solid samples.	2008	UV-VIS-NIR Spectrophotometer	Spectrophotometry	Testing and validation	Spectroscopy	Spectrophotometry is a method that measures the amount of light that is absorbed or transmitted by a sample as a function of the wavelength of that light. This measurement is a basic characterisation of the optical properties and can be applied to various forms of sample, such as thin film and liquids.
Materials Node	Materials for bio-med and bio device fab	UoW	Horiba Scientific FL-1057 (UoW)	Horiba Scientific	FL-1057	Fluorescence & PL Lifetime	2008	Fluorescence microscope	Optical microscopy	Testing and validation	Microscopy	A fundamental form of sample analysis, optical microscopy uses a series of lenses to focus light that is reflected from or passed through a sample. Various forms of light and magnification can be used to visualise the sample.
Materials Node	Materials for bio-med and bio device fab	UoW	Agilent Technologies 1260 Infinity (UoW)	Agilent Technologies	1260 Infinity	HPLC system for materials separation and characterisation	2008	High performance liquid chromatography (HPLC) system	Liquid Chromatography (LC)	Materials synthesis and modification	Chromatography	Chromatography involves separating a mixture by passing it through a separation medium that gradually traps solutes due to their size – in liquid chromatography (LC) a sample is dissolved in suitable solvent and passed through a separation medium as a liquid. This could be done immediately ahead of analysis step, perhaps to see how much of a specific protein is within a sample, or it could be done to synthesise a highly purified material for later fabrication steps. LC is commonly performed at high pressure (high-performance liquid chromatography (HPLC)), which his able to resolve to a higher degree, or in conjunction with a mass spectrometer (LC-MS) for immediate analysis.
Materials Node	Materials for bio-med and bio device fab	UoW	Shimadzu IR-Prestige 21 FT-IR (UoW)	Shimadzu	IR-Prestige 21 FT-IR	FT-IR Microscope that is capable of determining average true range (ATR) of a sample.	2008	FTIR microscope with additional Shimadzu AIM-8800 IR Microscope	Fourier Transform Infrared (FTIR) Spectroscopy	Testing and validation	Spectroscopy	Fourier-transform infrared (FTIR) spectroscopy is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. It is a technique used to examine chemical composition using the infrared (IR) part of the electromagnetic spectrum. FTIR spectroscopy flashes a sample with a series of broadband light of varying IR wavelengths. The resulting collection of spectra are then interpreted using the Fourier transform algorithm to indicate which parts of the spectrum were absorbed, and therefore, the chemical composition of the sample.
Materials Node	Materials for bio-med and bio device fab	UoW	Rousselet Robatel Continuous basket centrifuge (UoW)	Rousselet Robatel	Continuous basket centrifuge	Basket centrifuge for continuous filtration of larger volumes of solvents	2013	Continuous basket centrifuge	Purification and drying	Materials synthesis and modification	Support systems	Removing contaminants from a sample is vital to ensuring uniformity and reproducibility of a sample. It is also required to enable certain chemical reactions that would not be possible with even trace amounts of contaminants, such as water – high purity solvents are a good example of this. Producing high purity samples requires specialist equipment that is typically located in specialised environments.
Materials Node	Materials for bio-med and bio device fab	UoW	Shimadzu Axima Confidence (UoW)	Shimadzu	Axima Confidence	Characterisation of non-volatile or non-soluble organic materials	2009	MALDI Mass Spectrometer	Other spectroscopy	Testing and validation	Spectroscopy	Variations on the theme of spectroscopy provide specific advantages for a range of uses – tweaking of the principle of observing the spectral output of materials in a variety of conditions can provide incredible amounts of information about the composition of a sample.
Materials Node	Materials for bio-med and bio device fab	UoW	Büchi B-290 (UoW)	Büchi	B-290	Powder spray drier	2010	Mini spray drier	Purification and drying	Materials synthesis and modification	Support systems	Removing contaminants from a sample is vital to ensuring uniformity and reproducibility of a sample. It is also required to enable certain chemical reactions that would not be possible with even trace amounts of contaminants, such as water – high purity solvents are a good example of this. Producing high purity samples requires specialist equipment that is typically located in specialised environments.
Materials Node	Materials for bio-med and bio device fab	UoW	Agilent Technologies 5975c/7890a (UoW)	Agilent Technologies	5975c/7890a	GCMS - HPLC for Gel permeation chromatography	2012	Gel permeation chromatography (GPC)	Gel permeation chromatography (GPC)	Materials synthesis and modification	Chromatography	Chromatography involves separating out a mixture, typically by passing it through a separation medium that gradually traps solutes due to their size – in Gel permeation chromatography (GPC) a sample is dissolved in suitable solvent and passed through a gel-based separation medium. This could be done immediately ahead of analysis step, perhaps to see how much of a specific protein is within a sample, or it could be done to synthesise a highly purified material for later fabrication steps.
Materials Node	Materials for bio-med and bio device fab	UoW	Shimadzu LCMS 2020 2020-LCMS (UoW)	Shimadzu LCMS 2020	2020-LCMS	Liquid Chromatography Mass Spectrometer for materials separation and characterisation	2012	Liquid chromatography mass spectrometry (LC-MS) system	Liquid Chromatography (LC)	Materials synthesis and modification	Chromatography	Chromatography involves separating a mixture by passing it through a separation medium that gradually traps solutes due to their size – in liquid chromatography (LC) a sample is dissolved in suitable solvent and passed through a separation medium as a liquid. This could be done immediately ahead of analysis step, perhaps to see how much of a specific protein is within a sample, or it could be done to synthesise a highly purified material for later fabrication steps. LC is commonly performed at high pressure (high-performance liquid chromatography (HPLC)), which his able to resolve to a higher degree, or in conjunction with a mass spectrometer (LC-MS) for immediate analysis.
Materials Node	Materials for bio-med and bio device fab	UoW	Shimadzu LC20 - Gel Permeation Chromatography System HPLC LC20 GPC (UoW)	Shimadzu LC20 - Gel Permeation Chromatography System	HPLC LC20 GPC	HPLC system - specialist GPC system (aqueous & non-aqueous)	2012	HPLC - specialist GPC system (aqueous & non-aqueous)	Liquid Chromatography (LC)	Materials synthesis and modification	Chromatography	Chromatography involves separating a mixture by passing it through a separation medium that gradually traps solutes due to their size – in liquid chromatography (LC) a sample is dissolved in suitable solvent and passed through a separation medium as a liquid. This could be done immediately ahead of analysis step, perhaps to see how much of a specific protein is within a sample, or it could be done to synthesise a highly purified material for later fabrication steps. LC is commonly performed at high pressure (high-performance liquid chromatography (HPLC)), which his able to resolve to a higher degree, or in conjunction with a mass spectrometer (LC-MS) for immediate analysis.
Materials Node	3D Bio-fab	UoW	Me3D Me2 (UoW)	Me3D	Me2	Fused deposition modelling (FDM) system	2014	3D Printer	Fused Deposition Modelling (FDM) system	Manufacturing and machining	3D Printing	Fused deposition modelling (FDM), also know as fused filament fabrication (FFF), is an additive manufacturing (AM) process in which a physical object is created directly from a computer-aided design (CAD) model using layer-by-layer deposition of a feedstock plastic filament material extruded through a nozzle.
Materials Node	3D Bio-fab	UoW	Winding Units (UoW)		Winding Units	Winding Spools	2010					
Materials Node	3D Bio-fab	UoW	Fujifilm Dimatix (UoW)	Fujifilm	Dimatix	Inkjet and biological printing system	2008	2D inkjet printer	Inkjet printing	Manufacturing and machining	2D Printing	Inkjet printing is similar to the process conducted in most offices across the world, but instead of using conventional inks, researchers are beginning to use conductive liquids, or even photovoltaic ones, to give a printed product far greater functionality.
Materials Node	3D Bio-fab	UoW	KSV Nima Dip Coater (UoW)	KSV Nima	Dip Coater	Dip Coating System	2008					
Materials Node	3D Bio-fab	UoW	Cellink Inkredible (UoW)	Cellink	Inkredible	3D bioprinter	2016	Desktop bioprinter	3D additive biofabrication	Manufacturing and machining	3D Printing	3D additive biofabrication reapplies the layer-by-layer method of 3D printing to produce living tissues. One prominent technique involves printing layers of a biocompatible substance called a hydrogel that has been infused with a patients stem cells. Once a 3D structure has been printed, stem cells can proliferate across this hydrogel scaffold until a biomedical part is complete, ready for implantation.

Materials Node	3D Bio-fab	UoW	Allevi BioBots (UoW)	Allevi	BioBots	3D bioprinter	2016	Desktop bioprinter	3D additive biofabrication	Manufacturing and machining	3D Printing	3D additive biofabrication reapplies the layer-by-layer method of 3D printing to produce living tissues. One prominent technique involves printing layers of a biocompatible substance called a hydrogel that has been infused with a patients stem cells. Once a 3D structure has been printed, stem cells can proliferate across this hydrogel scaffold until a biomedical part is complete, ready for implantation.
Materials Node	3D Bio-fab	UoW	Formlabs Form1 (UoW)	Formlabs	Form1	Desktop stereolithography (SLA) system	2014	Desktop stereolithography (SLA) system	Plastic printing	Manufacturing and machining	3D printing	3D printing involves taking a model and slicing into layers, then printing these layers on top of one another to recreate a 3D component. It's an incredibly quick way to produce unique parts, or for small production runs, and is massively useful when wanting to quickly create prototypes. A variety of materials can be printed, such as metals and biological materials – however, desktop 3D printers tend to use plastics.
Materials Node	3D Bio-fab	UoW	Leica M205A Microscope (UoW)	Leica	M205A Microscope	Image acquisition and analysis	2012	Optical microscope	Optical microscopy	Testing and validation	Microscopy	A fundamental form of sample analysis, optical microscopy uses a series of lenses to focus light that is reflected from or passed through a sample. Various forms of light and magnification can be used to visualise the sample.
Materials Node	3D Bio-fab	UoW	Sherline 4410 Bench-Top Lathe (UoW)	Sherline	4410 Bench-Top Lathe	Benchtop Lathe	2008					
Materials Node	3D Bio-fab	UoW	EasyBeat Precision Spot Welder (UoW)	EasyBeat	Precision Spot Welder	Benchtop Spot Welder	2006					
Materials Node	3D Bio-fab	UoW	Brother XD - 1200N Furance (UoW)	Brother	XD - 1200N Furance	Benchtop Furnace	2013					
Materials Node	3D Bio-fab	UoW	Custom Needleless Electrospinner (UoW)	Custom	Needleless Electrospinner	Needleless Electrospinner	2015	Electrospinner	Fibre processing	Materials synthesis and modification	Fibres and textiles	Traditional techniques such as spinning, weaving and knitting are being scaled down to create and handle novel fibres that are vital to new materials, flexible electronics, wearable technologies, as well as new applications in medical and defence sectors.
Materials Node	3D Bio-fab	UoW	Ashford Weaving loom (UoW)	Ashford	Weaving loom	Weaving loom	2008	Weaving loom	Fibre processing	Materials synthesis and modification	Fibres and textiles	Traditional techniques such as spinning, weaving and knitting are being scaled down to create and handle novel fibres that are vital to new materials, flexible electronics, wearable technologies, as well as new applications in medical and defence sectors.
Materials Node	3D Bio-fab	UoW	Carver Hot press (UoW)	Carver	Hot press		2015	Hot press	Hot embossing	Lithography	Embossing	Hot embossing is a pattern-transfer technique, involving the application of pressure and heat to a polymeric or resist-coated substrate, placed in contact with a master mould. This allows the relief features on the mould to be transferred faithfully. Hot embossing achieves fast patterning at a resolution of 50nm. This technique addresses a wide range of applications, from polymer-based lab-on-chip systems, where imprinting is performed on thick polymers substrates, for the fabrication of sub 50nm features for bio-sensing or data recording applications, as well as microfluidics, MEMS, optoelectronics, packaging and SOI production.
Materials Node	3D Bio-fab	UoW	Barrell Cryomill (UoW)	Barrell	Cryomill	Used to mill resins	2015	Cryomill	Other milling	Manufacturing and machining	Milling	Various milling processes
Materials Node	3D Bio-fab	UoW	Objet Eden 260 (UoW)	Objet	Eden 260	Polyjet Printing System	2011					
Materials Node	3D Bio-fab	UoW	Dimension UPrint Plus (UoW)	Dimension	UPrint Plus	3D Fused deposition modelling (FDM) system	2010	Fused deposition modelling (FDM) system	Fused Deposition Modelling (FDM) system	Manufacturing and machining	3D Printing	Fused deposition modelling (FDM), also know as fused filament fabrication (FFF), is an additive manufacturing (AM) process in which a physical object is created directly from a computer-aided design (CAD) model using layer-by-layer deposition of a feedstock plastic filament material extruded through a nozzle.
Materials Node	3D Bio-fab	UoW	Dell Precision T3500 (UoW)	Dell	Precision T3500	Bookable computer suite with design packages installed	2010	Computer for CAD modelling	Computers	Modelling and device design	CAD	Professional CAD computing requires serious hardware – certain ANFF sites possess dedicated CAD computers for modelling and designing purposes. These computers will feature specific software packages to model complex systems such as optical or microfluidic devices, to interpret 3D scanner information, or to create new designs from scratch.
Materials Node	3D Bio-fab	UoW	Dell Precision T5600 (UoW)	Dell	Precision T5600	Bookable computer suite with design package installed	2013	Computer for CAD modelling	Computers	Modelling and device design	CAD	Professional CAD computing requires serious hardware – certain ANFF sites possess dedicated CAD computers for modelling and designing purposes. These computers will feature specific software packages to model complex systems such as optical or microfluidic devices, to interpret 3D scanner information, or to create new designs from scratch.
Materials Node	3D Bio-fab	UoW	Tiertime UP Plus 2 (UoW)	Tiertime	UP Plus 2	3D Fused deposition modelling (FDM) system	2015	Fused deposition modelling (FDM) system	Fused Deposition Modelling (FDM) system	Manufacturing and machining	3D Printing	Fused deposition modelling (FDM), also know as fused filament fabrication (FFF), is an additive manufacturing (AM) process in which a physical object is created directly from a computer-aided design (CAD) model using layer-by-layer deposition of a feedstock plastic filament material extruded through a nozzle.
Materials Node	3D Bio-fab	UoW	Roland Picza LPX 600 (UoW)	Roland	Picza LPX 600	3D scanner	2011	3D scanner	Laser scanning	Modelling and device design	3D Modelling	Laser scanning can be used to record a three-dimensional computer model of an object, often for CAD modelling, but also for part inspection or defect monitoring. A laser is used to take spot measurements in three dimensional space of an object. This can be done using a handheld or mounted scanner that revolves around the object while it is stationary. Once scanned, a computer file is created that can be used for 3D printing, further CAD work, or other digital steps.
Materials Node	3D Bio-fab	UoW	Lumen Dynamics Omnicure Series 1000 (UoW)	Lumen Dynamics	Omnicure Series 1000	UV light photocuring system	2012	UV flood exposure source	Plastic printing	Manufacturing and machining	3D printing	3D printing involves taking a model and slicing into layers, then printing these layers on top of one another to recreate a 3D component. It's an incredibly quick way to produce unique parts, or for small production runs, and is massively useful when wanting to quickly create prototypes. A variety of materials can be printed, such as metals and biological materials – however, desktop 3D printers tend to use plastics.
Materials Node	3D Bio-fab	UoW	Artec Spyder (UoW)	Artec	Spyder	A versatile handheld scanner that is used for product design and quality control applications.	2013	Handheld 3D scanner	Laser scanning	Modelling and device design	3D Modelling	Laser scanning can be used to record a three-dimensional computer model of an object, often for CAD modelling, but also for part inspection or defect monitoring. A laser is used to take spot measurements in three dimensional space of an object. This can be done using a handheld or mounted scanner that revolves around the object while it is stationary. Once scanned, a computer file is created that can be used for 3D printing, further CAD work, or other digital steps.
Materials Node	3D Bio-fab	UoW	Glovebox Process specific (UoW)	Glovebox	Process specific	Glovebox for handling metal powder	2014	Glovebox for handling metal powder	Gloveboxes	Laboratory infrastructure	Specialised environments	Gloveboxes provide an encapsulated environment to either protect a sample from the atmosphere, or to protect the cleanroom from a sample.
Materials Node	Materials for bio-med and bio device fab	UoW	Sonics Vibra-cell (UoW)	Sonics	Vibra-cell	Ultrasonic processor	2011	Ultrasonic processor	Ultrasonic processing	Materials synthesis and modification	Separation techniques	Ultrasonic processing uses ultrasonic waves to clean or separate pieces, to speed up reactions, or encourage dissolution.
Materials Node	Materials for bio-med and bio device fab	UoW	CEM Discover, DKSH laboratory microwave reactor and accessories (UoW)		CEM Discover, DKSH laboratory microwave reactor and accessories	CEM Discover, DKSH laboratory microwave reactor and accessories	2012					
Materials Node	Materials for bio-med and bio device fab	UoW	LC technology solutionsDry Solvents dispenser (UoW)		LC technology solutionsDry Solvents dispenser	LC technology solutionsDry Solvents dispenser	2011					
Materials Node	Materials for bio-med and bio device fab	UoW	Sonics VCX1500 (UoW)	Sonics	VCX1500	Ultrasonication probe	2011	Ultrasonication probe	Ultrasonic processing	Materials synthesis and modification	Separation techniques	Ultrasonic processing uses ultrasonic waves to clean or separate pieces, to speed up reactions, or encourage dissolution.
Materials Node	Materials for bio-med and bio device fab	UoW	Parr Instrument Company 5100 Reactor (UoW)	Parr Instrument Company	5100 Reactor	Low pressure glass reactor	2010	Low pressure glass reactor	Glass fabrication	Materials synthesis and modification	Material synthesis	Glass fabrication requires incredible temperatures and pressures, but can be harnessed to produce materials that are functionalised towards a large range of applications. Concocting different mixtures or introducing nanoparticles can result in glass with novel properties – these are then typically used in light-based applications like sensing, communications, or advanced optics.

Materials Node	Materials for bio-med and bio device fab	UoW	Grace Reveleris (UoW)	Grace	Reveleris	Large-scale purification system for complex organic mixtures	2013	Large-scale purification system for complex organic mixtures	Liquid Chromatography (LC)	Materials synthesis and modification	Chromatography	Chromatography involves separating a mixture by passing it through a separation medium that gradually traps solutes due to their size – in liquid chromatography (LC) a sample is dissolved in suitable solvent and passed through a separation medium as a liquid. This could be done immediately ahead of analysis step, perhaps to see how much of a specific protein is within a sample, or it could be done to synthesise a highly purified material for later fabrication steps. LC is commonly performed at high pressure (high-performance liquid chromatography (HPLC)), which his able to resolve to a higher degree, or in conjunction with a mass spectrometer (LC-MS) for immediate analysis.
Materials Node	Materials for bio-med and bio device fab	UoW	Sigma Laboratory Centrifuge (UoW)	Sigma Laboratory	Centrifuge	Centrifuge	2014	Centrifuge	Centrifuge	Materials synthesis and modification	Separation techniques	Centrifuges provide a simple way to separate materials that are suspended in a liquid. By spinning samples at high speeds, materials with different densities are separated from one another by centrifugal forces. This technique is often used in biological applications for, say, separating the constituent parts of blood.
Materials Node	Materials for bio-med and bio device fab	UoW	Balance (UoW)		Balance	Balance	2012					
Materials Node	Materials for bio-med and bio device fab	UoW	Carbolite Gero Tube Furnace (UoW)	Carbolite Gero	Tube Furnace	Horizontal tube furnace	2015	Horizontal furnace	Furnaces	Materials synthesis and modification	Material modification	High temperature furnaces used to melt materials to create glass fibre fabrication.
Materials Node	Materials for bio-med and bio device fab	UoW	Genser Germany Continiuous rotary evaporator (UoW)	Genser Germany	Continiuous rotary evaporator	Continuous rotary evaporator for sub-pilot scale synthesis	2012	Rotary Evaporator	Purification and drying	Materials synthesis and modification	Support systems	Removing contaminants from a sample is vital to ensuring uniformity and reproducibility of a sample. It is also required to enable certain chemical reactions that would not be possible with even trace amounts of contaminants, such as water – high purity solvents are a good example of this. Producing high purity samples requires specialist equipment that is typically located in specialised environments.
Materials Node	Materials for bio-med and bio device fab	UoW	GMM Pfaudler 35L Reactor system (Zone 1 - Class 3 solvents) (UoW)	GMM Pfaudler	35L Reactor system (Zone 1 - Class 3 solvents)	35L Reactor system (Zone 1 - Class Printer - 35-litre	2013	35-litre jacketed reactor	Reactor	Materials synthesis and modification	Material synthesis	Reactors provide controllable environments in which to produce new materials.
Queensland Node	Device Fabrication	UQ	ADT Provectus 7100 (UQ)	ADT	Provectus 7100	Fully programmable dicing saw capable of dicing up to 8 inch wafers.	2012	Wafer dicer	Wafer dicing	Packaging	Wafer processing	Nanofabricated devices are generally made in batches on wafers and need to be separated or packaged before use. This separation can be achieved through wet or dry dicing. In a wet dicing operation, a precision, high-speed, diamond impregnated blade is used to mill narrow grooves between the devices either partially or completely through the wafer. During this process, water is circulated over the cutting surface to cool the blade and prevent the liberation of dangerous particulates into the air. Materials which would be damaged by water are diced using a dry process known as scribing. Scribing utilises a diamond tipped stylus which is drawn across the wafer surface creating lines of high-stress which are later broken over precision fulcrum.
Queensland Node	Device Fabrication	UQ	AJA International ATC-2200 (UQ)	AJA International	ATC-2200	The system has RF and DC sputter sources in addition to Argon, Oxygen and Nitrogen gases for reactive film deposition.	2012	RF/DC sputtering system	Sputtering	Deposition	Physical Vapour Deposition (PVD)	Sputtering is a physical vapour deposition method that involves depositing thin films in a vacuum environment. During this process, a solid material and substrate are positioned separately within a vacuum system. A high-energy argon ion plasma stream is targeted at the material, resulting in the subject material being ejected and deposited onto the substrate, creating a thin film. As this is not an evaporative process, the temperatures required for sputtering are lower than evaporation methods. This makes it one of the most flexible deposition processes and it is particularly useful for depositing materials with a high melting point or a mixture of materials, as compounds that may evaporate at different rates, can be sputtered at the same rate. Certain processes will benefit from improved film adhesion due to higher impact energy. The sputtering process is used extensively in the semiconductor industry, screen displays, photovoltaics and magnetic data storage. Sputtering can be used to deposit a wide variety of thin films including metals, oxides, nitrides and alloys.
Queensland Node	Device Fabrication	UQ	Nanoscribe Photonic Professional GT (UQ)	Nanoscribe	Photonic Professional GT	3D Printing with a minimum voxel size of 100 x 350 nm. The dual photon technology is used to construct high resolution and complex structures in polymers (such as AZ resist, SU8 and proprietary IP resists from Nanoscribe).	2014	100-nanometre resolution 3D printer	Nanoprinting	Manufacturing and machining	3D Printing	3D printing involves taking a model and slicing into layers, then printing these layers on top of one another to recreate a 3D component. It's an incredibly quick way to produce unique parts, or for small production runs, and is massively useful when wanting to quickly create prototypes. 3D Printing at the nanoscale can help drastically reduce the cost and time drains of prototyping novel technologies and devices by rapidly creating new iterations.
Queensland Node	Device Fabrication	UQ	Temescal Systems FC-2000 (UQ)	Temescal Systems	FC-2000	Can perform thermal and e-beam evaporation on multiple wafers at the same time. Features six source pockets for multiple layer coatings.	2012	Electron beam evaporator	Electron Beam Evaporation (E-Beam Evaporation)	Deposition	Physical Vapour Deposition (PVD)	Electron-beam evaporation is a physical vapour deposition method for depositing thin films of metals, oxides and semiconductors in a high vacuum environment. Ultra high purity coating material is placed inside a vacuum chamber, typically as pellets in a crucible. Electron energy is used to heat these pellets, causing the coating material to enter the gas phase. Due to the vacuum environment, the evaporated particles can travel to the substrate without colliding with foreign particles, where they then condense on the substrate surface in a thin film. Electron beam evaporation is used to deposit electronic and optical films for the semiconductor industry and has applications in displays and photovoltaics. High melting point materials can be deposited at high deposition rates, making this a preferred process for refractory metal and ceramic films.
Queensland Node	Device Fabrication	UQ	Heidelberg µPG 101 (UQ)	Heidelberg	µPG 101	Direct writing of structures down to 1µm in photoresist coated substrates and writing of chrome masks.	2013	Direct laser lithography system on a 6 inch platform.	Direct laser lithography	Lithography	Direct Write Lithography	Laser processing uses a highly controlled and focused beam of high-energy photons of the same wavelength to burn away material. These processes are repeatable, scalable and cheap, but can induce thermal stresses on the substrate, and resolutions tend to be in the micrometre regime. Laser processing is often used within ANFF to create masks for later lithography steps, but it can also be used to create patterns directly into the substrate itself, skipping several ordinary fabrication steps.
Queensland Node	Device Fabrication	UQ	EVG 620 (UQ)	EVG	620	Multilayer exposures of photoresists through a mask. Can resolve alignment marks down to 1µm and perform front and backside alignment on both 4 and 6 inch wafers.	2009	Mask aligner and resist exposure system	Multiple mask lithography	Lithography	Photolithography	Photolithography is used to create a pattern on a substrate by shining light from a light source onto a photoresist that coats the surface of the substrate through a photomask and is followed by a development phase. Depending on the complexity of a device's design, various deposition, etching and lithography processes can be cycled through many times. This could mean that more than one photolithography stage is required, potentially dozens, and each iteration could require a new mask. Each mask used has to be aligned perfectly to the previously processed layer if the final device is to operate as desired. To do this, photomasks are often made to feature alignment marks, but to assist with accuracy, mask aligners are commonly used to ensure things line up. These mask aligning systems also offer a great deal of control over the exposure settings and conditions in which the photolithography process takes place.
Queensland Node	Device Fabrication	UQ	Plasma-Therm Versaline (UQ)	Plasma-Therm	Versaline	Controlled dry anisotropic etching of silicon wafers up to 6 inches in diameter utilising the Bosch process. The deep silicon etching (DSE) process alternates between deposition and isotropic etching in a chamber with an ICP configuration.	2008	Deep reactive ion etcher (DRIE)	Deep Reactive Ion Etching (DRIE)	Etching	Dry Etching	Deep Reactive Ion Etching (DRIE) is effectively an extension of the Reactive Ion Etching (RIE) process, but can provide higher aspect ratio structures. The DRIE process alternates between etch and passivation cycles to allow patterns to be cut deeper into a substrate. Etch channels or other feature geometries with extremely high uniformity into glass, plastic or silicon substrates

Queensland Node	Device Fabrication	UQ	Hitech CTF/150/3Z/1200C (UQ)	Hitech	CTF/150/3Z/1200C	Dry thermal oxidation produces high integrity oxides compared to sputtered, evaporated or PECVD films. Dry thermal oxidation of silicon to create SiO2 films up to 300 nm thick. The temperature and gas flow are tightly controlled.	2008	Oxidation Furnace	Furnaces	Materials synthesis and modification	Material modification	High temperature furnaces used to melt materials to create glass fibre fabrication.
Queensland Node	Device Fabrication	UQ	MBRAUN MBUV-O3 (UQ)	MBRAUN	MBUV-O3	Used for wafer cleaning or surface functionalisation.	2008	Glovebox with UV ozone cleaner	Gloveboxes	Laboratory infrastructure	Specialised environments	Gloveboxes provide an encapsulated environment to either protect a sample from the atmosphere, or to protect the cleanroom from a sample.
Queensland Node	Device Fabrication	UQ	Oxford Instruments PlasmaPro NGP80 (UQ)	Oxford Instruments	PlasmaPro NGP80	Dry etching of materials using CF4, CHF3, SF6, O2, or Argon gases	2016	Reactive ion etcher (RIE)	Reactive Ion Etching (RIE)	Etching	Dry Etching	Reactive Ion Etching (RIE) is a method that combines both chemical and physical etching to allow isotropic and anisotropic material removal. The etching process is carried out in a chemically reactive plasma containing positively and negatively charged ions generated from gases that are pumped into the reaction chamber. A mask on top of the substrate is used to protect designated areas from etching, exposing only the areas to be etched. Dry etching offers excellent process control for cleanliness, homogeneity, etch-rate, etch-profile, selectivity and run-to-run consistency, which is critical for high-fidelity pattern-transfer in micro- and nano-system technologies. RIE is extensively used in the field of displays & lighting (LEDs), semiconductors, electronics, MEMS, communication technology, microfluidics, optoelectronics and photovoltaics.
Queensland Node	Device Fabrication	UQ	EVG 520 (UQ)	EVG	520	Can emboss wafers of up to 6-inch diameter. Can also perform bonding such as anodic bonding, fusion bonding, eutectic bonding and epoxy bonding.	2009	Hot embossing tool for 6 inch wafers	Hot embossing	Lithography	Embossing	Hot embossing is a pattern-transfer technique, involving the application of pressure and heat to a polymeric or resist-coated substrate, placed in contact with a master mould. This allows the relief features on the mould to be transferred faithfully. Hot embossing achieves fast patterning at a resolution of 50nm. This technique addresses a wide range of applications, from polymer-based lab-on-chip systems, where imprinting is performed on thick polymers substrates, for the fabrication of sub 50nm features for bio-sensing or data recording applications, as well as microfluidics, MEMS, optoelectronics, packaging and SOI production.
Queensland Node	Device Fabrication	UQ	Class One Wetbench & spin dryer (UQ)	Class One	Wetbench & spin dryer	The wetbench has three baths for chemical etching and one dump rinse station.	2009	Wetbench with spin dryer	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
Queensland Node	Device Fabrication	UQ	Fumehoods Process specific (UQ)	Fumehoods	Process specific	This recirculating fume cupboard houses a spin coater, a hot plate, and a development station which are used for processing AZ photoresists.	2016	Fumehoods for lithography processes	Fumehoods	Laboratory infrastructure	Specialised environments	Fumehoods offer a safe space to process materials that may produce harmful gases.
Queensland Node	Device Fabrication	UQ	MBraun MB200 (UQ)	MBraun	MB200	Controlled isolated atmosphere for oxygen and moisture sensitive materials.	2008	Glovebox with solvent purification system	Gloveboxes	Laboratory infrastructure	Specialised environments	Gloveboxes provide an encapsulated environment to either protect a sample from the atmosphere, or to protect the cleanroom from a sample.
Queensland Node	Device Fabrication	UQ	MBraun Solvent Purification System (SPS) (UQ)	MBraun	Solvent Purification System (SPS)	A convenient way to provide dry solvents for synthesis work. Directly connected to an environmentally controlled glovebox.		Solvent purifier	Purification and drying	Materials synthesis and modification	Support systems	Removing contaminants from a sample is vital to ensuring uniformity and reproducibility of a sample. It is also required to enable certain chemical reactions that would not be possible with even trace amounts of contaminants, such as water – high purity solvents are a good example of this. Producing high purity samples requires specialist equipment that is typically located in specialised environments.
Queensland Node	Device Fabrication	UQ	Cleanroom Class 10,000 (UQ)	Cleanroom	Class 10,000	A 125m2 located in the Australian Institute for Bioengineering and Nanotechnology	2008	Class 10,000 cleanroom space	Cleanroom spaces	Laboratory infrastructure	Specialised environments	A cleanroom is a highly purified environment, containing as few as 100 "dirty" particles in one cubic foot of air -- a cubic foot of air on a typical street can contain approximately 350 million of dirty particles. Cleanrooms are essential to creating micro and nanotechnologies. Considering that the scale of most of the structures and devices made using micro or nanofabrication processes is 10's of thousands times smaller than a human hair, dust and dirt can ruin a sample. cleanroom suits are required for entry into these controlled spaces, not to protect the user from the samples, but rather to protect the samples from the user. However, temperature changes and lighting conditions can also ruin these delicate structures as they are being made. Cleanrooms are engineered to force potential contaminants from the local atmosphere, also maintaining consistent temperatures, and controlling lighting conditions.
Queensland Node	Device Fabrication	UQ	MBRAUN MBEVAP (UQ)	MBRAUN	MBEVAP	Evaporates organic materials within a controlled N2 glovebox		Thermal evaporator for depositing organic materials	Thermal evaporation	Deposition	Physical Vapour Deposition (PVD)	Thermal Evaporation is one of the simplest forms of physical vapor deposition (PVD). It uses heat to evaporate a high purity source material that moves through a vacuum chamber and deposits a thin film on a substrate. Thermal evaporation can be used to deposit metals, organic, and inorganic polymers. In this method, electrical energy is used to heat a filament which in turn heats a deposition material to the point of evaporation. The process can be performed at very high levels of vacuum to eliminate collisions with foreign particles and therefore fewer tendencies to introduce film impurities. High deposition rates can be achieved and lower energy particles can reduce substrate damage. Thermal evaporation is widely used when creating polymer solar cells and flexible electronics.
Queensland Node	Device Fabrication	UQ	MBRAUN MBEVAP (UQ)	MBRAUN	MBEVAP	Evaporates non-organic materials within a controlled N2 glovebox		Thermal evaporator for depositing metals	Thermal evaporation	Deposition	Physical Vapour Deposition (PVD)	Thermal Evaporation is one of the simplest forms of physical vapor deposition (PVD). It uses heat to evaporate a high purity source material that moves through a vacuum chamber and deposits a thin film on a substrate. Thermal evaporation can be used to deposit metals, organic, and inorganic polymers. In this method, electrical energy is used to heat a filament which in turn heats a deposition material to the point of evaporation. The process can be performed at very high levels of vacuum to eliminate collisions with foreign particles and therefore fewer tendencies to introduce film impurities. High deposition rates can be achieved and lower energy particles can reduce substrate damage. Thermal evaporation is widely used when creating polymer solar cells and flexible electronics.
Queensland Node	Device Fabrication	UQ	Custom Etcher (UQ)	Custom	Etcher	System used for isotropic etching of silicon using xenon difluoride gas.		XeF2 etcher	Vapour phase etching	Etching	Dry etching	Vapour phase etching involves exposing a substrate to a corrosive chemical in vapour form which will remove material that it comes into contact with. The sections of material that are removed can be selected by protecting parts of the substrate that are desired to be kept with a mask or coating.
Queensland Node	Device Fabrication	UQ	Cleanroom Class 10,000 (UQ)	Cleanroom	Class 10,000	A 26m2 cleanroom located in the UQ Long Pocket campus	2008	Class 10,000 cleanroom space	Cleanroom spaces	Laboratory infrastructure	Specialised environments	A cleanroom is a highly purified environment, containing as few as 100 "dirty" particles in one cubic foot of air -- a cubic foot of air on a typical street can contain approximately 350 million of dirty particles. Cleanrooms are essential to creating micro and nanotechnologies. Considering that the scale of most of the structures and devices made using micro or nanofabrication processes is 10's of thousands times smaller than a human hair, dust and dirt can ruin a sample. cleanroom suits are required for entry into these controlled spaces, not to protect the user from the samples, but rather to protect the samples from the user. However, temperature changes and lighting conditions can also ruin these delicate structures as they are being made. Cleanrooms are engineered to force potential contaminants from the local atmosphere, also maintaining consistent temperatures, and controlling lighting conditions.

Queensland Node	Metrology	UQ	Jeol NeoSCOPE (UQ)	Jeol	NeoSCOPE	Desktop SEM used to image small conductive samples, up to 70 mm in diameter.	2009	Desktop Scanning Electron Microscope (SEM)	Scanning Electron Microscopy (SEM)	Testing and validation	Scanning Electron Microscopy (SEM)	Scanning Electron Microscopy (SEM) is the process whereby a tightly focused electron beam is scanned onto the surface to be imaged. As the primary electrons hit the atoms in the surface, a number of secondary electrons are emitted, and collected by the instrument's detector, which assigns a level of grey accordingly, thereby creating a pixel for a digital image. The machines can routinely image features down to about 10nm, and in some special cases down to several nm in size. SEM is a key tool for process characterisation of surface topography. Most samples fabricated in the cleanroom undergoes at least one round of SEM imaging, in order to assess the quality of the fabrication and its defects. This information is fed into the process optimisation loop until a satisfying sample is produced. The tool is also used to image samples such as fixated cells and failed components.
Queensland Node	Metrology	UQ	NIKON Ti-U and V9.1 (UQ)	NIKON	Ti-U and V9.1	Inverted light microscope with epi fluorescence and attached high speed camera which allows analysis of moving particles.	2011	Microfluidic characterisation station – attached to Nikon Eclipse Ti-U optical microscope	High Speed Camera	Testing and validation	Cameras	High speed cameras can provide slow motion footage of events by recording many thousands of frames per second and playing them back at normal speed. This is incredibly useful when monitoring things that are too quick to see, such as crack propagation when testing a device to destruction, or monitoring biological effects in slow motion.
Queensland Node	Metrology	UQ	SCI FilmTek 2000M (UQ)	SCI	FilmTek 2000M	Provides quick and simple measurements of film thickness, index of refraction and extinction coefficient using reflected and absorbed white light when analysing transparent or semi-transparent thin films.	2013	Benchtop spectroscopic reflectometer	Reflectometry	Testing and validation	Thin film characterisation	Reflectometry is the characterisation of a surface or interface using the information gathered by the reflected wave of a generated signal. The signal can be light, sound, or particles.
Queensland Node	Metrology	UQ	Anton Paar SurPASS (UQ)	Anton Paar	SurPASS	Simple to use equipment to measure surface charge of solid surface, powder and fibre.	2012	Streaming potential measurement	Zeta potential analysis	Testing and validation	Particle characterisation	Solid surface analysis is important for determining electrokinetic potential of macroscopic solids where streaming potential and currents are measured. The instrument is capable of acquiring single measurements at a specific pH or a titration, which can range for pH 2 to 12. With the availability of three mounts, a variety of samples ranging from solid surfaces to fabrics and powdered samples can be assessed. The electrokinetic analyser can measure surface potential (zeta potential) of smooth surfaces and Isoelectric point of surfaces can also be identified. Surface potential of metal plates, ceramic tiles, wafers and thin films can be measured with a clamping cell whereas for measurements of polymer membranes, filters textile fabrics and minerals and rocks require an adjustable gap cell. A cylindrical cell can be acquired for measuring zeta potential of powdered and granular samples.
Queensland Node	Metrology	UQ	Agilent Technologies 1260 Infinity (UQ)	Agilent Technologies	1260 Infinity	Four detector system to separate and analyse molecular weight and PDI of water soluble compounds or polymers.	2013	Aqueous gel permeation chromatography (GPC) system with RI, UV, viscosity and light scattering detectors	Gel permeation chromatography (GPC)	Materials synthesis and modification	Chromatography	Chromatography involves separating out a mixture, typically by passing it through a separation medium that gradually traps solutes due to their size – in Gel permeation chromatography (GPC) a sample is dissolved in suitable solvent and passed through a gel-based separation medium. This could be done immediately ahead of analysis step, perhaps to see how much of a specific protein is within a sample, or it could be done to synthesise a highly purified material for later fabrication steps.
Queensland Node	Metrology	UQ	PV Measurements QEX7 (UQ)	PV Measurements	QEX7	This Quantum Efficiency(QE)/Spectral Response(SR)/Incident Photon to Current Conversion Efficiency(IPCE)/IV Measurement System is a low-cost, high-performance quantum efficiency measurement system for solar cell analysis. Supplies a calibrated light intensity over known spectrum for testing solar cell efficiency and performance.	2008	Quantum efficiency and spectral response measurement system for solar cell measurement	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.
Queensland Node	Metrology	UQ	JPK NanoWizard II (UQ)	JPK	NanoWizard II	AFM with cell adhesion module, suitable for live cell imaging built on a Zeiss inverted microscope base. Modes available: fluid cell; temperature and gas control for biological samples; cohesion module (piezo crystal 100 µm in Z); optical/AFM image overlay; and electrochemical unit.	2008	Atomic force microscope (AFM) for biological samples	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
Queensland Node	Metrology	UQ	J. A. Woollam VUV VASE (Gen-II) (UQ)	J. A. Woollam	VUV VASE (Gen-II)	Versatile, easy to use ellipsometer for measurement of optical properties, film thickness and refractive index.	2008	Variable angle spectroscopic ellipsometer	Spectroscopic ellipsometry	Testing and validation	Thin film characterisation	Spectroscopic ellipsometry is an optical characterisation technique which provides a highly sensitive, contactless method for thin film measurements. Multiple light wavelengths and variable angles of polarised light are reflected off the surface of a sample. As this light reflects, its characteristics change depending on a number of the sample's properties – it can therefore be used to characterise film thickness as well as composition such as roughness, crystalline nature, electrical conductivity and doping concentration.
Queensland Node	Metrology	UQ	Waters 1515 Isocratic HPLC Pump (UQ)	Waters	1515 Isocratic HPLC Pump	Separation and analysis of molecular weight and PDI of organic compounds or polymers that have been dissolved in Tetrahydrofuran (THF).	2008	Gel permeation chromatography (GPC) for organic materials	Gel permeation chromatography (GPC)	Materials synthesis and modification	Chromatography	Chromatography involves separating out a mixture, typically by passing it through a separation medium that gradually traps solutes due to their size – in Gel permeation chromatography (GPC) a sample is dissolved in suitable solvent and passed through a gel-based separation medium. This could be done immediately ahead of analysis step, perhaps to see how much of a specific protein is within a sample, or it could be done to synthesise a highly purified material for later fabrication steps.
Queensland Node	Metrology	UQ	Asylum Research MFP3D-BIO (UQ)	Asylum Research	MFP3D-BIO	General use Atomic Force Microscope (AFM) built on a Nikon inverted microscope base for integrated scanning-probe and optical microscopy. Modes available; Kelvin force probe/adhesion and stiffness maps, conductivity maps and single molecule spectroscopy, viscoelastic mapping, magnetic force mapping.	2008	Atomic force microscope (AFM) with inverted optical microscope	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.

Queensland Node	Metrology	UQ	Waters Alliance 2695 Separations Module (UQ)	Waters	Alliance 2695 Separations Module	Technique for the separation and detection of compounds using various mobile phases with a UV detector coupled with a mass spectrometer.	2008	Liquid chromatography mass spectrometry (LC-MS) system	Liquid Chromatography (LC)	Materials synthesis and modification	Chromatography	Chromatography involves separating a mixture by passing it through a separation medium that gradually traps solutes due to their size – in liquid chromatography (LC) a sample is dissolved in suitable solvent and passed through a separation medium as a liquid. This could be done immediately ahead of analysis step, perhaps to see how much of a specific protein is within a sample, or it could be done to synthesise a highly purified material for later fabrication steps. LC is commonly performed at high pressure (high-performance liquid chromatography (HPLC)), which his able to resolve to a higher degree, or in conjunction with a mass spectrometer (LC-MS) for immediate analysis.
Queensland Node	Metrology	UQ	Jeol IT-300 (UQ)	Jeol	IT-300	Tungsten filament SEM used to image samples up to 6 inches in diameter with a resolution of 3 nm at 30kV.	2015	Scanning Electron Microscopy (SEM)	Scanning Electron Microscopy (SEM)	Testing and validation	Scanning Electron Microscopy (SEM)	Scanning Electron Microscopy (SEM) is the process whereby a tightly focused electron beam is scanned onto the surface to be imaged. As the primary electrons hit the atoms in the surface, a number of secondary electrons are emitted, and collected by the instrument's detector, which assigns a level of grey accordingly, thereby creating a pixel for a digital image. The machines can routinely image features down to about 10nm, and in some special cases down to several nm in size. SEM is a key tool for process characterisation of surface topography. Most samples fabricated in the cleanroom undergoes at least one round of SEM imaging, in order to assess the quality of the fabrication and its defects. This information is fed into the process optimisation loop until a satisfying sample is produced. The tool is also used to image samples such as fixated cells and failed components.
Queensland Node	Metrology	UQ	WITec alpha300 RA+S (UQ)	WITec	alpha300 RA+S	Single system with the ability to analyse a the Raman spectrum, the surface topology and the SNOM signal of a sample.	2008	Atomic force microscope (AFM) with Raman and SNOM functionality	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
Queensland Node	Metrology	UQ	Asylum Research Cypher (UQ)	Asylum Research	Cypher	A purpose built AFM in a dedicated enclosure to investigate surface nanomechanics and topography. Modes available: Kelvin probe force microscopy (KPFM); high voltage piezoresponse force microscopy (HV-PFM); scanning tunnelling microscopy (STM); and AM-FM viscoelastic mapping mode.	2013	Atomic force microscope (AFM) with high resolution m	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
Queensland Node	Metrology	UQ	Leica SP8 (UQ)	Leica	SP8	Confocal Microscope with Hybrid Detector (HyD) and white light laser with resonance scanner for high-resolution and high-speed imaging.	2017	Confocal laser scanning microscope (LSM)	Confocal microscopy	Testing and validation	Microscopy	A confocal microscope records point-by-point scans of a sample to create two-dimensional images. Three-dimensional images can be created by combining the images of multiple planes, taken by repeating the scanning technique but varying the z-axis.
Queensland Node	Metrology	UQ	Semiprobe SA-6 (UQ)	Semiprobe	SA-6	Used to probe optoelectronic and semiconductor materials. Integrated into a glovebox system.	2008	Probe station	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.
Queensland Node	Metrology	UQ	KLA Zeta 300 (UQ)	KLA	Zeta 300	System features an automated stage and provides quick and flexible profiling of surface topography. The technique allows for superior capture of angled surfaces when compared to interferometric techniques. Used for 3D images using a shallow depth of field objective. This is then reconstructed into a 3D image.	2017	Optical profilometer	Optical profilometry	Testing and validation	Profilometry	Optical profilometry is a non-contact form of profilometry that can be used to characterise the surface steps and the roughness of a material. Optical profilometry employs phase-shifting and/or vertical scanning interferometry to resolve the topology of complex 3D structures. The technique marries precision z-axis control with interference-based techniques to resolve features from the angstrom to millimetre scale. The technique lends itself well to die-based measurements for ISO/QA and large area mapping. Profilometry is useful in process control steps such as measuring etch depth and lithography patterns.
Queensland Node	Metrology	UQ	Zeiss LSM 710 Confocal (UQ)	Zeiss	LSM 710 Confocal	High Resolution imaging of fluorescent structures and the ability to combine this with optical sectioning. This can be used to build a 3D image of sample. Has variable laser range which expands application possibilities	2008	Confocal laser scanning microscope (LSM)	Confocal microscopy	Testing and validation	Microscopy	A confocal microscope records point-by-point scans of a sample to create two-dimensional images. Three-dimensional images can be created by combining the images of multiple planes, taken by repeating the scanning technique but varying the z-axis.
Queensland Node	Metrology	UQ	Tecan LS Reload (UQ)	Tecan	LS Reload	Can be used to image whole well plates of samples.	2008	Microarray scanner	Photometric readers	Testing and validation	Biological analysis	Photometric readers collect a variety of responses to different forms of light. They can measure colour intensity at a particular wavelength, the fluorescence of a samples at a set of excitation and emission wavelengths or even inherent sample luminescence.
Queensland Node	Metrology	UQ	Agilent Technologies Agilent B1500A Analyzer (UQ)	Agilent Technologies	Agilent B1500A Analyzer	Testing of organic and electronic circuits. Provides IV, CV and pulsed measurements of conductive, capacitive, inductive or semiconductor samples	2009	Semiconductor Device Analyser	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.

Queensland Node	Metrology	UQ	Mettler Toledo DMA/SDTA861e (UQ)	Mettler Toledo	DMA/SDTA861e	Investigates the dynamic mechanical behaviour of a material sample as a function of frequency and temperature.		Dynamic mechanical analyser	Physical property analysis	Testing and validation	Material characterisation	When a material is developed, there are key properties that can be determined to define the materials. These can include the temperature profile of the material, the physical strength, the hardness, the colour or the size of the material. One important technique is differential scanning calorimetry (DSC), a thermoanalytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference is measured as a function of temperature. It can be used to determine the phase transitions of a material.
Queensland Node	Metrology	UQ	Keithlink Four Point Probe (UQ)	Keithlink	Four Point Probe	Provides sheet resistance measurements of metal oxide thin films.		Probe station	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.
Queensland Node	Metrology	UQ	Veeco Dektak 150 (UQ)	Veeco	Dektak 150	The Veeco Dektak 150 profilometer is a stylus profiler capable of measuring step heights, film stress, and surface roughness. This tool has a 0.1 nm vertical resolution with a 6" manual stage.		Stylus profilometer	Stylus profilometry	Testing and validation	Profilometry	Stylus profilometry is a direct form of profilometry that can be used to characterise the surface steps and the roughness of a material. A stylus profilometer drags a metal tip along the surface of a sample and measuring the distance traced by the stylus tip and its deflection along the vertical axis to register slight changes in the surface height of a material. This measurement is then converted into a cross-sectional plot and can be used to resolve steps as small as 10nm. Optical profilometry employs phase-shifting and/or vertical scanning interferometry to resolve the topology of complex 3D structures. The technique marries precision z-axis control with interference based techniques to resolve features from the angstrom to millimetre scale. The technique lends itself well to die-based measurements for ISO/QA and large area mapping.
Queensland Node	Metrology	UQ	Thermo Fisher Scientific Nicolet Almega XR (UQ)	Thermo Fisher Scientific	Nicolet Almega XR	Profiles large areas of samples of polymers, coal, and other organic materials.		Dispersive Raman Microscope	Other spectroscopy	Testing and validation	Spectroscopy	Variations on the theme of spectroscopy provide specific advantages for a range of uses – tweaking of the principle of observing the spectral output of materials in a variety of conditions can provide incredible amounts of information about the composition of a sample.
Queensland Node	Metrology	UQ	Veeco Wyko NT1100 (UQ)	Veeco	Wyko NT1100	For optical 3D profiling of samples and surface roughness measurements of most materials. Uses an interference technique to construct 3D images of nanofabricated structures	2009	Optical profilometer	Optical profilometry	Testing and validation	Profilometry	Optical profilometry is a non-contact form of profilometry that can be used to characterise the surface steps and the roughness of a material. Optical profilometry employs phase-shifting and/or vertical scanning interferometry to resolve the topology of complex 3D structures. The technique marries precision z-axis control with interference-based techniques to resolve features from the angstrom to millimetre scale. The technique lends itself well to die-based measurements for ISO/QA and large area mapping. Profilometry is useful in process control steps such as measuring etch depth and lithography patterns.
Queensland Node	Metrology	UQ	Mettler Toledo DSC 1 STARe System (UQ)	Mettler Toledo	DSC 1 STARe System	A system capable of analysing thermal properties of both organic and inorganic materials including glass transition temperature, enthalpy of melting, heat capacity, and thermal degradation.		Differential scanning calorimetry	Physical property analysis	Testing and validation	Material characterisation	When a material is developed, there are key properties that can be determined to define the materials. These can include the temperature profile of the material, the physical strength, the hardness, the colour or the size of the material. One important technique is differential scanning calorimetry (DSC), a thermoanalytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference is measured as a function of temperature. It can be used to determine the phase transitions of a material.
Queensland Node	Metrology	UQ	Mettler Toledo TGA/DSC 1 STAR e (UQ)	Mettler Toledo	TGA/DSC 1 STAR e	Evaluate stepwise changes in mass of polymers and organic compounds with temperature. Also combined with Differential scanning calorimetry to determine the temperature profile of the sample.		Thermogravimetric analysis	Physical property analysis	Testing and validation	Material characterisation	When a material is developed, there are key properties that can be determined to define the materials. These can include the temperature profile of the material, the physical strength, the hardness, the colour or the size of the material. One important technique is differential scanning calorimetry (DSC), a thermoanalytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference is measured as a function of temperature. It can be used to determine the phase transitions of a material.
Queensland Node	Metrology	UQ	Thermo Fisher Scientific Nicolet 5700 (UQ)	Thermo Fisher Scientific	Nicolet 5700	Used to identify chemical composition of organic compounds and polymers.		Fourier transform infrared (FTIR) spectrometer	Fourier Transform Infrared (FTIR) Spectroscopy	Testing and validation	Spectroscopy	Fourier-transform infrared (FTIR) spectroscopy is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. It is a technique used to examine chemical composition using the infrared (IR) part of the electromagnetic spectrum. FTIR spectroscopy flashes a sample with a series of broadband light of varying IR wavelengths. The resulting collection of spectra are then interpreted using the Fourier transform algorithm to indicate which parts of the spectrum were absorbed, and therefore, the chemical composition of the sample.
Queensland Node	Device Fabrication	UQ	Ultimaker 2 Extended + (UQ)	Ultimaker	2 Extended +	Fabrication of 3D structures down to 100µm in size.	2016	Fused filament fabrication (FFF) 3D printer	Plastic printing	Manufacturing and machining	3D printing	3D printing involves taking a model and slicing into layers, then printing these layers on top of one another to recreate a 3D component. It's an incredibly quick way to produce unique parts, or for small production runs, and is massively useful when wanting to quickly create prototypes. A variety of materials can be printed, such as metals and biological materials – however, desktop 3D printers tend to use plastics.
Queensland Node	Device Fabrication	UQ	Suite CAD Computing (UQ)	Suite	CAD Computing	Workstations that host various software packages to support design and analysis. Packages include Solidworks, L-Edit, ACE3D, Intellisuite, COMSOL.	2015	Computers for CAD modelling	Computers	Modelling and device design	CAD	Professional CAD computing requires serious hardware – certain ANFF sites possess dedicated CAD computers for modelling and designing purposes. These computers will feature specific software packages to model complex systems such as optical or microfluidic devices, to interpret 3D scanner information, or to create new designs from scratch.
Queensland Node	Device Fabrication	UQ	Harrick Plasma PDC-001 & PDC-002 (UQ)	Harrick Plasma	PDC-001 & PDC-002	Surface cleaning, sterilisation, activation, energy alteration, and preparation for bonding and adhesion (such as PDMS device fabrication); surface treatment of polymers and biomaterials through activation, grafting and surface coating; modification of surface chemistry	2008	Plasma asher	Cleaning	Lithography	Support systems	Cleaning, an essential step when operating on the micro and nanoscale, is used to remove contaminants from the surface of the substrate before it is used in another fabrication process. This sometimes means simply burning away material, often using an asher to do this. Ashers use heat to remove unwanted material, such as photoresist. They are often used to clean a wafer, although they can sometimes be used to selectively etch away material as well.
Queensland Node	Device Fabrication	UQ	OAI Model 30 UV Light Source (UQ)	OAI	Model 30 UV Light Source	Collimated light source for flood UV exposure of photoresists on substrates up to 4 inches in diameter	2008	UV flood exposure source	UV Flood Exposure	Lithography	Photolithography	UV flood exposure sources provide quick, non discriminant processing of UV-sensitive materials and substrates. This can be incredibly useful when a sample doesn't require more than one mask, or it's an abnormal shape or size.

Queensland Node	Device Fabrication	UQ	Kulicke & Soffa 4526 Wedge Bonder (UQ)	Kulicke & Soffa	4526 Wedge Bonder	Wire bonder for power semiconductors, automotive power modules and industrial hybrids and prototypes	2008	Wedge Bonder	Wire bonding	Packaging	Bonding	Wire bonding is the part of the fabrication that allows an electrical component to communicate with the outside world. A thin electrically conductive wire – typically gold, aluminium, copper or silver – is used to allow electricity to flow from contacts on the component to, or from, its packaging. There are two commonly used types of wire bonding – wedge and ball. Which one is more suitable depends on the substrate, the contact material, the bonding material, and a number of other physical factors. Bonders can be manual or automated, and some can feature pattern recognition software to help speed the bonding process up.
Queensland Node	Metrology	UQ	Tecan Infinite 200 (UQ)	Tecan	Infinite 200	Simple and quick measurements of absorbance and fluorescence in a microplate format.	2008	Multi-mode microplate reader	Photometric readers	Testing and validation	Biological analysis	Photometric readers collect a variety of responses to different forms of light. They can measure colour intensity at a particular wavelength, the fluorescence of a samples at a set of excitation and emission wavelengths or even inherent sample luminescence.
Queensland Node	Metrology	UQ	Agilent Technologies CARY 630 FTIR (UQ)	Agilent Technologies	CARY 630 FTIR	Examines chemical compositions of synthetic organic compounds and polymers using user-friendly software. Modules available; Transmission, Diamond ATR, Germanium ATR and TumblIR.	2016	Fourier transform infrared (FTIR) spectrometer	Fourier Transform Infrared (FTIR) Spectroscopy	Testing and validation	Spectroscopy	Fourier-transform infrared (FTIR) spectroscopy is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. It is a technique used to examine chemical composition using the infrared (IR) part of the electromagnetic spectrum. FTIR spectroscopy flashes a sample with a series of broadband light of varying IR wavelengths. The resulting collection of spectra are then interpreted using the Fourier transform algorithm to indicate which parts of the spectrum were absorbed, and therefore, the chemical composition of the sample.
Queensland Node		UQ	Idonus HF Vapour Etch (UQ)	Idonus	HF Vapour Etch	Performs dry etching of SiO2. HF vapour chemically etches SIO2 while substrate is heated		HF Vapour Etcher	Vapour phase etching	Etching	Dry etching	Vapour phase etching involves exposing a substrate to a corrosive chemical in vapour form which will remove material that it comes into contact with. The sections of material that are removed can be selected by protecting parts of the substrate that are desired to be kept with a mask or coating.
Queensland Node		UQ	Harrick Plasma PDC-002 (UQ)	Harrick Plasma	PDC-002	For nanoscale surface cleaning and surface activation. Used when making a glass-PDMS or PDMS-PDMS microfluidic chip		Plasma cleaner	Cleaning	Lithography	Support systems	Cleaning, an essential step when operating on the micro and nanoscale, is used to remove contaminants from the surface of the substrate before it is used in another fabrication process. This sometimes means simply burning away material, often using an asher to do this. Ashers use heat to remove unwanted material, such as photoresist. They are often used to clean a wafer, although they can sometimes be used to selectively etch away material as well.
Queensland Node		UQ	Harvard Apparatus Pump 33 DDS (UQ)	Harvard Apparatus	Pump 33 DDS	The Pump 33 DDS has two independent pumping channels controlled by an intuitive touch screen interface.		Microfluidic syringe pump	Microfluidic device analysis	Testing and validation	Device validation	After designing, refining, and fabricating a microfluidic device, specialist equipment is required to accurately test whether it performs as desired.
Queensland Node		UQ	KURABO V300SS (UQ)	KURABO	V300SS	Rapidly mix and degas polymers for further processing		Planetary mixer	PDMS moulding	Lithography	Soft lithography	Polydimethylsiloxane (PDMS) is widely used to create a low-cost micro-structured mould for microfluidic applications. PDMS is an incredibly well behaved material under a variety of conditions, it's biocompatible and is very easy to fabricate.
Queensland Node		UQ	TPT HB16 (UQ)	TPT	HB16	Wire Bonder with motorised Z- and Y-Axis and is capable of performing both wedge and ball bonding.		Wedge and ball bonder	Wire bonding	Packaging	Bonding	Wire bonding is the part of the fabrication that allows an electrical component to communicate with the outside world. A thin electrically conductive wire – typically gold, aluminium, copper or silver – is used to allow electricity to flow from contacts on the component to, or from, its packaging. There are two commonly used types of wire bonding – wedge and ball. Which one is more suitable depends on the substrate, the contact material, the bonding material, and a number of other physical factors. Bonders can be manual or automated, and some can feature pattern recognition software to help speed the bonding process up.
Queensland Node		UQ	Trotec Speedy 360 (UQ)	Trotec	Speedy 360	Engrave or cut a variety of materials using a CO2 laser		Trotec laser engraver	Laser engraving and cutting	Manufacturing and machining	Laser processing	Subtractive processes that use of lasers to create patterns on a substrate or to cut through a material.
New South Wales Node	Advanced Lithography	USYD	ASML PAS 5500/100 (USYD)	ASML	PAS 5500/100	A high throughput step-and-repeat projection lithography system that can pattern feature sizes down to 350 nm	1994	i-line Stepper	Stepper	Lithography	Photolithography	A stepper is a highly accurate photolithography system that enables a pattern to be repeated on a wafer many times. The traditional photolithography process creates a pattern on a substrate by shining light from a light source onto a photoresist that coats the surface of the substrate through a photomask and is followed by a development phase. In a stepper, the substrate is placed on a moveable stage so that the pattern can be to be projected onto the resist-coated substrate, redirected, and the pattern repeated. This is very useful when trying to create many of the same component on a single wafer.
New South Wales Node	Advanced Lithography	USYD	Heidelberg DWL 66+ (USYD)	Heidelberg	DWL 66+	Direct write laser lithography system capable of high resolution and grayscale patterning	2014	Direct laser lithography system	Direct laser lithography	Lithography	Direct Write Lithography	Laser processing uses a highly controlled and focused beam of high-energy photons of the same wavelength to burn away material. These processes are repeatable, scalable and cheap, but can induce thermal stresses on the substrate, and resolutions tend to be in the micrometre regime. Laser processing is often used within ANFF to create masks for later lithography steps, but it can also be used to create patterns directly into the substrate itself, skipping several ordinary fabrication steps.
New South Wales Node	Advanced Lithography	USYD	Rite Track SVG 88 (USYD)	Rite Track	SVG 88	A fully automated system for spin coating, HMDS application, baking, and development. The system is well suited to batch scale production, providing high process performance and consistency in coating and development.	2000	Spin coater and developer	Spin coating and wafer development	Lithography	Support systems	Spin coaters are capable of applying uniform thickness polymer films, such as a resist to substrates. Resist is essential for many types of lithography, such as UV lithography. Resists are termed either positive or negative -- this denotes whether, when cured, chemical bonds are made or broken, and therefore whether the sections of resist that remain are either the true pattern, or it's inverse. This selection must be considering etching or deposition stages that may follow as it will help to make.
New South Wales Node	MOS Process line	USYD	Reynolds Tech Wet Bench - Caustic Develop (USYD)	Reynolds Tech	Wet Bench - Caustic Develop	Exhausted wet bench used for handling of caustic based chemicals - primarily TMAH based developers	2016	Wet Bench for caustic development processes	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
New South Wales Node	Device packaging and integration	USYD	Karl Suss PM5 Probe Station (USYD)	Karl Suss	PM5 Probe Station	4 probe DC probe station for measuring electrical properties of materials and devices.	1990	Probe station	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.

New South Wales Node	Advanced materials growth	USYD	Bruker Dektak XT (USYD)	Bruker	Dektak XT	The Dektak XT profilometer is a stylus profiler capable of measuring step heights, film stress, and surface roughness. This tool has a 0.1 nm vertical resolution with a 6 inch automated stage.	2004	Stylus profilometer	Stylus profilometry	Testing and validation	Profilometry	Stylus profilometry is a direct form of profilometry that can be used to characterise the surface steps and the roughness of a material. A stylus profilometer drags a metal tip along the surface of a sample and measuring the distance traced by the stylus tip and its deflection along the vertical axis to register slight changes in the surface height of a material. This measurement is then converted into a cross-sectional plot and can be used to resolve steps as small as 10nm. Optical profilometry employs phase-shifting and/or vertical scanning interferometry to resolve the topology of complex 3D structures. The technique marries precision z-axis control with interference based techniques to resolve features from the angstrom to millimetre scale. The technique lends itself well to die-based measurements for ISO/QA and large area mapping.
New South Wales Node	Advanced materials growth	USYD	Nikon Instruments LV-100ND (USYD)	Nikon Instruments	LV-100ND	A manual microscope used for wafer inspection	2010	Nikon LV-100ND with NIS Software and UV Source	Optical microscopy	Testing and validation	Microscopy	A fundamental form of sample analysis, optical microscopy uses a series of lenses to focus light that is reflected from or passed through a sample. Various forms of light and magnification can be used to visualise the sample.
Optofab Node	Optical Fibres and speciality glass synthesis	USYD	Heathway Draw tower (USYD)	Heathway	Draw tower	Drawing specialty polymer, softglass and composite fibres.	2004	Polymer draw tower	Draw towers	Manufacturing and machining	Optical fibre pulling and processing	Draw towers are used to create fibres, such as optical fibres, by heating and stretching a bulk material (or preform) to create long strands. The design and composition of this preform results in different abilities of the fibres once drawn out, such as stronger fibres, more efficient data transmission, or a broader available bandwidths for carrying information.
Optofab Node	Optical Fibres and speciality glass synthesis	USYD	Lagan CNC Milling Machine (USYD)	Lagan	CNC Milling Machine	Machining Polymer preforms	2001	CNC milling machine	Computer Numerical Control (CNC) milling	Manufacturing and machining	Milling	CNC milling is a conventional manufacturing technique that uses a computer to control a milling cutter. It can be used to precisely machine geometries and features into a substrate, or to mill hot embossing stamps and jigs that may be used to fabricate microstructured features in devices. The equipment typically mills material in either two or three axes, processing wood, metal, ceramics or plastics depending on the cutter that is used.
Optofab Node	Optical Fibres and speciality glass synthesis	USYD	EXFO EXFO (USYD)	EXFO	EXFO	High Resolution Optical Fiber Analyser	2007					
New South Wales Node	Advanced Lithography	USYD	Brewer Science Spin Coater (USYD)	Brewer Science	Spin Coater	Brewer Spin Coater	2004	Spin coater	Spin coating and wafer development	Lithography	Support systems	Spin coaters are capable of applying uniform thickness polymer films, such as a resist to substrates. Resist is essential for many types of lithography, such as UV lithography. Resists are termed either positive or negative -- this denotes whether, when cured, chemical bonds are made or broken, and therefore whether the sections of resist that remain are either the true pattern, or it's inverse. This selection must be considering etching or deposition stages that may follow as it will help to make.
New South Wales Node	Advanced Lithography	USYD	Brewer Science Developer (USYD)	Brewer Science	Developer	Brewer Developer	2004	Developer	Spin coating and wafer development	Lithography	Support systems	Spin coaters are capable of applying uniform thickness polymer films, such as a resist to substrates. Resist is essential for many types of lithography, such as UV lithography. Resists are termed either positive or negative -- this denotes whether, when cured, chemical bonds are made or broken, and therefore whether the sections of resist that remain are either the true pattern, or it's inverse. This selection must be considering etching or deposition stages that may follow as it will help to make.
New South Wales Node	Advanced Lithography	USYD	PM-Plast Delta 15 (USYD)	PM-Plast	Delta 15	Automated single wafer cleaning tool	1990	Mask Cleaning tool	Spin coating and wafer development	Lithography	Support systems	Spin coaters are capable of applying uniform thickness polymer films, such as a resist to substrates. Resist is essential for many types of lithography, such as UV lithography. Resists are termed either positive or negative -- this denotes whether, when cured, chemical bonds are made or broken, and therefore whether the sections of resist that remain are either the true pattern, or it's inverse. This selection must be considering etching or deposition stages that may follow as it will help to make.
New South Wales Node	Advanced materials growth	USYD	Lasertec L2000 (USYD)	Lasertec	L2000	Lasertec Scanning Laser Microscope	1990	Confocal laser scanning microscope (LSM)	Confocal microscopy	Testing and validation	Microscopy	A confocal microscope records point-by-point scans of a sample to create two-dimensional images. Three-dimensional images can be created by combining the images of multiple planes, taken by repeating the scanning technique but varying the z-axis.
Optofab Node	Optical Fibres and speciality glass synthesis	USYD	Anritsu Anritsu (USYD)	Anritsu	Anritsu	Optical Unit for measuring	2001					
New South Wales Node		USYD	Reynolds Tech Wet Bench (USYD)	Reynolds Tech	Wet Bench	Exhausted wet bench used for handling of general purpose caustic based chemicals		Wet Bench for general purpose caustic etch processes	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
New South Wales Node		USYD	Reynolds Tech Wet Bench (USYD)	Reynolds Tech	Wet Bench	Exhausted wet bench used for handling of chromium etch chemicals		Wet Bench for Chromium etch processes	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
New South Wales Node		USYD	Reynolds Tech Wet Bench (USYD)	Reynolds Tech	Wet Bench	Exhausted wet bench used for handling of general purpose acids		Wet Bench for general purpose acid processes	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
New South Wales Node		USYD	Reynolds Tech Wet Bench (USYD)	Reynolds Tech	Wet Bench	Exhausted wet bench used for handling of general purpose acids		Wet Bench for general purpose acid processes	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
New South Wales Node		USYD	Reynolds Tech Wet Bench (USYD)	Reynolds Tech	Wet Bench	Exhausted wet bench used for handling of hydrofluoric acid		Wet bench for Hydrofluoric acid processes	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
New South Wales Node		USYD	Reynolds Tech Wet Bench (USYD)	Reynolds Tech	Wet Bench	Exhausted wet bench used for solvent based metal lift-off and cleaning processes		Wet bench for solvent based lift-off processes	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
New South Wales Node		USYD	Reynolds Tech Wet Bench (USYD)	Reynolds Tech	Wet Bench	Exhausted wet bench used for resist coating processes dedicated to thicker photolithography based resists		Wet Bench for photolithography resist coating processes	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
New South Wales Node		USYD	Reynolds Tech Wet Bench (USYD)	Reynolds Tech	Wet Bench	Exhausted wet bench used for resist coating processes dedicated to EBL resists		Wet Bench for electron beam lithography resist coating processes	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
New South Wales Node		USYD	OEM Spin Rinse Dryer - Etch (USYD)	OEM	Spin Rinse Dryer - Etch	Automated batch wafer cleaning tool		Wafer Cleaning tool	Cleaning	Lithography	Support systems	Cleaning, an essential step when operating on the micro and nanoscale, is used to remove contaminants from the surface of the substrate before it is used in another fabrication process. This sometimes means simply burning away material, often using an asher to do this. Ashers use heat to remove unwanted material, such as photoresist. They are often used to clean a wafer, although they can sometimes be used to selectively etch away material as well.
New South Wales Node		USYD	OEM Spin Rinse Dryer (USYD)	OEM	Spin Rinse Dryer	Automated batch wafer cleaning tool		Wafer Cleaning tool	Cleaning	Lithography	Support systems	Cleaning, an essential step when operating on the micro and nanoscale, is used to remove contaminants from the surface of the substrate before it is used in another fabrication process. This sometimes means simply burning away material, often using an asher to do this. Ashers use heat to remove unwanted material, such as photoresist. They are often used to clean a wafer, although they can sometimes be used to selectively etch away material as well.
New South Wales Node		USYD	Reynolds Tech Wet Bench - Solvent Develop (USYD)	Reynolds Tech	Wet Bench -Solvent Develop	Exhausted wet bench used for solvent based development processes		Wet bench for solvent based development processes	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.
New South Wales Node		USYD	Reynolds Tech Hotplate Tower (USYD)	Reynolds Tech	Hotplate Tower	Exhausted stacked hotplates for baking during solvent based processes		Stacked Hotplate tower	Wetbench	Laboratory infrastructure	Wet processing tools	A wetbench is a potentially automated process tool that is used to carry out wet etching or cleaning steps of a fabrication process.

New South Wales Node		USYD	Emitech K550 (USYD)	Emitech	K550	Small throw sputter coater for coating of small samples		Sputter Coater	Sputtering	Deposition	Physical Vapour Deposition (PVD)	Sputtering is a physical vapour deposition method that involves depositing thin films in a vacuum environment. During this process, a solid material and substrate are positioned separately within a vacuum system. A high-energy argon ion plasma stream is targeted at the material, resulting in the subject material being ejected and deposited onto the substrate, creating a thin film. As this is not an evaporative process, the temperatures required for sputtering are lower than evaporation methods. This makes it one of the most flexible deposition processes and it is particularly useful for depositing materials with a high melting point or a mixture of materials, as compounds that may evaporate at different rates, can be sputtered at the same rate. Certain processes will benefit from improved film adhesion due to higher impact energy. The sputtering process is used extensively in the semiconductor industry, screen displays, photovoltaics and magnetic data storage. Sputtering can be used to deposit a wide variety of thin films including metals, oxides, nitrides and alloys.
New South Wales Node		USYD	South Bay RIE3000 (USYD)	South Bay	RIE3000	Reactive ion etch system dedicated to O2 and Ar plasma processes		O2 Plasma Asher/RIE	Plasma etching	Etching	Dry Etching	Plasma etching uses a finely controlled plasma to selectively remove material from a substrate.
New South Wales Node		USYD	Finetech FINEPLACER lambda (USYD)	Finetech	FINEPLACER lambda	Sub-micron die-bonder for precision die attach and advanced chip packaging.		Sub-Micron Die Bonder	Wafer bonding	Packaging	Bonding	Bonding a wafer to another wafer is a step commonly used when packaging components in an micro or nanoelectrical device. It can help a form new functions in a device, or can ensure mechanical and hermetic encapsulation of devices and electronics. The result is irreversible. Common bonding methods include using heat or with an adhesive for thermally sensitive samples.
Optofab Node	Nano, Micro, Macro Optics fabrication	UTS	Seki CVD- small unit (UTS)	Seki	CVD- small unit	Small bell-jar type reactor for growing small samples of doped diamond films	2011	MPCVD system for deposition of doped diamond	Microwave Plasma-enhanced Chemical Vapour Deposition (MPCVD)	Deposition	Chemical Vapour Deposition (CVD)	MPCVD is a chemical vapour deposition process which uses a continuous microwave source to create and help to maintain a highly reactive plasma made up of the reacting chemicals and necessary catalysts. MPCVD is heavily used in the ANFF network to deposit layers of diamond – methane and hydrogen are introduced and used to grow new diamond on a diamond-seeded substrate. ANFF equipment can introduce dopants to the carbon structure while its being grown. These include boron which can create superconducting diamond, and nitrogen vacancies which can produce interesting photo-luminescence properties that are being exploited for quantum information systems.
Optofab Node	Nano, Micro, Macro Optics fabrication	UTS	FIBSEM (UTS)		FIBSEM	FIBSEM facility upgradeable to large FOV						
Western Australia Node	IR Tech	UWA	XXXX – Exclude? XPS on Riber 32B Molecular Beam Epitaxy System (UWA)	XXXX – Exclude?	XPS on Riber 32B Molecular Beam Epitaxy System	In-situ x-ray photoelectron spectroscopy during MBE growth.	1980's	XPS attached to MBE	Molecular Beam Epitaxy (MBE)	Deposition	Physical Vapour Deposition (PVD)	Molecular Beam Epitaxy is a deposition technique that allows for crystals to be grown with extremely high purity. The process allows for subnanometre control over the structure of the crystal as it's grown and positioning of dopants within the material, as well as film thickness. A series of molecular beams are directed onto a heated crystalline substrate. Upon collision with the substrate, the molecules in the beam bind, forming a new crystal layer. The entire growth occurs in an ultra high vacuum and there is no chemical mixing before the beams reach the substrate surface.
Western Australia Node	IR Tech	UWA	Custom 32B Molecular Beam Epitaxy System (Se source) (UWA)	Custom	32B Molecular Beam Epitaxy System (Se source)	Versatile tool that deposits precise amounts of material onto substrates. Often used to design and create semiconductor structures for manufacturing many novel devices.	1980's	MBE for II-VI Hg-based semiconductors	Molecular Beam Epitaxy (MBE)	Deposition	Physical Vapour Deposition (PVD)	Molecular Beam Epitaxy is a deposition technique that allows for crystals to be grown with extremely high purity. The process allows for subnanometre control over the structure of the crystal as it's grown and positioning of dopants within the material, as well as film thickness. A series of molecular beams are directed onto a heated crystalline substrate. Upon collision with the substrate, the molecules in the beam bind, forming a new crystal layer. The entire growth occurs in an ultra high vacuum and there is no chemical mixing before the beams reach the substrate surface.
Western Australia Node	IR Tech	UWA	Custom Indium Thermal Evaporator (UWA)	Custom	Indium Thermal Evaporator	Thermal evaporator designed for Indium deposition	1990's	Custom system for Indium (In) thermal evaporation	Thermal evaporation	Deposition	Physical Vapour Deposition (PVD)	Thermal Evaporation is one of the simplest forms of physical vapor deposition (PVD). It uses heat to evaporate a high purity source material that moves through a vacuum chamber and deposits a thin film on a substrate. Thermal evaporation can be used to deposit metals, organic, and inorganic polymers. In this method, electrical energy is used to heat a filament which in turn heats a deposition material to the point of evaporation. The process can be performed at very high levels of vacuum to eliminate collisions with foreign particles and therefore fewer tendencies to introduce film impurities. High deposition rates can be achieved and lower energy particles can reduce substrate damage. Thermal evaporation is widely used when creating polymer solar cells and flexible electronics.
Western Australia Node	IR Tech	UWA	Custom IR characterisation system (UWA)	Custom	IR characterisation system	IR transmission/reflection system to characterise spectrometer/filter performance	1980's	Cryostat IR array characterisation system	Other spectroscopy	Testing and validation	Spectroscopy	Variations on the theme of spectroscopy provide specific advantages for a range of uses – tweaking of the principle of observing the spectral output of materials in a variety of conditions can provide incredible amounts of information about the composition of a sample.
Western Australia Node	IR Tech	UWA	Custom Thermal Evaporator (UWA)	Custom	Thermal Evaporator	Thermal evaporator designed for Zinc Sulfide deposition	1990's	Custom system for Zinc sulfide (ZnS) thermal evaporation	Thermal evaporation	Deposition	Physical Vapour Deposition (PVD)	Thermal Evaporation is one of the simplest forms of physical vapor deposition (PVD). It uses heat to evaporate a high purity source material that moves through a vacuum chamber and deposits a thin film on a substrate. Thermal evaporation can be used to deposit metals, organic, and inorganic polymers. In this method, electrical energy is used to heat a filament which in turn heats a deposition material to the point of evaporation. The process can be performed at very high levels of vacuum to eliminate collisions with foreign particles and therefore fewer tendencies to introduce film impurities. High deposition rates can be achieved and lower energy particles can reduce substrate damage. Thermal evaporation is widely used when creating polymer solar cells and flexible electronics.
Western Australia Node	IR Tech	UWA	Edwards Auto 500 (UWA)	Edwards	Auto 500	Ability to deposit ultra pure films of materials with high melting points, and other materials that are difficult to deposit by resistance evaporation. The tool allows thick film deposition and also multiple coatings.	2004	Electron beam evaporator	Electron Beam Evaporation (E-Beam Evaporation)	Deposition	Physical Vapour Deposition (PVD)	Electron-beam evaporation is a physical vapour deposition method for depositing thin films of metals, oxides and semiconductors in a high vacuum environment. Ultra high purity coating material is placed inside a vacuum chamber, typically as pellets in a crucible. Electron energy is used to heat these pellets, causing the coating material to enter the gas phase. Due to the vacuum environment, the evaporated particles can travel to the substrate without colliding with foreign particles, where they then condense on the substrate surface in a thin film. Electron beam evaporation is used to deposit electronic and optical films for the semiconductor industry and has applications in displays and photovoltaics. High melting point materials can be deposited at high deposition rates, making this a preferred process for refractory metal and ceramic films.
Western Australia Node	IR Tech	UWA	Oxford Instruments Plasmalab80 (UWA)	Oxford Instruments	Plasmalab80	Low stress plasma chemical vapour deposition of low-stress films to satisfy mechanical requirement of MEMS devices. Dual Chamber PECVD/RIE	1980's	System for plasma enhanced chemical vapour deposition system (PECVD) and reactive ion etching (RIE)	Reactive Ion Etching (RIE)	Etching	Dry Etching	Reactive Ion Etching (RIE) is a method that combines both chemical and physical etching to allow isotropic and anisotropic material removal. The etching process is carried out in a chemically reactive plasma containing positively and negatively charged ions generated from gases that are pumped into the reaction chamber. A mask on top of the substrate is used to protect designated areas from etching, exposing only the areas to be etched. Dry etching offers excellent process control for cleanliness, homogeneity, etch-rate, etch-profile, selectivity and run-to-run consistency, which is critical for high-fidelity pattern-transfer in micro- and nano-system technologies. RIE is extensively used in the field of displays & lighting (LEDs), semiconductors, electronics, MEMS, communication technology, microfluidics, optoelectronics and photovoltaics.

Western Australia Node	IR Tech	UWA	Waterloo Scientific LBIC by Waterloo Scientific (UWA)	Waterloo Scientific	LBIC by Waterloo Scientific	Mapping of material quality and device performance using a laser induced current.	1990's	Laser Beam Induced Current (LBIC) Scanning Laser Microscope	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.
Western Australia Node	IR Tech	UWA	Agilent Technologies 4156A Semiconductor Parameter Analyzer (UWA)	Agilent Technologies	4156A Semiconductor Parameter Analyzer	Digital sweep parameter. Used for failure analysis and automated incoming inspection.	1995	Semiconductor parameter analyser	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.
Western Australia Node	IR Tech	UWA	EVG Group EVG105 (UWA)	EVG Group	EVG105	Softbake, post-exposure bake and hardbake processes. Programmable proximity pins provide the best available control of resist hardening processes and temperature profiles	2004	Photolithography thermal curing	Spin coating and wafer development	Lithography	Support systems	Spin coaters are capable of applying uniform thickness polymer films, such as a resist to substrates. Resist is essential for many types of lithography, such as UV lithography. Resists are termed either positive or negative -- this denotes whether, when cured, chemical bonds are made or broken, and therefore whether the sections of resist that remain are either the true pattern, or it's inverse. This selection must be considering etching or deposition stages that may follow as it will help to make.
Western Australia Node	IR Tech	UWA	Custom Electrical Characterisation (UWA)	Custom	Electrical Characterisation	2T electromagnet to perform Hall effect measurements	1990's	Hall effect measurement system	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.
Western Australia Node	IR Tech	UWA	Kulicke & Soffa 4526 Wedge Bonder (UWA)	Kulicke & Soffa	4526 Wedge Bonder	Manual wedge bonder, simple set-up and incorporates analogue controls for ease of use. This allows rapid adjustment of individual bonding parameters.	2001	Wedge Bonder	Wire bonding	Packaging	Bonding	Wire bonding is the part of the fabrication that allows an electrical component to communicate with the outside world. A thin electrically conductive wire – typically gold, aluminium, copper or silver – is used to allow electricity to flow from contacts on the component to, or from, its packaging. There are two commonly used types of wire bonding – wedge and ball. Which one is more suitable depends on the substrate, the contact material, the bonding material, and a number of other physical factors. Bonders can be manual or automated, and some can feature pattern recognition software to help speed the bonding process up.
Western Australia Node	IR Tech	UWA	Rucker & Kolls 680A (UWA)	Rucker & Kolls	680A	Probe station with B&L Microzoom	1990's	Semi-automatic wafer probe station	Electrical characterisation	Testing and validation	Device validation	For electrical devices, MEMS, and solar cells, the electrical properties are often what dictates whether the device is performing as expected. As such there are a range of ways to understand different aspects of these properties.
Western Australia Node	IR Tech	UWA	Custom DLTS (UWA)	Custom	DLTS	Characterisation of semiconductor bandgap energy levels using deep-level transient spectroscopy (DLTS)	1990's	Deep-level transient spectroscopy (DLTS)	Other spectroscopy	Testing and validation	Spectroscopy	Variations on the theme of spectroscopy provide specific advantages for a range of uses – tweaking of the principle of observing the spectral output of materials in a variety of conditions can provide incredible amounts of information about the composition of a sample.
Western Australia Node	IR Tech	UWA	Finetech Fineplacer-96 (UWA)	Finetech	Fineplacer-96	Manual flip chip bonder with high accuracy of 0.5 µm.	2004	Flip chip bonder	Wafer bonding	Packaging	Bonding	Bonding a wafer to another wafer is a step commonly used when packaging components in an micro or nanoelectrical device. It can help a form new functions in a device, or can ensure mechanical and hermetic encapsulation of devices and electronics. The result is irreversible. Common bonding methods include using heat or with an adhesive for thermally sensitive samples.
Western Australia Node	MEMS	UWA	Custom Dual Chamber Thermal Evaporator (UWA)	Custom	Dual Chamber Thermal Evaporator	Custom made dual chamber thermal evaporator for deposition of metal and non-metal materials with high deposition rate and high purity.	1980's	Custom dual chamber system for multi-material thermal evaporation	Thermal evaporation	Deposition	Physical Vapour Deposition (PVD)	Thermal Evaporation is one of the simplest forms of physical vapor deposition (PVD). It uses heat to evaporate a high purity source material that moves through a vacuum chamber and deposits a thin film on a substrate. Thermal evaporation can be used to deposit metals, organic, and inorganic polymers. In this method, electrical energy is used to heat a filament which in turn heats a deposition material to the point of evaporation. The process can be performed at very high levels of vacuum to eliminate collisions with foreign particles and therefore fewer tendencies to introduce film impurities. High deposition rates can be achieved and lower energy particles can reduce substrate damage. Thermal evaporation is widely used when creating polymer solar cells and flexible electronics.
Western Australia Node	MEMS	UWA	Scientific Vacuum Systems V6000 (UWA)	Scientific Vacuum Systems	V6000	Confocal sputtering systems for creating research mirrors. Featuring the same quality of design and components the V6000 research coaters are ideal for single wafer processing.	1990	Electron beam evaporator	Electron Beam Evaporation (E-Beam Evaporation)	Deposition	Physical Vapour Deposition (PVD)	Electron-beam evaporation is a physical vapour deposition method for depositing thin films of metals, oxides and semiconductors in a high vacuum environment. Ultra high purity coating material is placed inside a vacuum chamber, typically as pellets in a crucible. Electron energy is used to heat these pellets, causing the coating material to enter the gas phase. Due to the vacuum environment, the evaporated particles can travel to the substrate without colliding with foreign particles, where they then condense on the substrate surface in a thin film. Electron beam evaporation is used to deposit electronic and optical films for the semiconductor industry and has applications in displays and photovoltaics. High melting point materials can be deposited at high deposition rates, making this a preferred process for refractory metal and ceramic films.
Western Australia Node	MEMS	UWA	Anealsys AS-One150 RTA (UWA)	Anealsys	AS-One150 RTA	A cold wall bench top rapid thermal processor, to provide high cooling rates and low memory effect of the process chamber	2006	Rapid thermal annealer	Annealing	Materials synthesis and modification	Material modification	Annealing is a process that can reduce residual stress in a substrate that has accumulated during prior processes such as deposition. The material is heated to high temperatures and allowed to cool at a controlled rate. This allows the material's crystal structure to relax into a less intrinsically stressed state, and to settle into a more desirable microstructure as it cools.
Western Australia Node	MEMS	UWA	Polytec OFV-500 (UWA)	Polytec	OFV-500	Non-contact vibration analysis commonly used to characterise MEMS devices. Wide selection of high-performance vibration displacement, acceleration and vibrational velocity decoders that cover the frequency range from DC to 24 MHz, vibrational velocities up to ±25 m/s and displacement resolutions down to 0.1 pm	2005	Laser Doppler Vibrometer (LDV)	Laser Doppler Vibrometry (LDV)	Testing and validation	Vibrometry	Laser Doppler Vibrometry (LDV) measures the high frequency vibrations of surfaces by focusing a laser onto a sample and observing the reflected light. As the surface of a sample oscillates, it causes the wavelength of incident laser light to lengthen or shorten. Comparing this Doppler shifted reflected light to a reference beam provides information on the velocity, displacement, and phase of the surface vibrations. LDV is useful in the characterisation of MEMS devices, as well as piezoelectrics and surface acoustic wave devices.
Western Australia Node	MEMS	UWA	Horiba Scientific iHR320 (UWA)	Horiba Scientific	iHR320	1/3 metre imaging spectrometer with gratings	1990's					
Western Australia Node	MEMS	UWA	Olympus LEXT OLS5000 (UWA)	Olympus	LEXT OLS5000	Provides sub-micron 3D observation/measurement with the ability to compare very rough surface shapes.	1990's	Optical 3D microscope	Optical microscopy	Testing and validation	Microscopy	A fundamental form of sample analysis, optical microscopy uses a series of lenses to focus light that is reflected from or passed through a sample. Various forms of light and magnification can be used to visualise the sample.
Western Australia Node	MEMS	UWA	Oxford Instruments Plasmalab80 plus ICPCVD (UWA)	Oxford Instruments	Plasmalab80 plus ICPCVD	Plasma Technology Plasmalab80	2000's		Plasma Enhanced Chemical Vapour Deposition (PECVD)	Deposition	Chemical Vapour Deposition (CVD)	Plasma Enhanced Chemical Vapour Deposition (PECVD) uses a plasma to deposit a thin film of silicon dioxide or silicon nitrate onto a substrate. PECVD uses lower temperatures than the furnace systems to achieve an insulating layer on a variety of materials. PECVD is used in optics, microelectronics, energy applications, packaging and chemistry for the deposition of anti-reflective coatings, scratch resistant transparent coatings, electronically active layers, passivation layers, dielectric layers, isolating layers, etch stop layers, encapsulation and chemical protective coatings.
Western Australia Node	MEMS	UWA	cooling water system (UWA)		cooling water system	delivery of cooling water to the tools	2004					

Western Australia Node	MEMS	UWA	UPS and power surge protection (UWA)		UPS and power surge protection	facility wide protection against short power disturbances	2004					
Western Australia Node	MEMS	UWA	fume hood extraction systems (UWA)		fume hood extraction systems	fume hood extraction systems	2004					
Western Australia Node	MEMS	UWA	gas extraction system (UWA)		gas extraction system	extraction of plasma processing gas exhaust	2004					
Western Australia Node	MEMS	UWA	gas delivery system (UWA)		gas delivery system	delivery system of gas precursors for plasma processing	2004					
Western Australia Node	MEMS	UWA	4Wave The Laboratory Alloy and Nanolayer System (LANS) (UWA)	4Wave	The Laboratory Alloy and Nanolayer System (LANS)	Provides atomically engineered thin films and interfaces. The tool can vary process pressures, adatom energies, and provides good uniformity and repeatability.	2011	Biased target ion beam deposition system	Sputtering	Deposition	Physical Vapour Deposition (PVD)	Sputtering is a physical vapour deposition method that involves depositing thin films in a vacuum environment. During this process, a solid material and substrate are positioned separately within a vacuum system. A high-energy argon ion plasma stream is targeted at the material, resulting in the subject material being ejected and deposited onto the substrate, creating a thin film. As this is not an evaporative process, the temperatures required for sputtering are lower than evaporation methods. This makes it one of the most flexible deposition processes and it is particularly useful for depositing materials with a high melting point or a mixture of materials, as compounds that may evaporate at different rates, can be sputtered at the same rate. Certain processes will benefit from improved film adhesion due to higher impact energy. The sputtering process is used extensively in the semiconductor industry, screen displays, photovoltaics and magnetic data storage. Sputtering can be used to deposit a wide variety of thin films including metals, oxides, nitrides and alloys.
Western Australia Node	MEMS	UWA	Zygo NewView6300 (UWA)	Zygo	NewView6300	Non-contact 3D scanning white light and optical phase-shifting interferometer. Featured modes: Microscope, Films, Stitch and Dynamic MEMS.	1990's	Optical profilometer	Optical profilometry	Testing and validation	Profilometry	Optical profilometry is a non-contact form of profilometry that can be used to characterise the surface steps and the roughness of a material. Optical profilometry employs phase-shifting and/or vertical scanning interferometry to resolve the topology of complex 3D structures. The technique marries precision z-axis control with interference-based techniques to resolve features from the angstrom to millimetre scale. The technique lends itself well to die-based measurements for ISO/QA and large area mapping. Profilometry is useful in process control steps such as measuring etch depth and lithography patterns.
Western Australia Node	MEMS	UWA	Digital Instruments DI500 AFM (UWA)	Digital Instruments	DI500 AFM	this is too old and needs to be replaced - exclude	1990's	Atomic force microscope (AFM)	Atomic Force Microscopy (AFM)	Testing and validation	Topological analysis and surface profiling	Atomic force microscopy (AFM) is one of the most versatile characterisation methods. AFM performs scanning probe microscopy, scanning the surface of a material with a nanoscale cantilever, either through direct contact or through oscillating the cantilever just above the surface. When the cantilever is positioned in close proximity to the surface, forces between the tip and the sample lead to deflection of the cantilever, which is then measured with a laser signal reflected to a photodiode detector. The properties of the material surface such as topography, mechanical properties and tip-surface interaction forces can then be generated leading to an understanding of the material surface at the nanoscale. AFM has a wide range of applications including nanoscale materials and surface characterisation, electrical materials characterisation, interaction forces and mechanical properties mapping. Bio AFM is useful for pharmaceutical studies, immunology studies, biosensing applications, antibody/antigen binding studies, as well as intra-molecular studies such as protein folding.
Western Australia Node	MEMS	UWA	Sentech SI 500D (UWA)	Sentech	SI 500D	Variable plasma properties providing high density, low ion energy, and low pressure plasma deposition of dielectric films. A large variety of substrates from wafers up to 200 mm diameter to parts loaded on carriers can be processed.		System for ICP plasma deposition	Plasma Enhanced Chemical Vapour Deposition (PECVD)	Deposition	Chemical Vapour Deposition (CVD)	Plasma Enhanced Chemical Vapour Deposition (PECVD) uses a plasma to deposit a thin film of silicon dioxide or silicon nitrate onto a substrate. PECVD uses lower temperatures than the furnace systems to achieve an insulating layer on a variety of materials. PECVD is used in optics, microelectronics, energy applications, packaging and chemistry for the deposition of anti-reflective coatings, scratch resistant transparent coatings, electronically active layers, passivation layers, dielectric layers, isolating layers, etch stop layers, encapsulation and chemical protective coatings.
Western Australia Node	MEMS	UWA	Oxford Instruments Plasmalab100 ICPRIE (UWA)	Oxford Instruments	Plasmalab100 ICPRIE	ICP-Reactive Ion etcher	2000's		Reactive Ion Etching (RIE)	Etching	Dry Etching	Reactive Ion Etching (RIE) is a method that combines both chemical and physical etching to allow isotropic and anisotropic material removal. The etching process is carried out in a chemically reactive plasma containing positively and negatively charged ions generated from gases that are pumped into the reaction chamber. A mask on top of the substrate is used to protect designated areas from etching, exposing only the areas to be etched. Dry etching offers excellent process control for cleanliness, homogeneity, etch-rate, etch-profile, selectivity and run-to-run consistency, which is critical for high-fidelity pattern-transfer in micro- and nano-system technologies. RIE is extensively used in the field of displays & lighting (LEDs), semiconductors, electronics, MEMS, communication technology, microfluidics, optoelectronics and photovoltaics.