Equipment Name: Electron Microscopy	**Category:** **C. Particle Characterisation in and ex-situ and/or** **D. In-vitro toxicity studies** **Institute:** University College Dublin **Location:** Geology Department, University College Dublin, Belfield, Dublin4, Ireland **Contact Details of Technology Expert:** **Name:** Dimitry Scholtz **Phone:** +353 1 716 6736 **Fax:** **E-mail:** dimitri.scholz@ucd.ie

Short technology description/Overview:

Image resolution in light microscopy is limited by the wavelength of light and is incapable of revealing structures of less than 0.25mm, placing serious limitation on our understanding of biological material structures smaller than this. However, electron beams can be generated having a wavelength of less than 0.2nm and when used in Transmission Electron Microscopy (TEM), image resolution is increased to less than 0.2nm, which allows scientific exploration of molecular and even atomic structures.

The equipment in UCD allows comprehensive ultra-structural research to be undertaken in both the material and biological sciences, ranging from ultrathin section analysis of cells and tissues with detail maximally resolved at a few nanometres to topographical studies using scanning electron microscopy (SEM) and elemental analysis.

Research topics in the biological sciences include human ultrastructural pathology servicing most of the Dublin hospitals. Examples of the many research programmes ongoing in the laboratory include diabetes, inflammation, breast cancer, the vasculature and morphology of zebra fish eye, arthritis, diseases of the spleen and liver as well as the morphology of viruses, bacteria and parasitology. Research topics in the material sciences include food science, polymer films for biosensors, nano-membranes for CO_2 recovery, nano-particle analysis from a size and size distribution in solution perspective and from a cellular/tissue uptake and sub-cellular localisation perspective. Detailed mechanisms of particle uptake can be elucidated. Application of stereological counting allows quantification of nanoparticle uptake.

Protocols for all aspects of nanoparticle size determination by TEM, and nanoparticle interaction and uptake by cells using TEM are available from UCD via QNano.

Main Features (Equipment Capabilities):

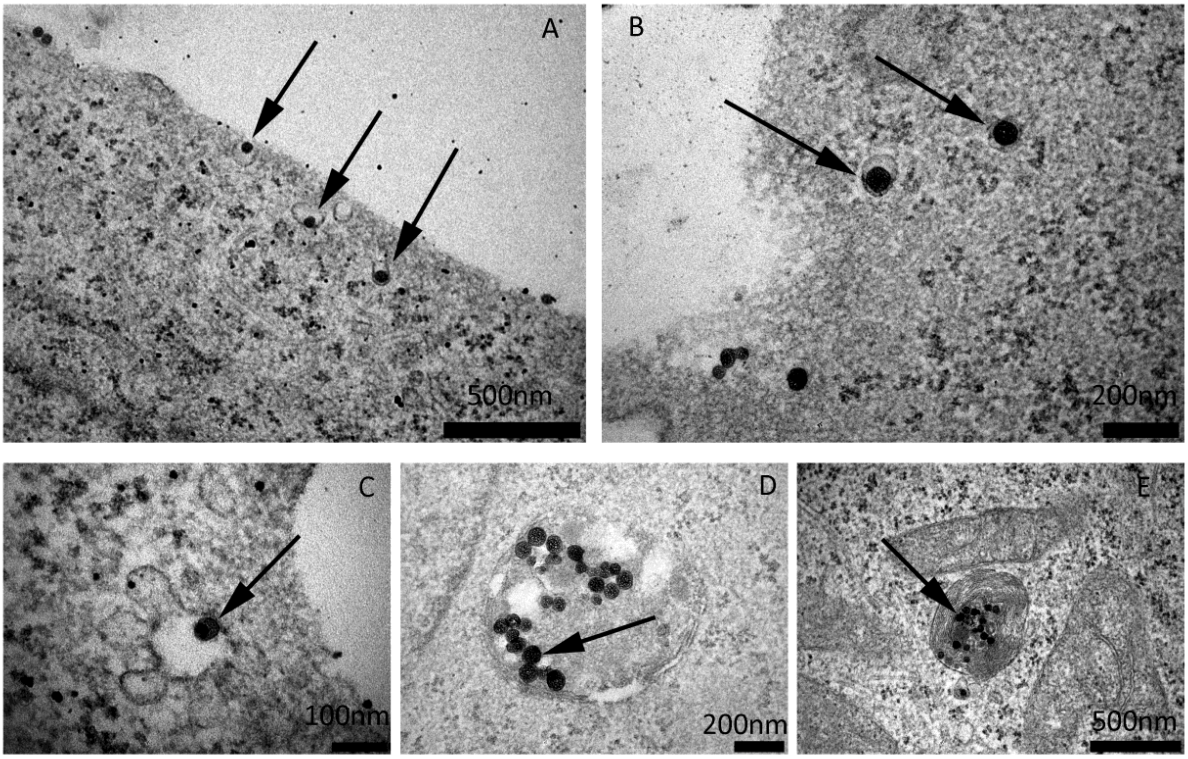
- Four high-resolution Transmission Electrom Microscopes (TEMs)
- One scanning electron micropscope (SEM)
- One cryo-stage SEM equipped with an elemental analysis system

- Three ultramicrotomes, a cryo-ultramicrotome and a wide range of SEM ancilliary preparation instruments.

Points to consider when designing experiments for TA:

- Not all nanomaterials are sufficiently dense to be detected by EM, especially in the presence of other scatterers such as cells. Some preliminary checks of your specific nanomaterials may be required prior to TA visit to assess feasibility of proposed study.
- Nanomaterials dispersion quality is critical to the success of all uptake and cellular interaction studies. Support and advice on dispersion protocols can also be provided via QNano.

Typical Samples & Images:



EM images of the early events of uptake of (A) 50 nm and (B) 100 nm green SiO_2 nanoparticles. (C-E): 50 nm green SiO_2 nanoparticles in early endosomes, multilamellar bodies and multivescicular bodies, respectively. Arrows indicate he localization of nanoparticles in the cells. From Shapero et al., Mol Biosyst., 2011, 7, 371-378.

Key publications:

- Elsaesser A, Barnes CA, McKerr G, Salvati A, Lynch I, Dawson KA, Howard CV. Quantification of nanoparticle uptake by cells using an unbiased sampling method and electron microscopy. Nanomedicine (Lond). 2011 6, 1189-98.
- Shapero K, Fenaroli F, Lynch I, Cottell DC, Salvati A, Dawson KA. Time and space resolved uptake study of silica nanoparticles by human cells. Mol Biosyst. 2011, 7, 371-378.

Any further Information:

EM may be used in conjunction with flow cytomtery or HCA installations.