

# CHART

Materials Characterisation Facility



Electron Microscopy, X-ray &  
Computed Tomography Equipment

Materials Analysis for Industry

UNIVERSITY OF  
BIRMINGHAM

# Introduction

The CHART Materials Characterisation Facility welcomes industrial enquiries from commercial business, research and development organisations, and from individuals. Whether you need access to equipment, or a longer term collaborative solution, our expertise and equipment are available to help solve your production, development and materials related challenges.

The CHART project, through investment from the European Regional Development Fund (ERDF), has further developed and extended the University of Birmingham's Centre for Electron Microscopy (CEM), with a specifically selected and comprehensive range of complementary techniques and equipment, designed to enhance its materials characterisation capabilities.

The CHART Materials Characterisation Facility offers a range of destructive or non-destructive techniques, over a broad scale range, from macro 3D examination through to nano scale chemical composition analysis – providing a complete, client centred, advanced material characterisation service.

We have a designated business team who will manage your enquiry and assist in partnering you with a specialist academic or technical expert to help with your requirements.


## Typical applications for industrial purposes:

- Fracture analysis
- High resolution characterisation of alloy joints and welds
- High resolution chemical analysis of advanced structural components
- Particle size and chemical composition analysis
- Surface engineering and analysis
- Characterisation of nano structures
- Imaging and chemical analysis of nano particles
- Fault detection and failure analysis
- Assembly inspection of complex mechanisms
- Dimensional measurement of internal components
- Digital archiving of models

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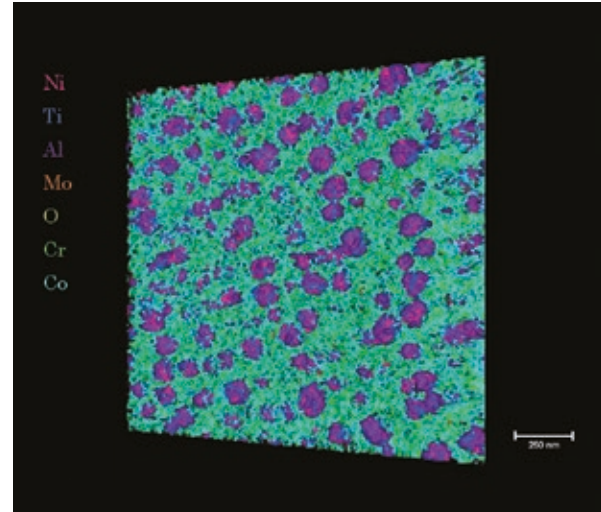
# Scanning Transmission Electron Microscope (S/TEM)

# FEI Talos 200X

## Scanning Transmission Electron Microscope (S/TEM)



Next generation in TEM, built to deliver rapid 2D and 3D analysis.



Innovative materials play essential roles in clean energy, transportation, human health, and industrial productivity. The corresponding advances in material science demand analytical equipment that can provide ever more precise and higher resolution results. The CHART materials characterisation facility has responded to this challenge by investing in some of the best electron microscopy equipment available.

The FEI Talos F200X Scanning / Transmission Electron Microscope (S/TEM) delivers the fastest, most precise, quantitative characterisation of nanomaterials. With features designed to specifically increase throughput, it is ideal for advanced research and analysis across academic, government, and industrial research environments. It quickly delivers S/TEM images that reveal atomic structure, defects, grain and interfaces of solid materials, including metals and alloys, and enables rapid analysis of their chemical composition.

Capable of quantitative materials characterisation in multiple dimensions it pairs outstanding high-resolution S/TEM and TEM imaging with industry-leading energy-dispersive X-ray spectroscopy (EDX) performance, including unique EDX tomography, to deliver structural information as both 2D images and 3D volumes. Furthermore, our facility is enhanced with innovative new software to extend the range of materials that can be analysed.

Typically any specimen will be prepared for analysis by nano-machining, using our on-site Focused Ion Beam (FIB) equipment, enabling a smooth and logical throughput of work.

The FEI Talos is suitable for all advanced industrial manufacturing.

> <b>Destructive / Non Destructive</b>	Destructive
> <b>Sample Size</b>	Microns ( $\mu\text{m}$ )
> <b>Run Time</b>	1 day
> <b>Materials</b>	All solids
> <b>Resolution</b>	Atomic (<1nm)



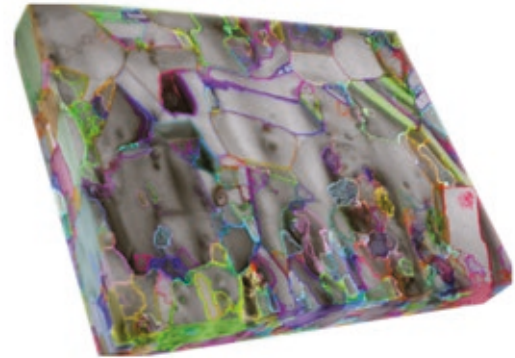
The background of the slide is a dark blue gradient. Overlaid on this is a complex network of light blue circles of various sizes, connected by thin, light blue lines. The network is most dense on the left side of the slide, where many circles are clustered together, and becomes sparser towards the right. The circles vary in size, with some being significantly larger than others. The lines connecting them form a web-like structure.

# Optical Tomography

# UES Robomet 3D

## Optical Tomography (3D)

A Fully Automated, Serial Sectioning System for Three-Dimensional Microstructural Investigations.




It is difficult to determine the relationship between microstructure and a material's properties, which is compounded significantly by the inability of two-dimensional characterisation to fully capture the shape of individual grains. Three-dimensional characterisation offers materials scientists the ability to more accurately capture the true shapes of grains and grain boundaries, and therefore provides a clearer depiction of the microstructure of a material.

Serial sectioning is an established method to obtain three-dimensional information about a given material. However, it is a labour intensive and difficult task to achieve consistent and accurate results. The CHART materials characterisation facility has solved this problem through the acquisition of UES's Robo-Met 3D equipment, which takes optically obtained serial sections and renders them into three-dimensional segmented images, providing the opportunity to investigate material defects, precipitates and voids.

The system is completely automated and every slice is produced consistently to a user-defined specification. With programmable capabilities that include grinding, polishing, sample cleaning, chemical etching and image acquisition, the equipment allows data acquisition to be completed in days rather than months. Slice thickness can range from 0.20 to 10 microns.

Whether metal, ceramic, polymer, composite or monolith, this technique provides valuable information that cannot be obtained from a two dimensional image. A fully automated, serial sectioning system for three-dimensional microstructural investigations.

> <b>Destructive / Non Destructive</b>	Destructive
> <b>Sample Size</b>	Centimetre (cm)
> <b>Run Time</b>	Hours
> <b>Materials</b>	All solids
> <b>Resolution</b>	$\mu\text{m}$



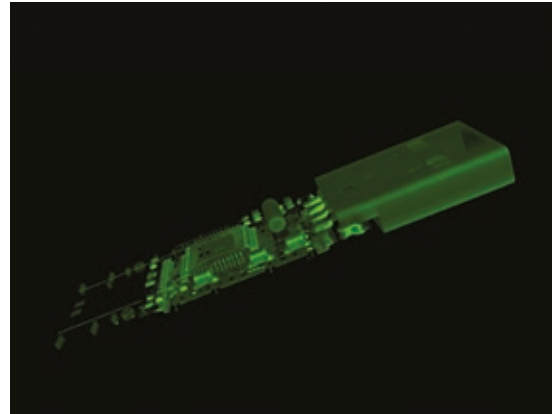
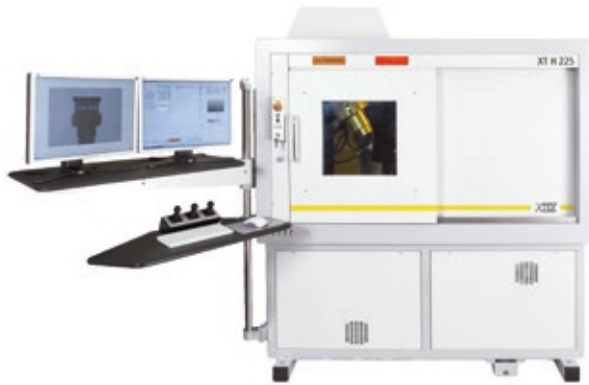
# X-ray Tomography (XRT/CT)



# Nikon XT H 225

## X-ray Tomography (XRT/CT)

Image complex industrial parts by looking into the internal structure. Examine internal components using a non-destructive process.

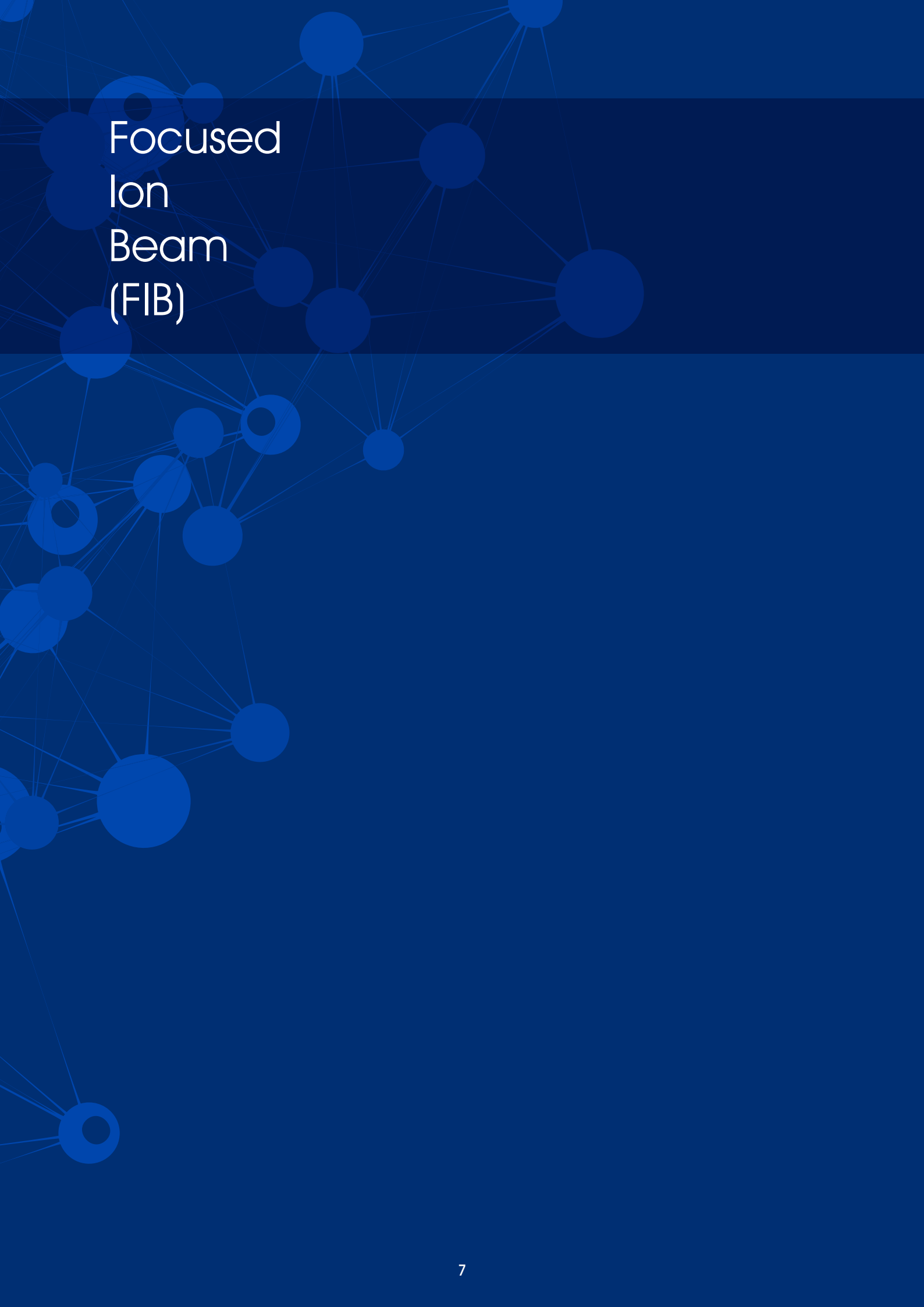


Detailed capture and measurement of internal features are often vital for quality control, failure analysis and material research across various industries. Achieving this using a non-destructive method is often essential and requires specialised equipment and software. Wherever internal structure analysis matters, X-ray and CT technology serve as an efficient tool to provide valuable information.

The CHART materials characterisation facility recognises the importance of this technique to industry and has invested in equipment, computer processing hardware, and specialist software that can examine and visually reconstruct samples at the micron scale.

The Nikon XT H 225 brings high accuracy and the ability to measure internal and external dimensions simultaneously without destroying the part being analysed. With the capability of examining a range of materials, from dense metals to lightweight ceramics, composites and plastics, using X-ray tomography can provide additional insight about material structure, and rapidly makes X-ray technology a must have tool in the production toolbox.

> <b>Destructive / Non Destructive</b>	Non Destructive
> <b>Sample Size</b>	Centimetre (cm)
> <b>Run Time</b>	Hours
> <b>Materials</b>	All solids
> <b>Resolution</b>	$\mu\text{m}$



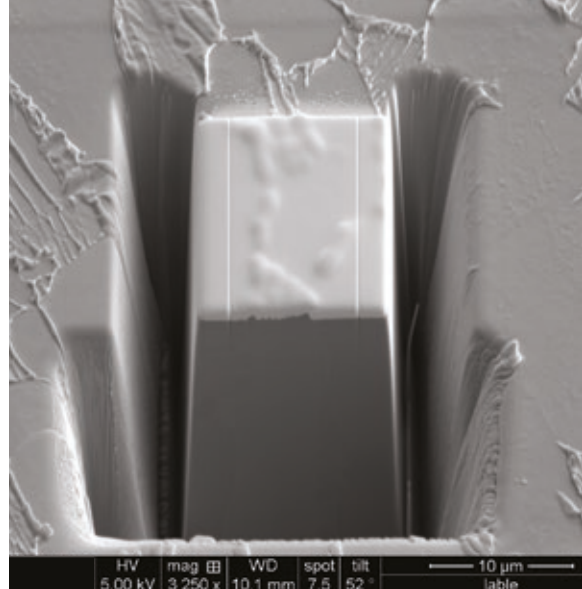
# Focused Ion Beam (FIB)

# FEI Quanta 3D FEG FIB-SEM

## Focused Ion Beam (FIB)



3D nanocharacterisation, prototyping and analysis



The Quanta 3D FEG is a high-resolution, Scanning Electron Microscope/ Focused Ion Beam (SEM/FIB) for 2D and 3D material characterisation and analysis. Advanced electron and ion optics allow for faster and more comprehensive materials characterisation, analysis and sample preparation.

The Quanta 3D (Field Emission Gun) FEG's unprecedented high-current FIB enables fast material removal. Automated FIB sectioning programmes support accurate cross-sectioning. Quanta 3D FEG features live SEM imaging while milling, making it a superior solution for fast preparation of large samples over a wide range of materials.

### Typical applications include:

- TEM specimen preparation
- Serial sectioning with imaging
- Nano and micro scale milling

> <b>Destructive / Non Destructive</b>	Destructive
> <b>Sample Size</b>	µm
> <b>Run Time</b>	Hours
> <b>Materials</b>	All solids
> <b>Resolution</b>	µm



# X-ray Fluorescence (XRF)

# Bruker S2 Ranger

## Xray Fluorescence (XRF)

Equipment Photo  
Multi-element Analysis from Sodium to Uranium



X-ray fluorescence (XRF) spectrometry offers an effective way to perform rapid multi-elemental analysis, determining concentrations in all forms of samples: solids, powders and liquids.

XRF analysis provides very precise answers to two crucial analytical questions: which elements, and what quantity of those elements, are in any particular sample?

The CHART Materials Characterisation Facility has an advanced and portable system that can quickly provide multi-element analysis, at parts per million (ppm) levels, in solids, powders or liquids, with little or no sample preparation. The Bruker S2 Ranger can quickly provide quantitative data across a broad range of elements from Sodium (Na) to Uranium (U).

Useful throughout many industries, XRF offers rapid and superior quality control for your products and processes.

> <b>Destructive / Non Destructive</b>	Non Destructive
> <b>Sample Size</b>	50ml — liquid. 40mm diameter — solid
> <b>Run Time</b>	Minutes
> <b>Materials</b>	Solid, powers and liquids



# Additional Equipment



# Additional equipment

The following equipment is also available within the facility:

## **SEM (Scanning Electron Microscopes)**

- FEI XL-30 FEG Environmental SEM with Oxford Inca EDS
- Jeol 7000F WITH Oxford Inca EDS, Wave WDS and Crystal EBSD
- FEI XL-30 (LaB6) with Link Isis EDS
- Jeol 6060 with Oxford Inca EDS

## **TEM (Transmission Electron Microscopes)**

- Jeol 2100 200kV LaB6 TEM with Oxford Inca EDS
- FEI Tecnai F20 with S/TEM, Gatan EELS and Oxford Isis EDS (SDD)
- Jeol 1200EX with SEM and S/TEM unit (LaB6 filament)

# Portable equipment

- Bruker S2 Ranger Xray Fluorescence (XRF)
- Hitachi TM3030 — Portable Scanning Electron Microscope
- Met Prep — Metallographic Microscope
- Zwick — ZHR4150AK Rockwell — Hardness Tester
- Zeiss Axioskop 2 — Optical Microscope

For further information and enquiries, including access to facilities, research consultancy or collaboration:

CHART Materials Characterisation Facility

School of Metallurgy & Materials

University of Birmingham. B15 2TT

[www.birmingham.ac.uk/chart](http://www.birmingham.ac.uk/chart)

E: [chart@contacts.bham.ac.uk](mailto:chart@contacts.bham.ac.uk)

T: 0121 414 3036

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