NIBEC Equipment Model/Manufacturer	**Description of its usage (generic functionality)**	**Potential range of applications**	**General availability**	**Any special requirements for the use of the equipment**	**Contact Person**
Nanoindenter **Nanoindentor XP/MTS (nanoinstruments)**	Characterise the mechanical properties of materials on nanometer length scales. Elastic modulus and deformation behaviour are determined from an analysis of the force vs. displacement response measured during indentation of the material.	Elasto-plastic properties of layers as thin as 10nm	Booking system	• Hard layer on soft substrate. • Depth res.~0.1nm, Force res. ~, 1nN, with ambient noise, 100nN	Dr Patrick Lemoine
Atomic Force Microscope (AFM) **Dimenssion3000/Digital Instruments, Veeco**	An Atomic Force Microscope (AFM) provides 3 dimensional topographic information about a sample by probing its surface structure with a very sharp tip.	Mainly topography, although there are a lot of other functionalities (MFM, STM, etc.)	Booking system	• Imaging without vacuum, in liquids, Quantitative metrology • Lateral res. (~1nm) • Vertical res. (~1nm) • Small scan range (~90 m)	Dr Patrick Lemoine
Scanning Electron Microscope (SEM) **S3200N/Hitachi**	Uses a focused electron beam to scan small areas of solid samples. Secondary electrons are emitted from the sample and are collected to create an area map of the secondary emissions. Since the intensity of secondary emission is very dependent on local morphology, the area map is a magnified image of the sample.	Mainly topography, although there is also some compositional contrast	Booking system	• Fast imaging, nearly as good as AFM in many situations. • Lateral res. ~5nm, in best case scenario. • High vacuum and low vacuum (for insulating or moist samples) • Surface sensitive in SE mode	Dr Patrick Lemoine, Dr Jeremy Hamilton
X-ray Diffraction (XRD)	Obtain structural information on an atomic scale from both crystalline and non-crystalline (amorphous) materials.	To analyse the thickness (down to a few nm) and the density of thin layers.	Booking system	• Measure thickness, roughness, layering and density • Lateral res. (mm-cm) • Vertical res. ~0.1nm	Dr. Adrian Boyd

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Contact Profiler (CP) **Dektak8/Veeco**	Surface metrology technique that is commonly used to characterise the surface roughness of materials and in particular metals	Contour surfaces mechanically	Booking system	• To look at fairly hard surfaces over large distance with good Z resolution, useful for transparent thin films • Lateral res. (µm) • Vertical res. ~0.1nm • Large lateral range (up to 10cm) • Fast acquisition	Dr. Adrian Boyd
Optical profiler (OP) **WYKO NT8000/ Veeco**	Rapid measurement of step heights, roughness and surface topology. OP involves the use of white light interaction with a sample surface whereby yhe interference fringes created are passed through an interferometer where the data is automatically computed to render images of the surface topology	Measure the height from the optical interferogram, done either in PSI or WSI mode	Booking system	• To look at soft surfaces over large distance with good Z resolution, useful for thick (>µm) transparent thin (<160nm) films or thin opaque films	Dr. Adrian Boyd
Raman spectroscopy (**LabRam 300/Horiba Scientific)**	Measurement of the wavelength and intensity of inelastically scattered light from molecules. The Raman scattered light occurs at wavelengths that are shifted from the incident light by the energies of molecular vibrations. Typical applications are in structure determination, multicomponent qualitative analysis, and quantitative analysis.	Useful for characterising molecular bonding, especially in carbon and polymers	Booking system	• Analyse 'some' molecular vibrations • Lateral res. ~1µm • Surface sensitivity ~few nm	Dr Susanta Roy

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FTIR (Fourier Transform Infrared) Spectroscopy,	FTIR Analysis, is a failure analysis technique that provides information about the chemical bonding or molecular structure of materials, whether organic or inorganic. It is used in failure analysis to identify unknown materials present in a specimen, and is usually conducted to complement EDX analysis.	Useful for characterising molecular bonding, especially in carbon and polymers	Booking system	• Analyse 'some' molecular vibrations • Lateral res. none • Surface sensitivity ~few 10 nm in ATR mode, otherwise, µm	Dr Adrian Boyd
X-ray Photoelectron Spectroscopy (XPS)	Surface chemical analysis technique. It is based on the photoelectric effect and works by irradiating a sample material with x-rays causing electrons to be ejected. Identification of the elements in the sample can be made directly from the kinetic energies of these ejected photoelectrons.	Gives the surface composition of organic and inorganic materials, with profiling, can give a cross-section	Booking system	• Analyse bonding, give composition • Surf. Sensitivity ~few nm • Energy resolution ~0.25 eV • Lateral res. ~few 10 µm	Dr. Adrian Boyd

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Secondary Ion Mass Spectroscopy (SIMS)	SIMS operates on the principle that bombardment of a material with a beam of ions with high energy (1-30 keV) results in the ejection or sputtering of atoms from the material. A small percentage of these ejected atoms leave as either positively or negatively charged ions, which are referred to as 'secondary ions.' The collection of these sputtered secondary ions and their analysis by mass-to-charge spectrometry gives information on the composition of the sample, with the elements present identified through their atomic mass values. Counting the number of secondary ions collected can also give quantitative data on the sample's composition. Thus, SIMS works by analyzing material removed from the sample by sputtering, and is therefore a locally destructive technique.	Gives the surface composition of organic and inorganic materials	Booking system	• Analyse bonding, give composition • Surf. Sensitivity ~few nm • Lateral res. ~few nm	Dr. Adrian Boyd

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Dual beam FEI SEM (with EDX) **Quanta 200 3D/FEI**	Produces a beam of electrons or ions which upon reflection off a sample give morphological images of the sample down to scales of ~5nm. Additionally the ion beam can also be used to ablate or deposit material on the surface of the sample. The addition of EDX to this system gives quantifiable elemental information on the composition features obtained in SEM analysis	Morphological / topological imaging Elemental analysis Ion milling / deposition Surface patterning at scales inaccessible by lithography TEM sample prep.	Limited booking	Sample must be conducting to obtain optimal SEM resolution. Insulating samples can be imaged by SEM under environmental vacuum mode but resolution reduced significantly. Elemental analysis penetration depth dependent on accelerating voltage but not generally considered a surface sensitive technique more of a bulk measurement	Dr Patrick Lemoine, Dr Jeremy Hamilton
Radio Frequency (RF) Magnetron Sputter System **DIAVAC ACM Ltd.**	A physical vapour deposition technique used for the deposition of metal/ceramic thin films. Sputtering is a vacuum process whereby the source material (target) is bombarded by gaseous (Argon) ions causing the ejection of atoms. Ejected atoms or whole molecules are driven toward a substrate where they form a well bonded thin film. The sputter deposition procedure allows for a high degree of process control and the ability to deliver reproducible surface conditions.	Sputtering can be used to deposit thin films of electrically conductive or non-conductive materials onto a variety of substrates.	Booking system	• 2D substrate surface	Dr. Adrian Boyd

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RF and DC Magnetron Sputter System **Minilab/Moorefield**	A physical vapour deposition technique used for the deposition of metal/ceramic thin films. Sputtering is a vacuum process whereby the source material (target) is bombarded by gaseous (Argon) ions causing the ejection of atoms. Ejected atoms or whole molecules are driven toward a substrate where they form a well bonded thin film. The sputter deposition procedure allows for a high degree of process control and the ability to deliver reproducible surface conditions.	Sputtering can be used to deposit thin films of electrically conductive or non-conductive materials onto a variety of substrates. Currently this machine is extensively used for Au, Co, Ti, Ni, Fe depositions.	Booking system	• 2D surface	Dr. Susanta Roy
Filtered Cathodic vacuum Arc (FCVA) **(nanofilm, Singapore)**	A physical vapour deposition technique used for the deposition of ta-C (amorphous carbon) thin films. Ta-C can be doped with various elements such N, Si etc	Can be used for hard coating. Gas barrier coating. Thermal barrier coating.	Booking system	• 2D surface	Dr. Susanta Roy
RF –PECVD **DIAVAC ACM Ltd.**	A chemical vapour deposition technique used for the deposition of a-C;H (amorphous carbon) thin films. a-C: can be doped with various elements such O, N, Si etc	Can be used for moderate hard coating. Gas barrier coating. Thermal barrier coating.	Booking system	• 2D and 3D surface	Dr. Susanta Roy

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Thermal CVD **Carbolite Inc Ltd. (Single Zone And OTF1200X/ MTI (Double Zone)**	A chemical vapour deposition technique used for the growth of CNTs and carbon based nano-materials and semiconductor Nanomaterials such as ZnO, Si nanowires.	Various carbon base and semi-conducting Nanomaterials can be made with low cost.	Booking system	• 2D surface. Surface must be coated with special catalyst before deposition.	Dr. Susanta Roy
MICROWAVE-PECVD	A chemical vapour deposition technique used for the growth of CNTs and carbon based nano-materials.	We can produce range of materials such as align CNTs, Carbon nano-wires, carbon nano-walls. Diamond thin films, Nano-crystalline diamond, etc.	Booking system	• 2D surface. Surface must be coated with special catalyst before deposition.	Dr. Susanta Roy

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MANTIS SOFT LANDING SYSTEM FOR NANOPARTICLE DEPOSITION **MANTIS deposition Ltd.**	The system is based on magnetron sputtering technique that can be used to generate nanoparticles of sizes ranging from 30 atoms up to 15 nm in diameter. The formation and size of the nanoparticle population can be controlled by varying several parameters which includes, gas flow over the magnetron (Argon), carrier gas flow (Helium), plasma power, aperture geometry and position. In this system a quadrupole mass filter provides an unmatched level of control over the nano-particle size.	Titanium (Ti), Platinum (Pt), Cobalt (Co) and Gold (Au) nanoparticles can be formed on various substrates. For example, theses 2D arrays of nanoparticles/nano-patterned surfaces can significantly enhance the sensitivity of Surface Plasmon Resonance (SPR) biosensor.	Booking system	• 2D surface.	Dr. Susanta Roy