Equipment Name: **Auriga Focused Ion Beam**	**Category:** **B. Particle Labelling and/or** **C. Particle Characterisation in and ex-situ** **Institute: CRANN, Trinity College Dublin** **Location: CRANN Advanced Microscopy Laboratory, Unit 27-29, Trinity Enterprise Centre, Grand Canal Quay, Dublin 2, Ireland** **Contact Details of Technology Expert:** **Name: Dr. Colm Faulkner** **Phone: +353-1-896 4170** **Fax,: +353-1-896 3037** **E-mail: colm.faulkner@tcd.ie**

Short technology description/Overview:

The Carl Zeiss Auriga focused ion beam [FIB], is a one stop shop for nano-fabrication, 2-D and 3-D analysis and materials characterisation

In a FIB, a beam of gallium ions, as narrow as 2.5 nm, is selectively written over a sample, acting as an 'atomic chisel' or 'atomic power hose.' The ion beam selectively etches away material, performing a rapid, dry, site specific, mask-less lithography with sub 5 nm patterning resolution. The system is "dual-beam" – a FIB to cut and a FESEM to image. The tool is perfect for nano and micro-fabrication, for example patterning prototype devices for micro-fluidics, or texturing a substrate for cell adhesion and movement investigations.

The FIB is ideally suited to cross-sectionning material to resolve sub surface information, such as buried nano-particles, and has specialised software for acquiring 3-D information about samples using an automated slice and image function.

The system has an in-situ micromanipulator, for placing/manipulating objects with sub 50 nm precision in-situ, and 5 different materials including Pt, W, and SiO_2 can be locally deposited in-situ, with a gas injections system [GIS]. Electron beam and ion beam lithography can be performed over large areas with Raith software package.

The field emission electron column is capable of 1 nm imaging resolution at 30 KeV. It can operate down to 0.1 KeV – ideal for imaging challenging biological specimens and uncoated cells. Further by varying the energy of the electron beam intercellular structure, and embedded nano-particles in various samples can be imaged in a non-destructive manner.

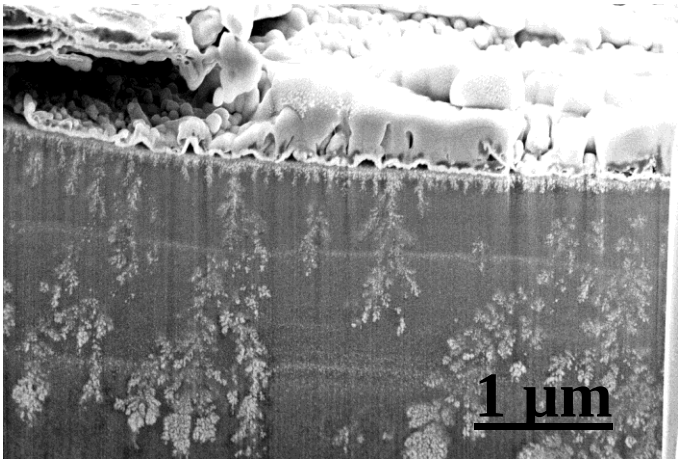
Main Features (Equipment Capabilities):

- **3-D site specific reconstructions** – i.e. 3-D reconstruction of buried & embedded nano-particles
- **Site specific TEM sample preparation –** *in situ* and low KV capability to analyse buried nano-particles
- **Site specific FIB cross-sections –** characterisation of embedded nano-particles and objects embedded in coatings, cells, and bio-materials, by site selective sputtering and FESEM imaging.
- **Atom probe sample fabrication.** Fabrication of high aspect ratio pillars or material [potentially with embedded nano-particles], for high resolution characterisation by atom probe microscope or transmission electron microscope tomography.
- **High Resolution Imaging:** Field emission scanning electron microscope [Spec – 1 nm, 0.3 KV- 30 KV]]

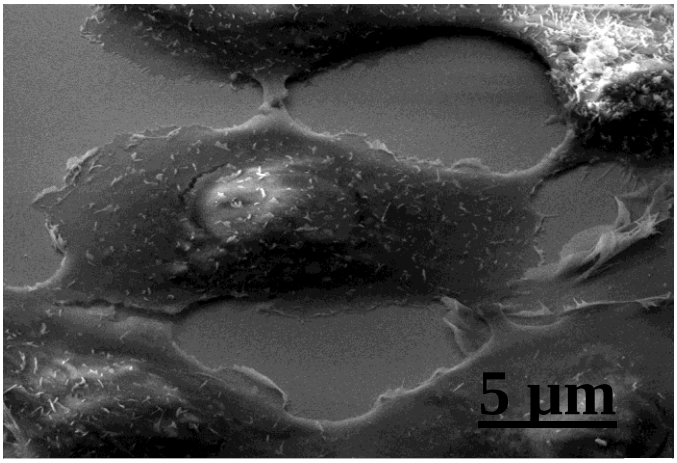
- **Cut:** 2.5 nm diameter gallium focused ion beam probe [FWHM].
- **Deposit: Localized metal or insulator deposition, e.g. Pt, SiO_2, W**
- **Manipulate:** *In Situ* Kliendiek Micromanipulator
- **Pattern:** Elphi Quantum Lithography package for ion beam lithography or electron beam lithography

Typical Samples & Images:

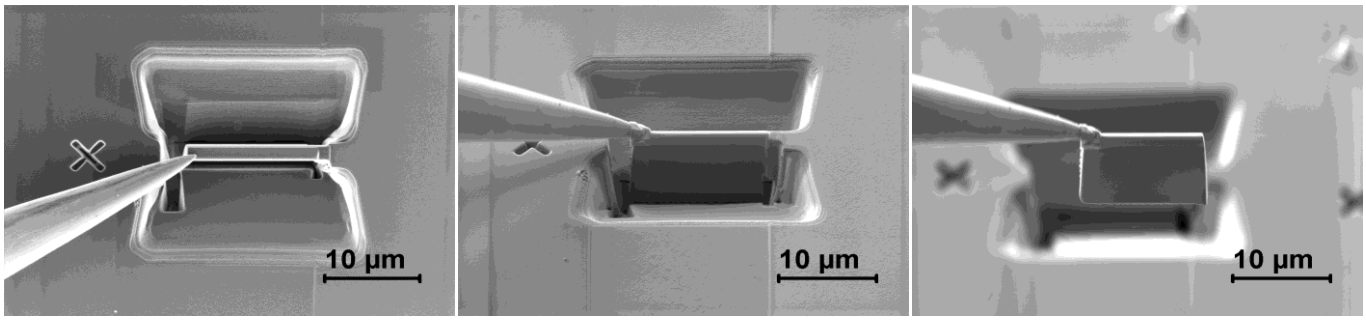
Some typical biological samples include uncoated and coated cells, collagen, drug impregnated polymers, elastin, candidate bone substitute materials, hydroxyapatite, platelets. Nano particles, composites, nanowires, nanotubes, and buried nano-particles for use in anti-bacterial coatings are all characterised. A wide range of silicon based samples are prepared for TEM.



FIB cross section of buried silver nano-particles in a polymer host material. [A. Satti, Y.K. Gun'ko, TCD]



FESEM imaging of uncoated cells. [D. Bazou, H. Z. Zhang, TCD]



FIB sample preparation on the TCD CRANN Auriga FIB.