BRIDGE

APPLICATION CASE STUDY

Metallographic Sample Preparation and Analysis

BRIDGING BUSINESS WITH INNOVATION

The Bridge Advanced Materials and Engineering R&D facility at the University of Lincoln provides advanced capabilities for metallographic sample preparation and analysis, supporting industry partners across materials science, manufacturing, and engineering.

Our facility includes state-of-the-art sectioning, mounting, polishing, and microscopy equipment enabling high-quality characterisation of metallic, ceramic, and composite materials.

APPROACH

Our leading-edge instrumentation allows us to carry out the full-life cycle of analysis for metallurgical samples, from sample preparation right through to investigative analysis.

Sectioning

Our QCut precision saw can be used to sectioning the most demanding samples with the following features:

- **Gentle, low-damage cutting** using low-contact cutting (LCC) for metals, composites, ceramics, and electronics, reducing heat and deformation.
- **High precision and repeatability** with automatic horizontal/vertical axes, optional cross-feed, and automatic touch detection for consistent sectioning.
- **Flexible sample handling** thanks to a large stainless steel cutting chamber, side openings for long parts, and a wide range of clamping tools.
- **Advanced automation features** such as Multi-Position Process (MPP), programmable cutting parameters, and electronic control of force, distance, and feed rate.
- **Improved efficiency** with enhanced cooling systems that reduce wheel wear (up to 15%) and automated cleaning functions.

Mounting / Polishing

Following sectioning we can mount samples in a range of materials to suit the final application (e.g. conductive resin, epoxy etc.) before polishing to micron level smoothness using our advanced QPol polishing equipment which benefits from:

- **Fully automated grinding, polishing and cleaning** to streamline sample preparation and ensure consistent, repeatable results.
- **High reproducibility** through programmable, sequenced operations and integrated control of abrasives, lubricants, and suspensions.
- **Automated handling with sample-holder stack** reduces manual labour and speeds up throughput, supporting up to 5 holders.
- **Integrated magnetic disc systems** enabling quick, secure mounting of grinding/polishing media for efficient workflow.

Focused Ion Beam Polishing

For nanoscale imaging we can provide access to our focused ion beam scanning electron microscope (Scios FIB-SEM, Thermo Scientific). Using a focused beam of gallium ions we can perform high quality and site-specific TEM/STEM sample preparation with precise milling, low-energy polishing, and consistent lamella quality. The instrument has automated cross-sectioning and 3D characterisation features to streamline subsurface analysis, reducing operator intervention, and deliver consistent high-quality surfaces.

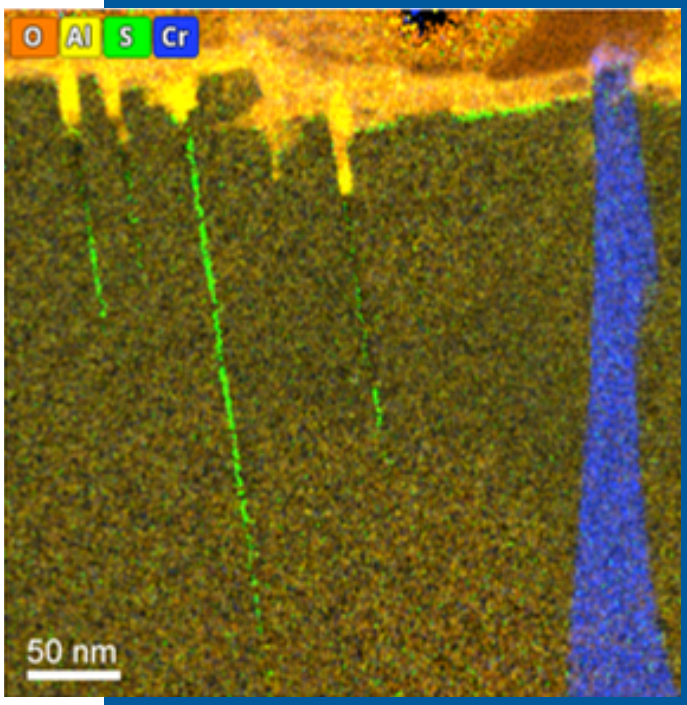

Figure 1. FIB-prepared sample showing nanoscale structural integrity and EDX chemical analysis in STEM.

ANALYSIS

Coupling our metallography sample preparation with our advanced state-of the art electron microscopy imaging facility we can get atomic level insight into a wide range of metallurgical materials, including superalloys for high-stress applications.

This insight can provide information on the sample history and modes of failure analysis. Using our focussed ion beam we can provide ultra-polishing of samples to reveal nanoscale features and defects in materials offering unparalleled insight.

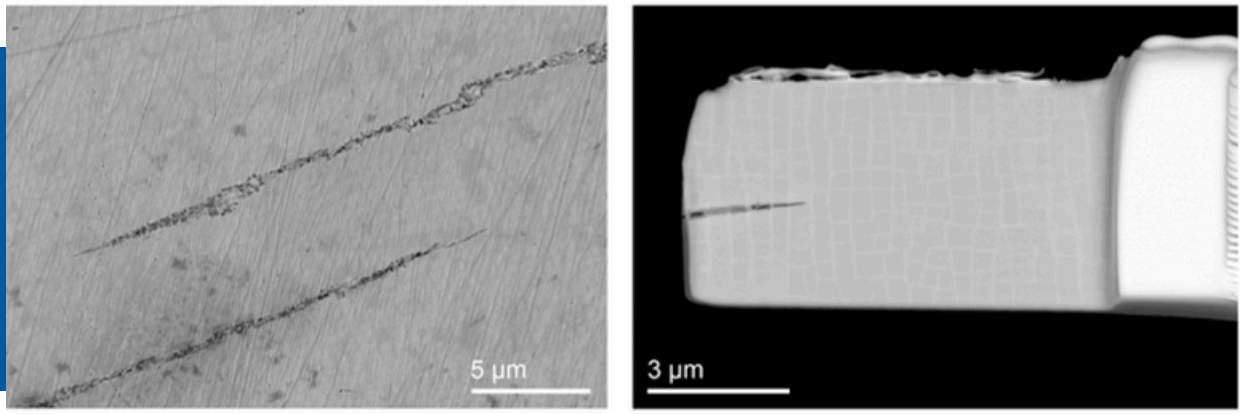

Figure 2. Left: An SEM image of a polished section of an aged alloy sample showing two microcracks. Right: SEM image of the planar lift-out extracted chunk (bottom crack from left-hand image) welded to a TEM grid before thinning and polishing showing the crack tip.

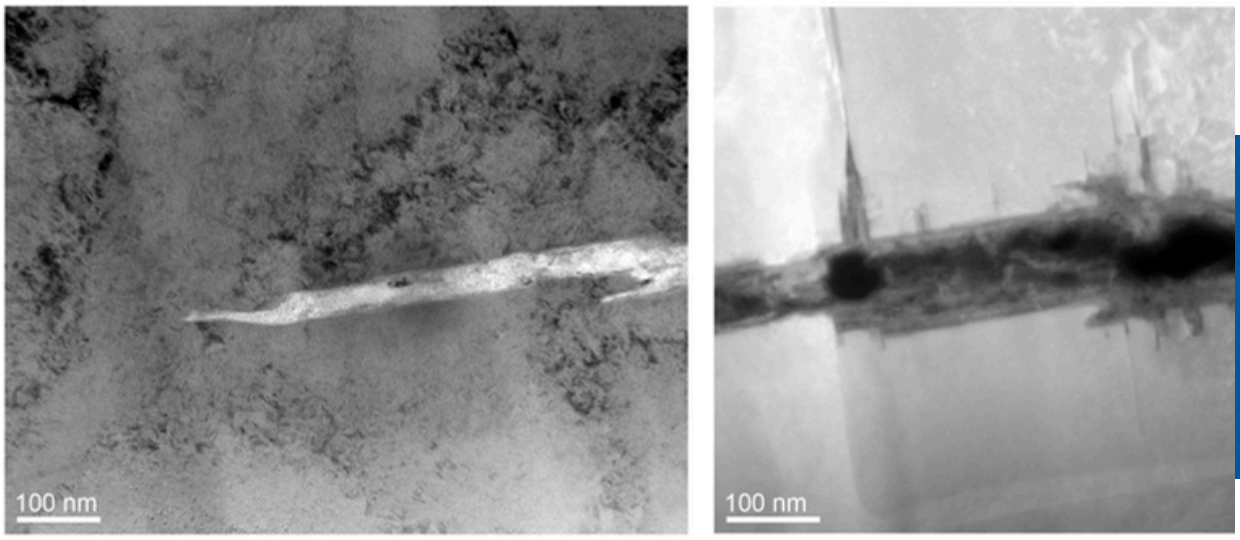

Figure 3. A TEM brightfield image of the crack tip in the alloy (left image) with a STEM HAADF image (right image) showing small microcracks leading off at 90° to the axis of the main crack in the same sample.

Summary: Driving Excellence in Material Analysis

The Bridge's metallographic preparation and analytical capabilities enable industry partners to obtain high-quality insights into material behaviour, structure, and performance. Our combination of precision preparation tools and advanced analytical instruments supports rapid, reliable investigation and materials characterisation and development.

BRIDGE

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