Electron Microscopy in Ireland – National Spotlight

February 2025 EMUKI

Dr Jon Peters
Dr Kerry Thompson

MSI MICROSCOPY SOCIETY OF IRELAND

Chan Zuckerberg Initiative

Taighde Éireann Research Ireland

Universities and Research Facilities/Centres across the Island of Ireland that carry out/facilitate EM work

SETU

TU DUBLIN

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Ollscoil na Gaillimhe
University of Galway

MTU
Ollscoil Teicneolaíochta na Mumhan
Munster Technological University

University of Limerick
Ollscoil Luimnigh

Maynooth University
National University of Ireland Maynooth

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

DCU
Ollscoil Chatha Bhaile Átha Cliath
Dublin City Uni

Queen's University Belfast

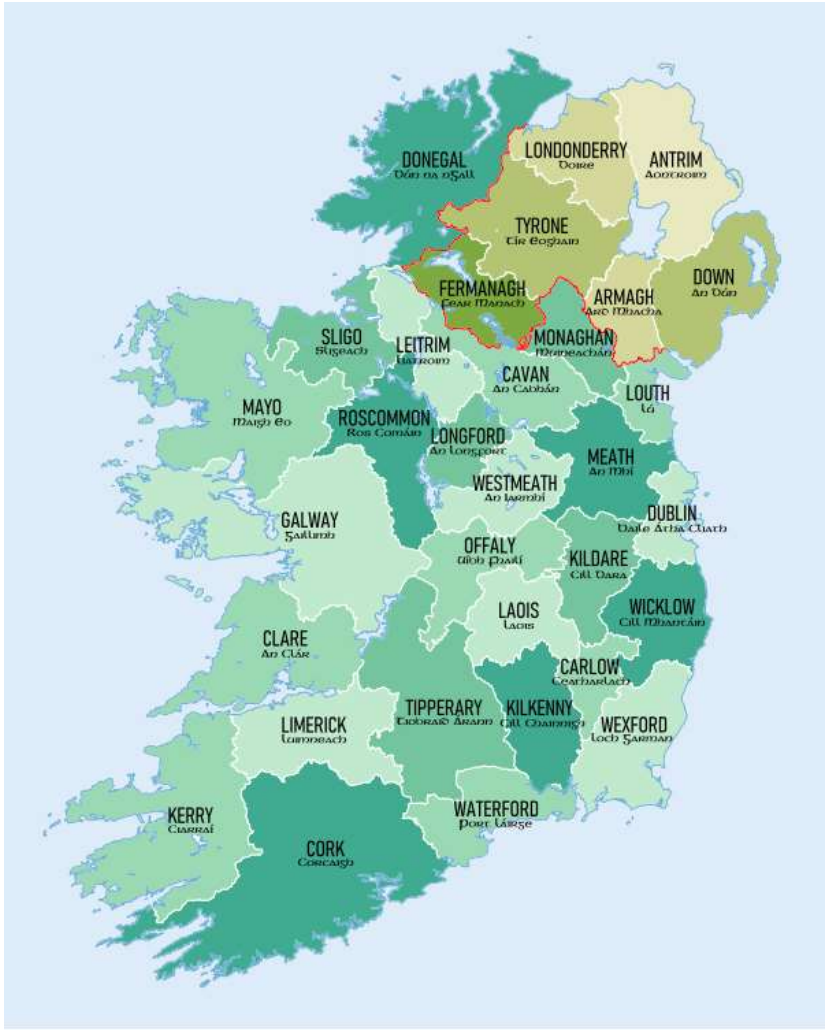
UCD Dublin

Ulster University

RCSI

Tyndall
National Institute
Institiúid Náisiúnta

Bernal Institute



About the Community

- Technologies are generally affiliated with and located in:
  - **Universities** and **Research Centres** or **facilities** in Universities
  - **Industries** (privately owned and managed)

- Managed generally by Facility Director, Academic or Technical Lead

- Life/Bio, Physical, Material (Including Biomaterial and Biomed Eng constructs), Chemical Analysis

- Research, Teaching and Training, Workflow Development - Most
- Contract work - Full service (Costed) or Collaboration - differs

- SEM - VP, Environmental, SBFSEM, AT, FIBSEM, soon Cryo FIBSEM for Bio workflows

- TEM - Aberration Corrected, Standard TEM, soon Cryo TEM

About the Community

Commonly experienced issues across the Island

Staffing

- Current lack of opportunities for funding staff (technical/core facility)
- Often precarious short term posts/positions
- Often research staff driven
- Postdocs allocated to a project - Enthusiastic and skilled :)
- But Loss of Institutional Memory on completion of a post/contract

Funding

- National strategy not currently clear for Infrastructures or Core Technologies
- BUT in past few years, frequent calls from SFI/Research Ireland
- HEA - Strategic funds for larger equipment
- Local repair/replace for small equipment - limited budget
- Often end up with understaffed high end cutting edge technologies

Where we're going next..

Developing and increasing national community building opportunities - Rebuilding the Network

Continued collaboration **Nationally** and **Internationally**
And with our **Industry Colleagues** - both **Microscopy Companies** and local SME's/large international enterprises.

Developing and expanding **National Platforms and Consortia** for

- Cryo EM
- Volume EM

Focussed Interest or Working Groups for **Strategy and Funding**
Encourage engagement with our national funders
Ensure broad representation

Volume Electron Microscopy – AT and SBFSEM



Ileana Micu, Queens University Belfast
Dimitri Scholz, Tiina O'Neill, University College Dublin
Emma Mc Dermott, University of Galway
Kerry Thompson, University of Galway

All Island Consortium…

- Optimized and Standardized Sample Prep
- Working together – Better return for Tax Payers Money

Zeiss Gemini SEM 360 with Volutome - Galway

First Group Training event led by Steve Furzeland (Zeiss) in November 2024

Next steps – formalise regular meetings with the group

Project development locally

Cryo Electron Microscopy National Platform

Funded by Research Ireland in 2024

- Cryo FIBSEM
- CryoTEM

Led by UCD

- Prof Oliver Blacque and the Conway Team

All Island Support

Who we are…

Whistle stop tour

Slide deck on www.microscopy.ie
More details or if you want to get in touch

Ollscoil na Gaillimhe
University of Galway

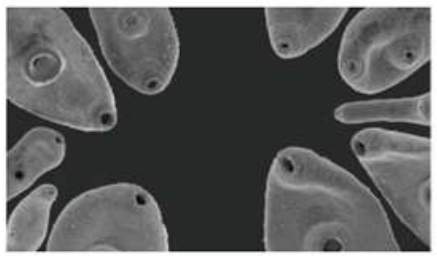
- **NEW** Zeiss Gemini SEM 360 with Volutome
- Hitachi SEM/EDX S4700
- Hitachi SEM S-2600

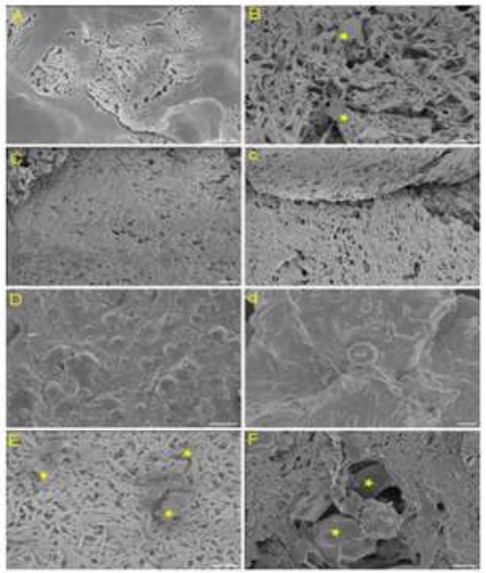
- Hitachi TEM H7500 TEM
- **NEW** JEOL 2100 installed Summer 2025

Director
Prof Peter Dockery
Anatomy
School of Medicine

Core Staff:
Dr EadaoinTimmins
Dr Emma McDermott

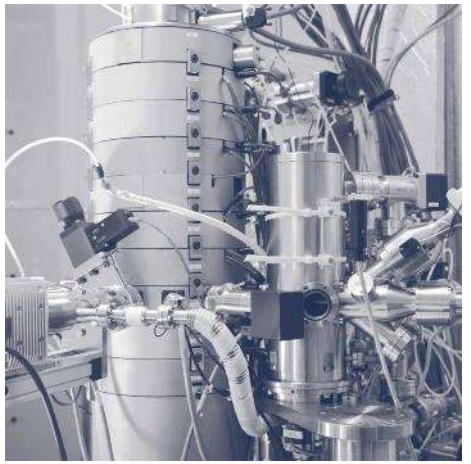
Imaging Scientist Fellow:
Dr Kerry Thompson
Kerry.Thompson@universityofgalway.ie





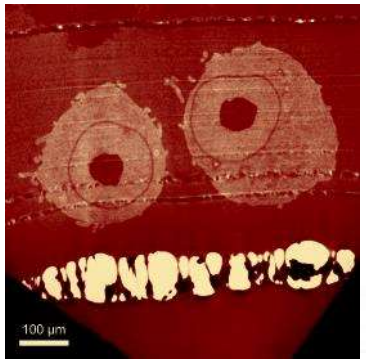
Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

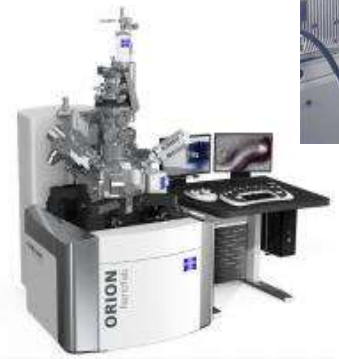
Facilities Manager
Cathal McAuley
cathal.mcauley@tcd.ie



Based in central Dublin,
the Advanced Microscopy Laboratory (AML)

Nion Ultrastem 200 (EELS, EDX)
FEI Titan 300 kV STEM/TEM (EELS, EDX, in-situ)
JEOL 2100 TEM



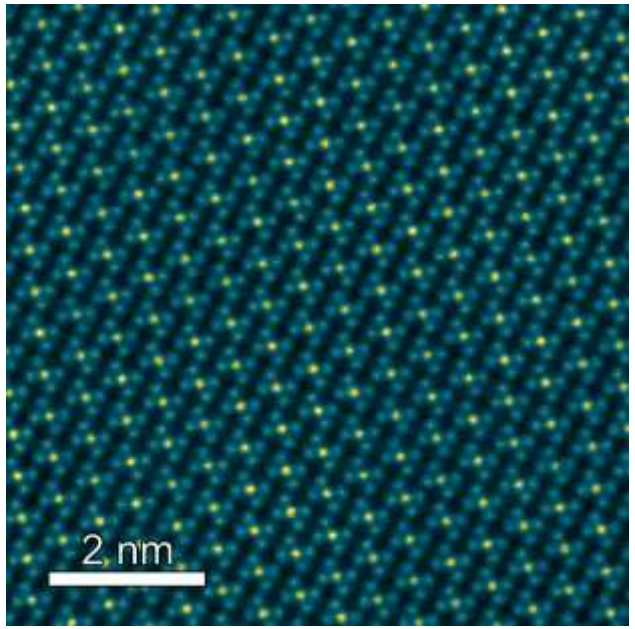


Zeiss Orion Nanofab (He Ion, Ga, lithography)
Zeiss Auriga FIB-SEM
Fischione Nanomill

Zeiss Ultra plus (EDX)
Zeiss Ultra plus (EDX, Cryo)
Zeiss Supra (EBSD, lithography)
Zeiss Evo (VP)

Elionix ELS 7700 lithography system

3 dedicated staff members



CORE
Technology Platforms at
UCD Conway Institute

UCD DUBLIN

Equipment

- 2x TEM
- 1x SEM
- Cryo Soft XRay - Partners - Sirius XT
- 3x Ultramicrotomes, including one suitable for cryo-ultramicrotomy
- Sample preparation instruments

Director: Dimitri Scholz
dimitri.scholz@ucd.ie

Contact:
Ms Tiina O'Neill
T: +353 1 716 6880
E: tiina.oneill@ucd.ie

Dr Niamh Stephens
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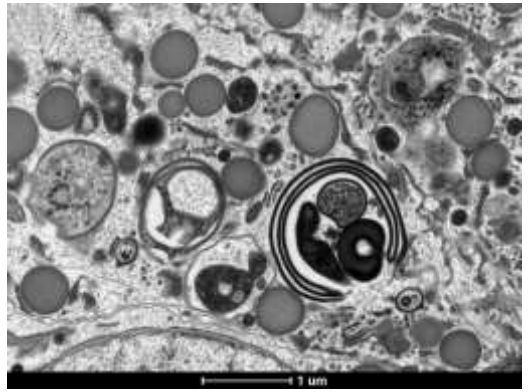
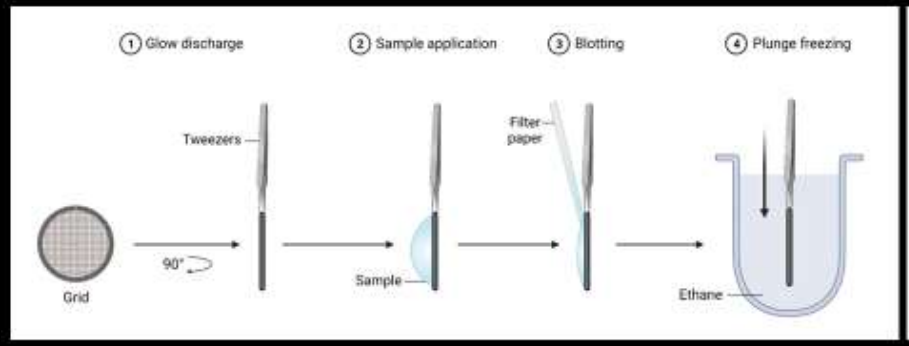
Graduate and **continuing professional development modules** to scientists interested in using imaging technologies within their research.



Will host the new Cryo EM capabilities

https://www.ucd.ie/conway/research/coretechnologies/imagingcore/

Cryo Electron Microscopy National facility



FAST SHIPPING

UCD DUBLIN

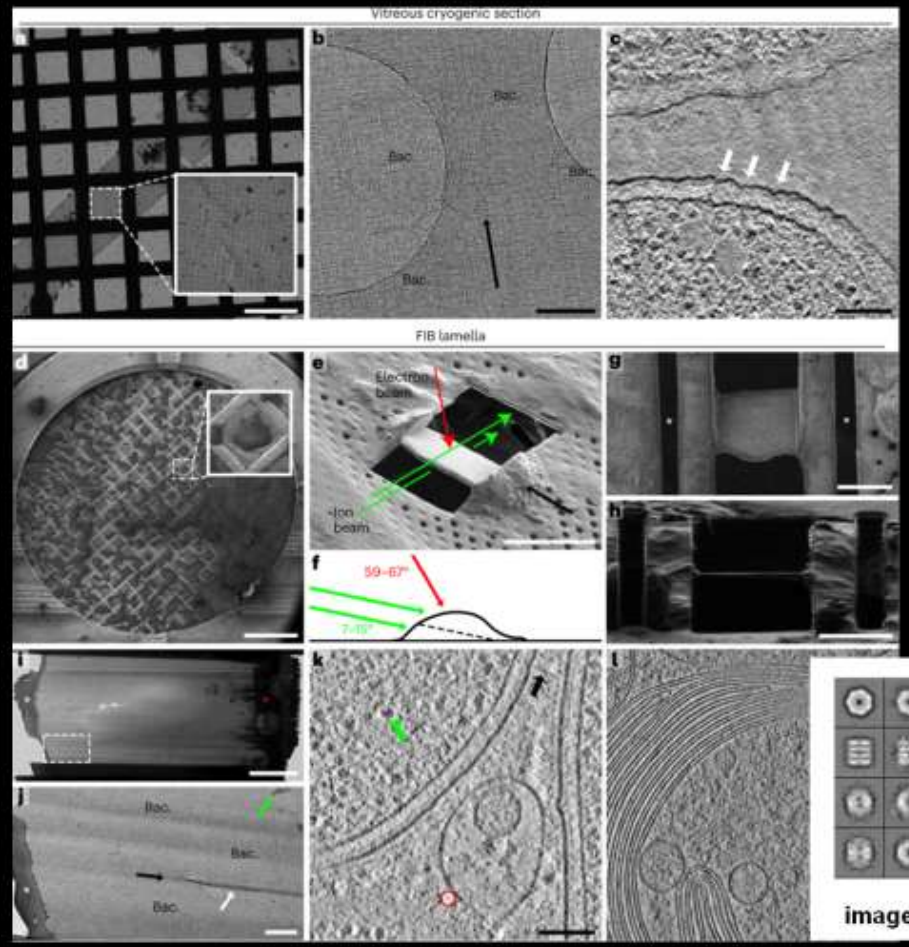
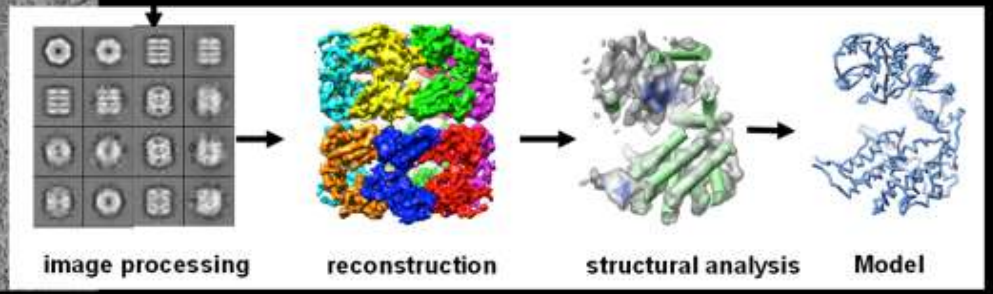


Image analysis
Segmentation
Modelling

- Data management
- Know-how sharing
- Training
- Teaching
- Communication



OLLSCOIL TEICNEOLAÍOCHTA
BHAILE ÁTHA CLIATH
DUBLIN
TECHNOLOGICAL
UNIVERSITY DUBLIN

Hitachi SU 6600 FESEM with Cryotransfer Stage

hugh.byrne@TUDublin.ie
Head of FOCAS Research Institute

Coláiste na hOllscoile Corcaigh
University College Cork, Ireland

FOSSIL COLOUR @ UCC

Preservation and paleobiology of exceptionally preserved fossils.

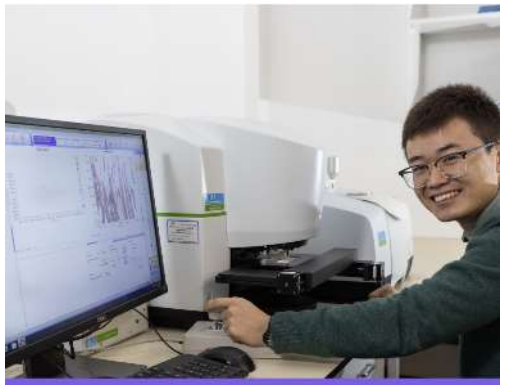
Maria McNamara

EM facility used for analysis of:

- Fossils
- Rocks
- Sediment
- Biological tissues
- Biochar
- Microplastics
- Plant tissues
- Tyre and road wear particles

JEOL JSM-IT100 SEM

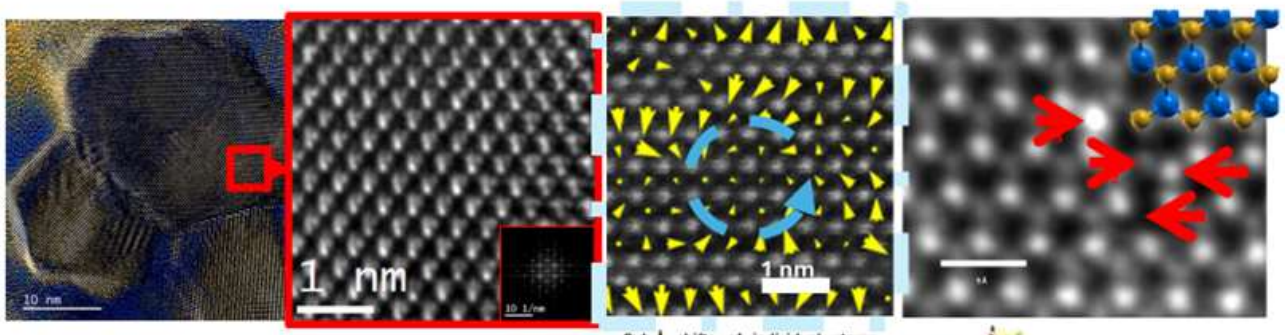
Leica EM UC7RT ultramicrotome



Perkin Elmer Spotlight micro FT-IR

Titan Themis at UL

- In-situ specimen holders
- Direct detection camera is in its constellation making it one of a few in the world



A pharmaceutical crystal (FFA) exhibiting hexagonal morphology with its atomic its column arrangement in the red box, magnified on the right (the inset shows the corresponding FFT).

Sub-Å shifts of individual atoms (indicated by yellow arrows on a relative scale) of atoms in a ferroelectric material ($Bi_6Ti_1Fe_2Mn_1O_{18}$) leading to electric dipole formation

2-D MoS_2 implanted with Se at ultra-low energies (~10 eV) with 10^{15} ions/cm^2 resulting in:

1 Se in chalcogen position, 2 Foreign atom in Mo position, 3 Adatom, 4 Sulfur divacancy

- Double aberration corrected
- Monochromated (pico-meter res)
- Super EDX
- Energy loss filtered imaging and spectroscopy
- Sub-Angstrom resolution
- <80 meV energy resolution
- 4-quadrant annular EDX detector
- STEMx

- **Collaborate with:**
  - Daresbury SuperSTEMs
  - Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons, Forschungszetrum Juelich

The TEM facility at UL also includes a Jeol TEM and a (just acquired) Talos TEM.

Instrument Scientists
Esther.Adegoke@ul.ie
Serguei.Belochapkine@ul.ie

TEMUL Group
Dr. Alan Harvey (Instrument Scientist)
Dr. NingBin Zhang (Research Fellow)
Samad Abdus (PhD student)

Group members of previous years are shown below, from left, and going round in a circle:
Dr. Eoghan O'Connell, Dr. Eoin Moynihan, Dr. Kalani Moore, Dr. Alan Harvey, Dr. Eileen Courtney, Dr. Michelle Conroy, Dr. Jennifer Cookman, **Middle** Prof Ursel Bangert

Electron microscopy @ RCSI

Contact:

Dr Brenton Cavanagh

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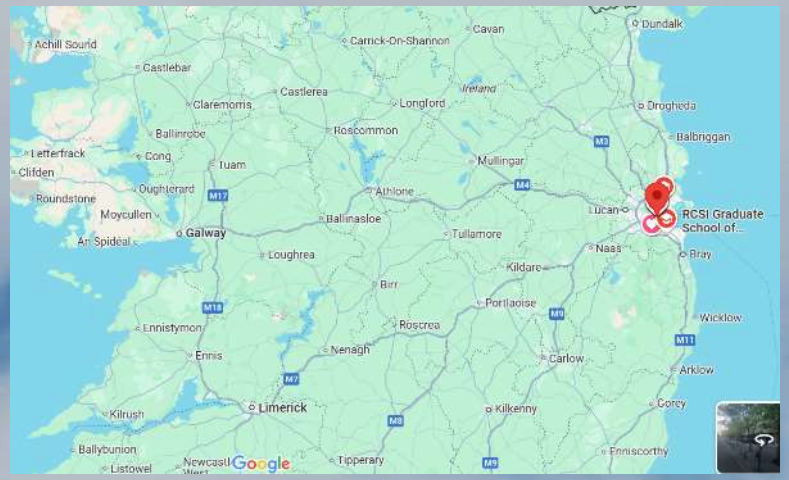


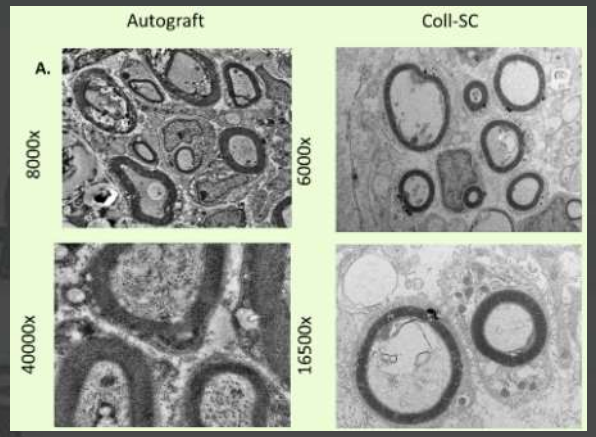
RCSI UNIVERSITY OF MEDICINE AND HEALTH SCIENCES

WORLD #5 for GOOD HEALTH and WELL-BEING
Times Higher Education Impact Rankings 2024

Equipment

Hitachi H-7650

Leica UM6 ultramicrotome



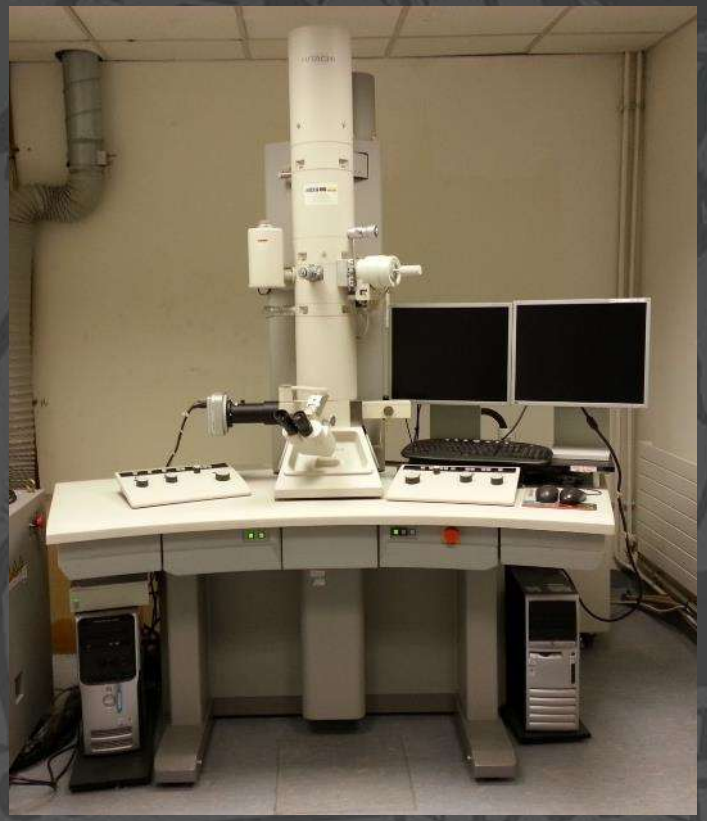
Hibbitts, A et al. J Mat Bio, 2022

DOI: 10.1016/j.matbio.2022.01.002

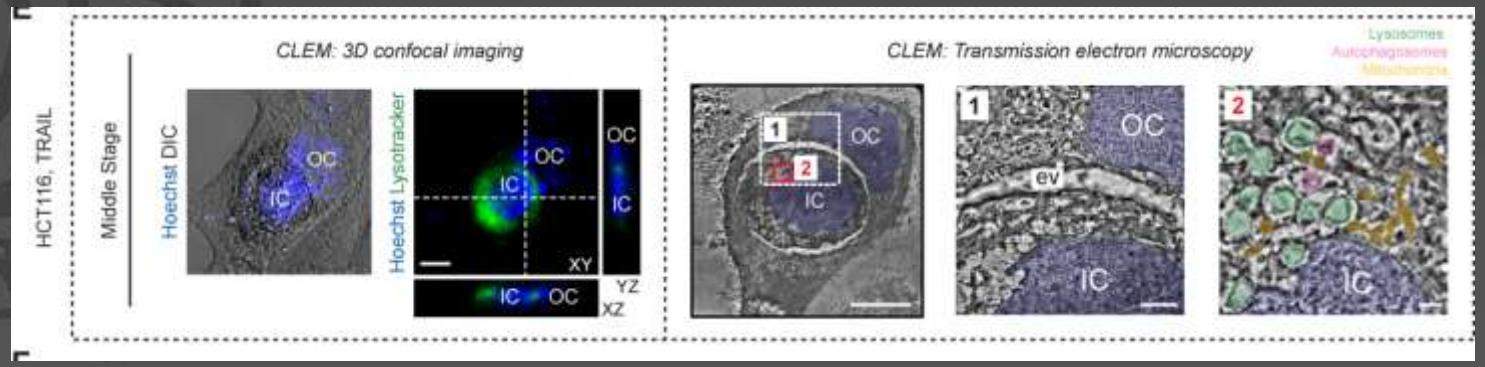
Bozkurt, E *et al.* J Cell Biol, 2021

DOI: 10.1083/jcb.202010030

RCSI UNIVERSITY OF MEDICINE AND HEALTH SCIENCES



- **Human and animal tissue analysis**
- **Nanoparticle characterisation**
- **Correlative light and electron microscopy (CLEM) of subcellular organelles and entosis**
- **Biomimetic material host integration**



CENTRE FOR ADVANCED PHOTONICS & PROCESS ANALYSIS

CAPPA

Innovation Through Light

Your Research Partner for Photonics Solutions

- *Pharmaceuticals*
- *Food Technology*
- *Medical Devices*
- *Sensors & Systems*

Electron Microscopy

Large chamber SEM with VP and EDS

Liam.Lewis@mtu.ie

The Centre for Advanced Photonics & Process Analysis (CAPPA) is a research group at Munster Technological University (MTU) and one of the 17 centres part of Enterprise Ireland Technology Gateway Network.

CAPPA conducts both applied and fundamental research on photonics for applications in areas as diverse as telecommunications, medical devices, food and pharmaceutical manufacturing.

MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University

Rialtas na hÉireann Government of Ireland

Arna chomhchistiú ag an Aontas Eorpach
Co-funded by the European Union

Tionól Réigiúnach an Deiscirt
Southern Regional Assembly

Enterprise Ireland

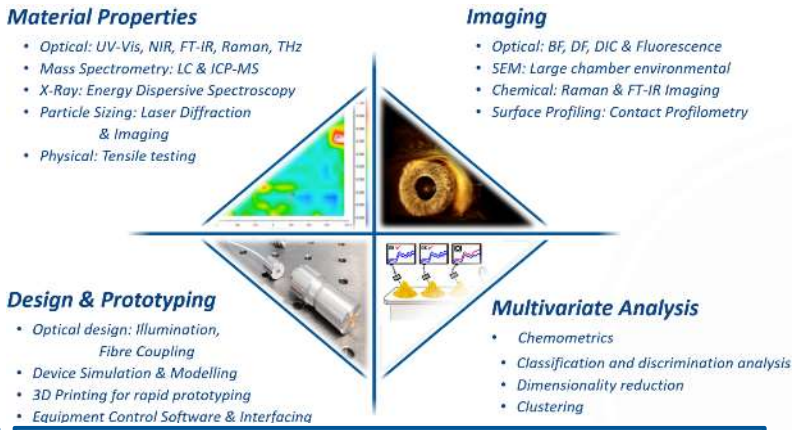
WWW.CAPPA.IE

CAPPA Facilities and Equipment

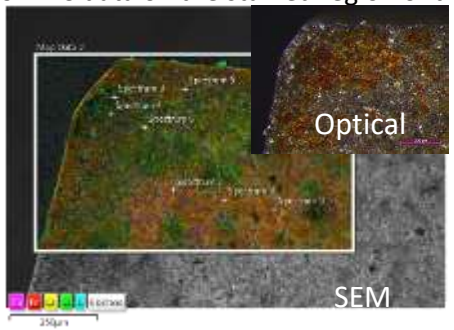
Current SEM

Other Analytical Equipment

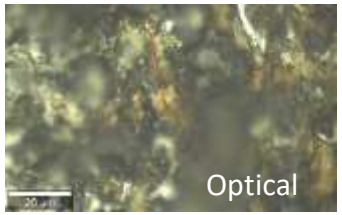
Research Capabilities

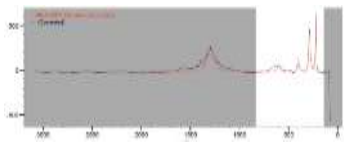


Overlay of EDS data on the stained region of the piece



Raman microscopy to confirming iron oxide





- ***SEM with EDS***
- ***Raman spectrometers***
  - *3D Confocal Raman Imaging*
  - *Hyperspectral image generation at 1-micron resolution*
  - *5 laser lines – 249, 532, 633, 785, 830 nm*
  - *Deep UV Raman*
- ***IR spectrometer Imaging***
  - *Dual mode single point and MCT array*
  - *Mid-IR and Near-IR*
  - *Hyperspectral image generation at 6.25, 25, or 50 microns*
- *Wide-field spectroscopic microscopy and imaging platform - QCL*
- ***NMR – benchtop 80Mhz***
- ***Supercontinuum light source + spectrograph development platform***
- ***VIS & SWIR Hyperspectral system***

- ***Typical projects***
  - *Develop Inspection systems for coating applications*
  - *Contamination and failure analysis*
  - *Point-of-Care Diagnostics*
  - *Cancer Screening Technologies*
  - *Environmental Monitoring*
  - *Process Monitoring*
  - *Horizon Europe Projects*

CAPPA conducts ~ 50-60 Industry engagements per annum varying from

½ days to long term multi year collaborative projects, 500+ total projects

MTU
Rialtas na hÉireann Government of Ireland
Arna chomhchistiú ag an Aontas Eorpach
Co-funded by the European Union
Tionól Réigiúnach an Deiscirt
Southern Regional Assembly
Enterprise Ireland

New SEM and Advanced Analytical equipment in 2025

- **SEM** – large chamber, Backscattered Electron Detector, Low Vacuum Hybrid Secondary Electron Detector, EDS
- **FLIM -** fluorescence imaging technique
- **Non-Contact 3D Optical Profiling**
- **TERS-Raman system**
- **Tri-range FTIR system**
- **Steady state fluorescence system**

CAPPA's latest additions will enhance our analytical capabilities, enabling cutting-edge research and innovation in photonics and process analysis.

MTU
Rialtas na hÉireann Government of Ireland
Arna chomhchistiú ag an Aontas Eorpach Co-funded by the European Union
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Enterprise Ireland

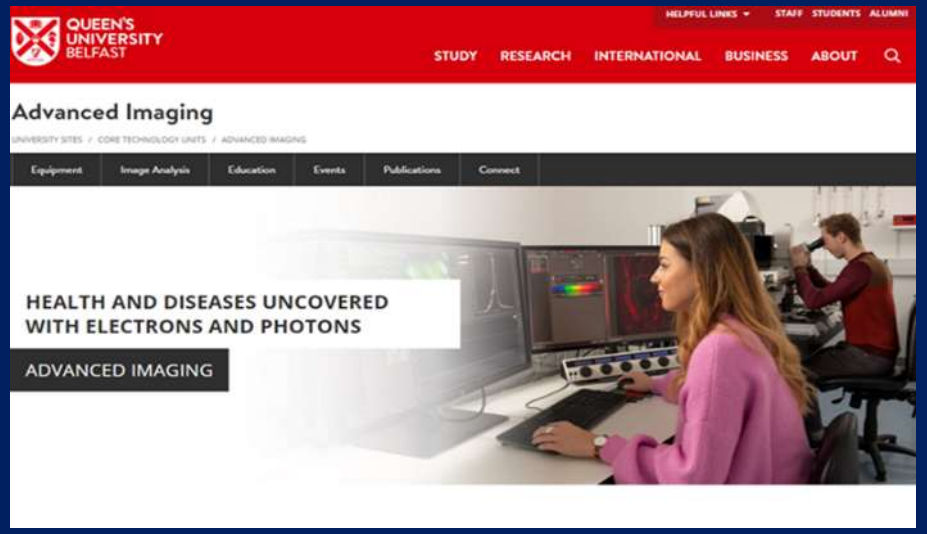
QUEEN'S UNIVERSITY BELFAST

FACULTY OF MEDICINE, HEALTH AND LIFE SCIENCES

https://www.qub.ac.uk/sites/core-technology-units/AdvancedImaging/

Advanced Imaging and Histology Core Technology Unit

Dr. Colin Adrain
Professor Tim Curtis
Dr. Ryan Delaney
Dr. Carmel McVicar
Dr. Ileana Micu

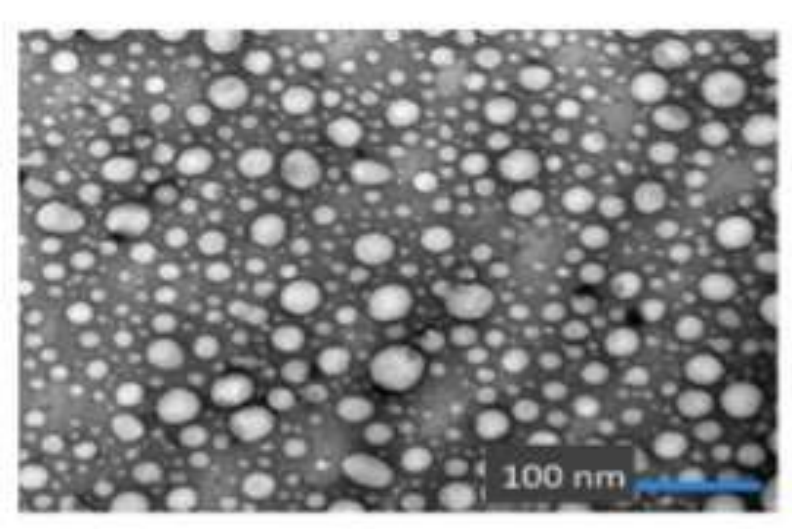


Provide professional training and access *to cutting edge microscopy,* imaging equipment, image analysis and sample preparation

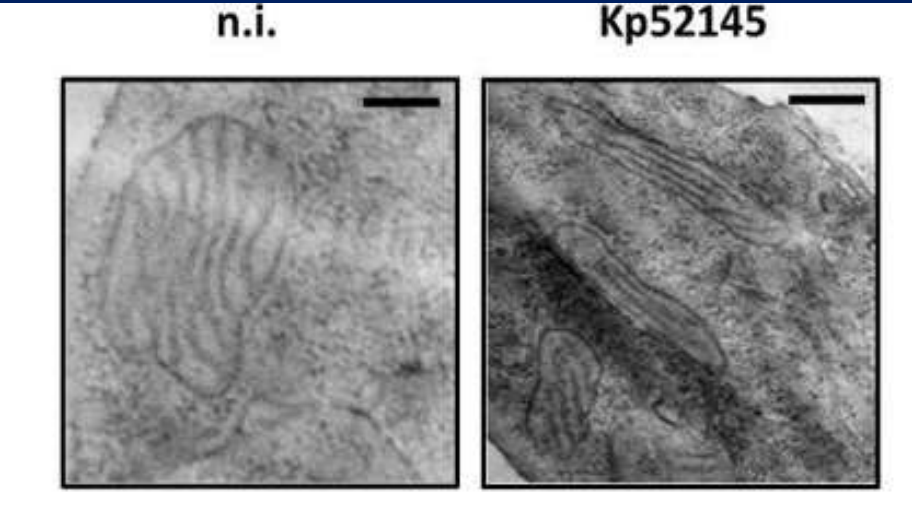
Joel JEM -1400 Plus Transmission Electron Microscope

- Acceleration voltage 40kV to 120kV
- Magnification x10 to x800,000
- JEOL Ruby 8MP Bottom mounted CCD digital Camera
- Standard specimen holder
- +/- 70º tilt with support for tomography
- High Tilt tomography holder
- Liquid Nitrogen Cold Trap -Cryo ready
- 2D montaging and 3D tomography
- Selected area electron diffraction

Recent Work



Demonstrating the homogeneity and nanoscale of RALA-SME-liposomes



A trans-kingdom T6SS effector induces the fragmentation of the mitochondrial network and activates innate immune receptor NLRX1 to promote infection

Future Goals:

- Volume electron microscopy workflow development
- Tomography image analysis
- C.L.E.M - develop and implement

Ulster University

The Bio-Imaging Core Facility Unit
Biomedical Sciences Research Institute

Dr Barry O'Hagan (Academic Lead)
Bmg.ohagan@ulster.ac.uk

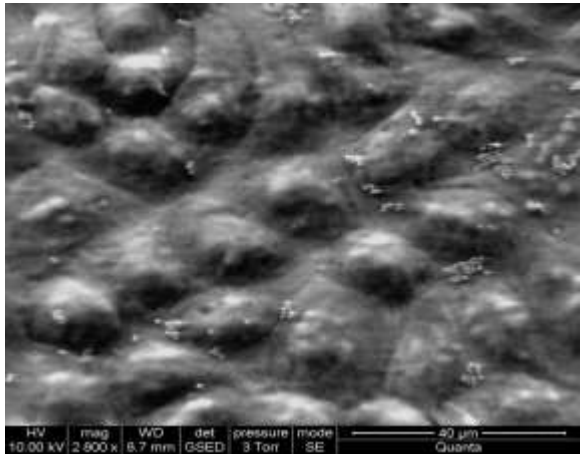
FEI Quanta ESEM

Scanning Electron Microscopy

- High and low vacuum SEM (conductive samples)
- Low vacuum SEM (insulating samples)

Environmental SEM (FEI Quanta)

- Novel imaging of hydrated specimens



Fully hydrated cellular monolayer with *Staphylococcus aureus*

Ulster University

Recent Collaborations

- Successful **DairyDry Project** 2016 – 2022 (€2.6M FIRM project, funded by DAFM and DAERA) "**Developing the next generation of protein-enriched spray dried dairy powders with enhanced hydration properties**"

- Partners: Teagasc, University College Cork, Cork Institute of Technology, Ulster University, Waterford Institute of Technology.

- Extensive ongoing collaborations with industrial partners from the food and pharmaceutical industries

Future plans for facility

- Bid under consideration for a **Centre for Food and Drug Discovery (CFDD)**, estimated 2026.
- **New suite** of Electron microscopes including:
  - Cryo equipped FEG Environmental SEM with EDS
  - Biological 120KV TEM with 3d Tomography, EDS and STEM

DCU Core Facilities - EM Capabilities

Current and planned

Specialist

Barry O’Connell

barry.oconnell@dcu.ie

Manager DCU Core Technologies

Robbie Sinnott

Currently available

Hitachi S-5500

STEM

- Cold Field Emission
- In-lens SE & BS detectors
- ~300pm resolution
- Brightfield + Darkfield transmission detectors
- EDS

JEOL IT-100

SEM

- Large Sample Chamber
- Variable Pressure
- Student-Proof
- SE + BS detectors

Currently funded – In procurement

Surface Metrology System

Planned Installation

- X-Ray Photoelectron Spectroscopy
- Scanning Electron Microscopy
- Scanning Auger Microscopy
- Optical Modules available (Raman, IR absorption spectroscopy)

Electron Microscopy Analysis Facility

Tyndall National Institute
Institiúid Náisiúnta

Based in Tyndall National Institute in Cork City, Ireland

UCC
Coláiste na hOllscoile Corcaigh
University College Cork, Ireland

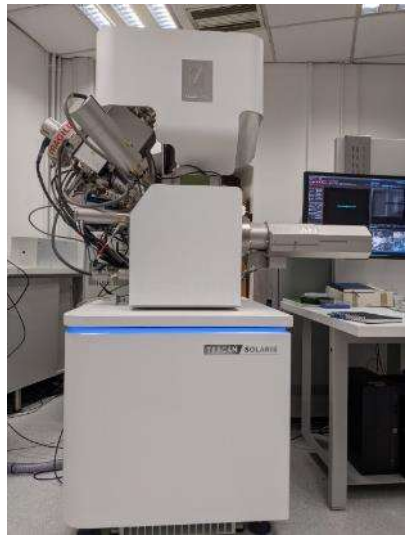
University College Cork
Coláiste na hOllscoile Corcaigh

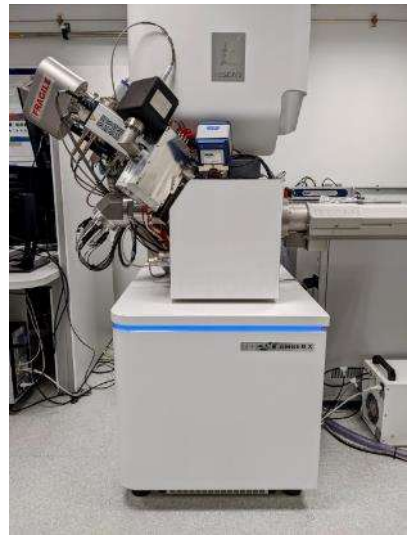
EMAF: Sample Preparation & Analytics

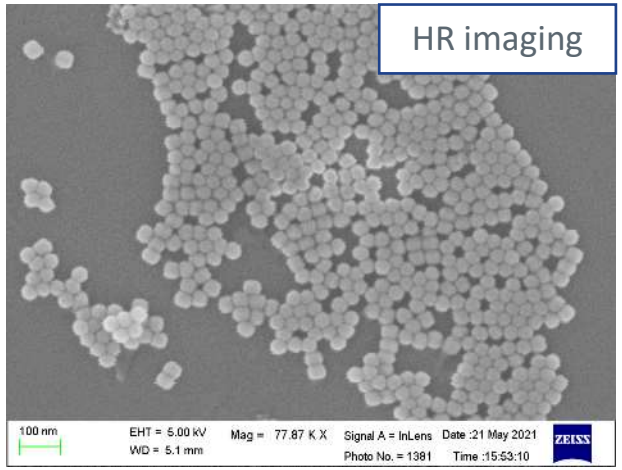
Tyndall National Institute
Institiúid Náisiúnta

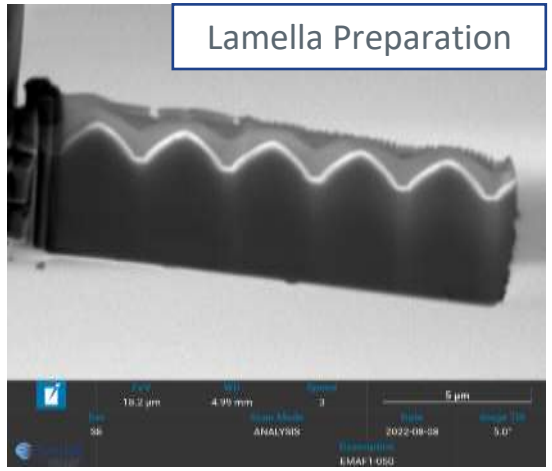
We develop customer- and product-specific analysis of materials and devices and provide comprehensive understanding of the measurement results:

- Product contamination analysis
- Thin film analysis (thickness + structure)
- Failure analysis
- Materials characterisation
- Surface analysis
- (S)TEM sample preparation
- Trace analysis >10ppm
- 3D visualisation
- Correlative microscopy
- Focused ion beam (FIB) patterning/prototyping.









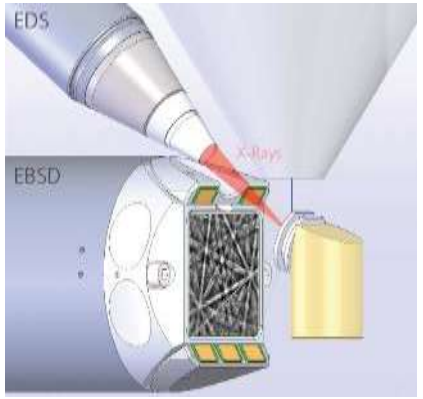
2x Dual Beam FIB (Ga)
1x Dual Beam PFIB (Xe)
1x HRSEM + 1x SEM
1x Jeol TEM 2100

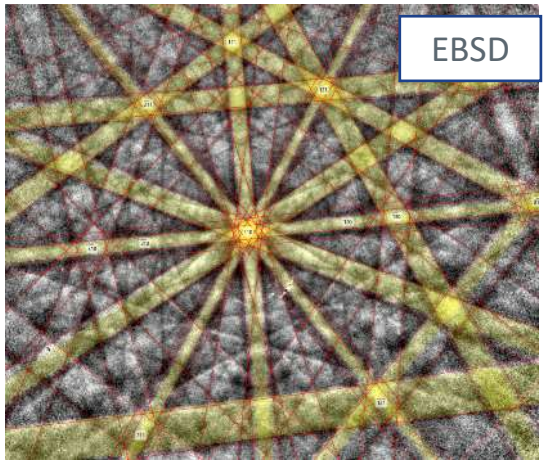
All have Oxford EDS detectors with STEM

EMAF: New additions to Analytics Capability

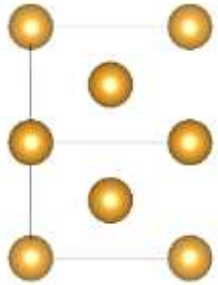
Tyndall National Institute
Institiúid Náisiúnta

EBSD Detector (Xe PFIB)





Au Kikuchi pattern (110)

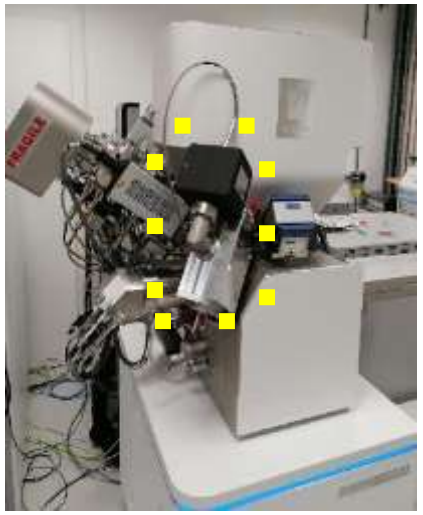


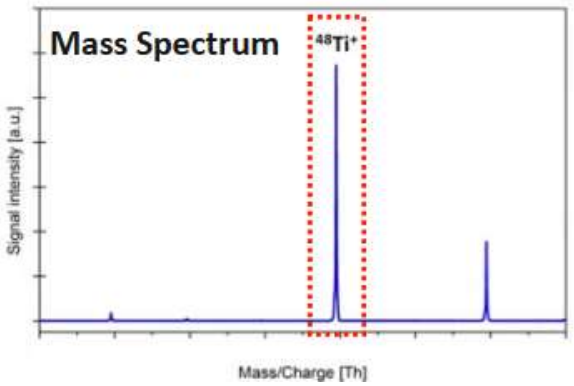
Au (110) unit cell orientation

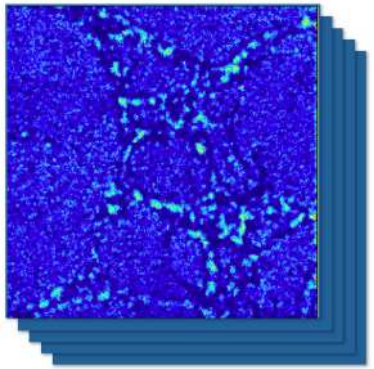
Applications

- Crystallography
- Grain Mapping
- Grain shape / morphology
- Grain average orientation
- Strain study
- Phase mapping

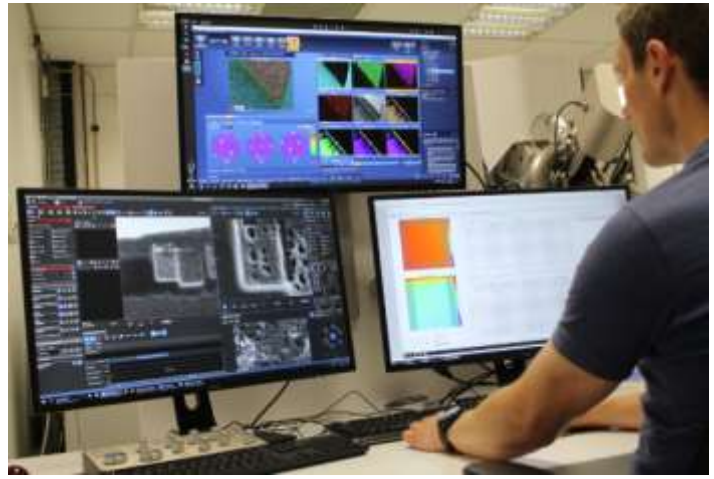
TOF-SIMS (Xe PFIB)







ToF-SIMS is a surface-sensitive technique that provides information on material composition



Rialtas na hÉireann
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ATU Ollscoil Teicneolaíochta an Atlantaigh Atlantic Technological University
TECHNOLOGY GATEWAYS delivering solutions for industry an Enterprise Ireland network
Enterprise Ireland

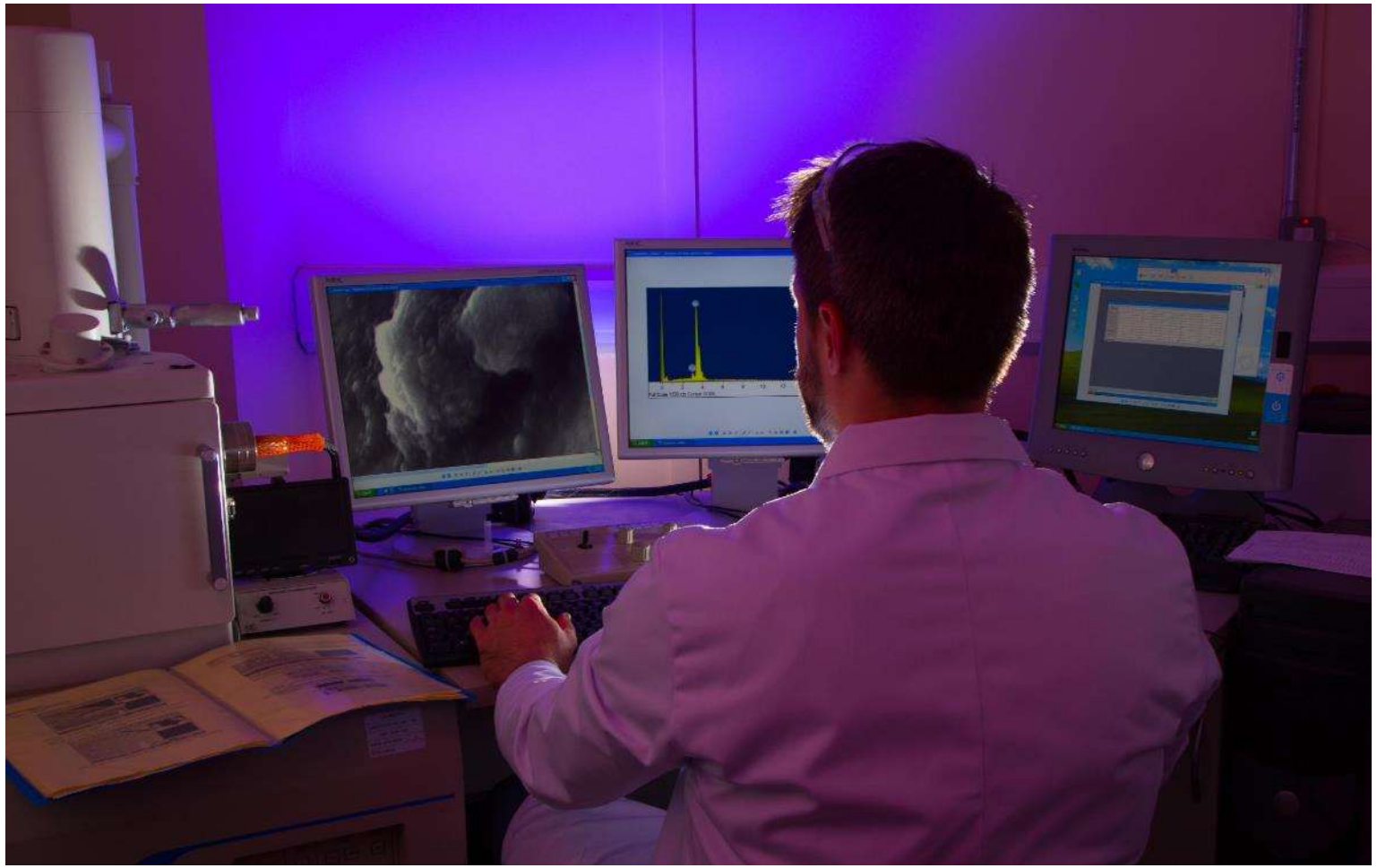
Imaging for Medical Devices

- **Jeol JSM-6490 LV SEM**

(Scanning Electron Microscope) to carry out **failure investigation and forensic analysis** on medical devices.

Projects carried out with Industry and SME's:

Cerenovus, Atrian, Perfuze, WhiteSwell, Versono, Crannmed, Aurigen, TE, Vivasure.



The Microscopy Society of Ireland will celebrate its 50th anniversary in 2026

The Irish EM Community look forward to hosting the EMUKI meeting next year

Destination TBC 😎