NANORO M

Materials Microsphere Nanoscope

About

LIG Nanowise is a Manchester, UK, based scientific instrumentation company which specialises in microsphere lens technology. This patented, platform technology offers new capabilities to stretch light to its limits and enhance the traditional performance of optics-based instrumentation. The company has brought together a world leading team of optical engineers, nanophotonics experts, and software developers to fulfil this vision.

NANORO is the microscopy brand of LIG Nanowise.
LIG Nanowise have their headquarters in
Manchester Science Park (MSP) in the UK.

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NANOROM

POWERED BY SMAL

Overview

NANORO'S Super-resolution Microsphere Amplifying Lens (SMAL) enables users to extend the reach of brightfield optical microscopy past the diffraction limit of light* (200 nm). Our patented microsphere** lens allows our brightfield nanoscope to resolve features down to 50 - 150 nm depending on the sample. SMAL, is quick, easy, non-destructive, and images in full, real colour.

We aim to make sub-diffraction limit bright-field imaging accessible to all, with no need for expensive environmental equipment, or extensive sample preparation.

***Optical diffraction limit**
As discovered by Ernst Abbe and Lord Rayleigh, the resolving power of an optical microscope is limited to 200 nm.

****Microsphere**
A polymer sphere with a very high refractive index. Microspheres function like optical amplifiers.

Microsphere Theory

In 2011 Prof. Lin Li and Dr Wei Guo observed that the use of high refractive index microspheres placed on a surface allowed optical imaging beyond the conventional resolution limit (approximately 200 nm for a white light source).[1] The findings of this and subsequent studies using microspheres on a surface were published in several high impact journals.[2,3] The same phenomenon has been independently reported by other groups.[4–9] The exact physical description of the underlying mechanism of microsphere super-resolution microscopy is the subject of rigorous research.

There are three theoretical models for microsphere imaging: the photonic nanojet model, [1,5,6] the enhanced constructive light model (or Whispering Gallery Mode)[11,12] and the super-resonance theory. [12,13]

Other phenomena, such as substrate effects,[14] partial or oblique illumination,[7] microsphere partial immersion[15] and a coherent illumination effect,[16] are all considered to contribute, to a lesser extent, to microsphere resolution.

The exact physical mechanism by which microsphere imaging allows resolution of objects far beyond the conventional resolution limit is still a source of debate. However, the general consensus points towards a complex theory in which all the previously described phenomena contribute to some extent, making microsphere super resolution microscopy an exciting and promising field.

We are currently exploiting our position as the world leaders in applied microsphere imaging to work on a novel theory that explores the impact of each of these proposed factors on the physics of microsphere imaging.

NANOROM

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Specifications

Camera

- (12MP) CMOS
- 4000 x 3000 pixels at 15 FPS
- Rolling shutter with global reset

Lenses

- SMAL water / oil immersion objective
- Nikon 100x
- Nikon 40x
- Nikon 10x

XY Nano-precision Stage

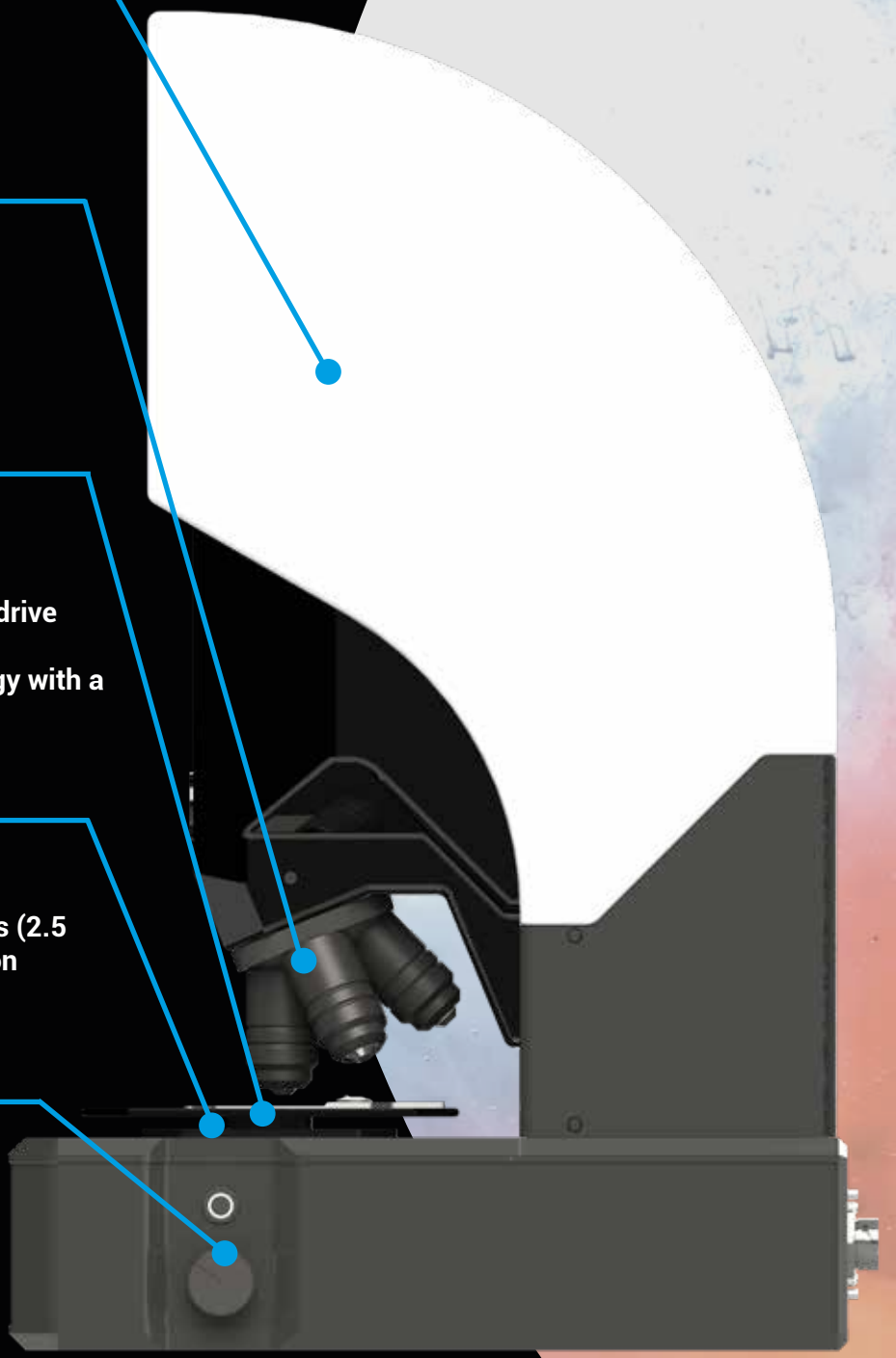
- Travel range of 50 x 50mm
- Resolution 1nm
- Anti-creep crossed-roller bearings
- High dynamic performance with direct drive technology
- Brush-less linear servomotor technology with a non-contact linear encoder

Z Stage

- Travel range of 60mm
- Stage Holder : 18 x 18 cm.
- Default holder : microscopy glass slides (2.5 x 7.5 cm) other holder types available on request.

Light Control

- Easily accessible manual light control



POWERED BY SMAL

Why?

01 / World leading optical resolution
With up to 50 - 70 nm lateral resolution SMAL allows you to go beyond the diffraction limit of light to see the nanoscopic world optically for the first time.

02 / The nanoscopic world in full colour
Seeing is believing. With SMAL you can see the nanoscopic world as it is, in full, real colour. The NANORO M offers users a new way of examining their sample, from identifying nanometric electrical faults on semiconductors to nanoscale deposits in geological samples.

03 / Accessible to anyone, anywhere
SMAL does not require expensive environmental conditions: it works at room temperature, without the need of a vacuum. As long as the sample is relatively level, flat, and smooth, SMAL works on both metallic and non-metallic samples, with wither water or oil as an immersion medium.

Applications

Offline failure analysis of electronics faults in semiconductors and microelectronics.

Full colour imaging of nano-structures in geological samples.

High resolution inspection of metal faults, alloys, and composites.

Sample validation, using SMAL you can select the samples with the desired nanometric features before you take your sample to the SEM or TEM.

Free Imaging

By expanding the range of optical microscopy we have enabled researchers to access new information about the samples they work with. As microsphere imaging is a new, novel technology we offer a free imaging service to see if microsphere imaging can provide an advantage in your imaging area.

Please get in touch with us: enquiry@lig-nanowise.com for more details or at www.lig-nanowise.com.

Software

An Improved Workflow - Search and Image

Like a classic brightfield microscope you can easily search your sample with a wide-field view, starting with 10x, and working your way up through magnification levels to inspect a specific area in super-resolution. Once the interest area is found, our software produces an automatic scan of the area at a size of your choice.

Powerful Image Scanning

Our scanning software automatically corrects the spherical aberration generated by our microsphere lens and stitches multiple images together to generate a large area, distortion-free scan of the sample.

Post-Imaging Tools

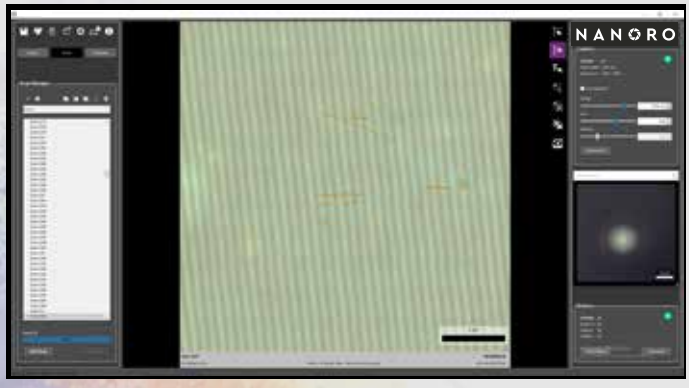
Our software allows for the easy exportation of the optical image to any software, such as ImageJ, for post-processing.

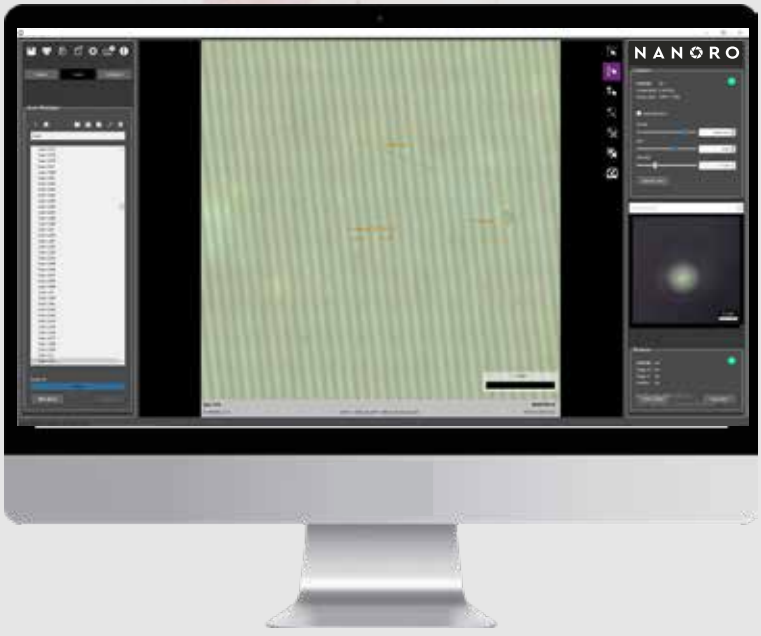
Software Features

Measuring tool with scale
Imaging scanning and stitching
Autofocus
Image export
Image sharing
Camera control
Stage control
Lighting

Measuring Tools

Our software allows you to measure features in your image at the nanoscale.

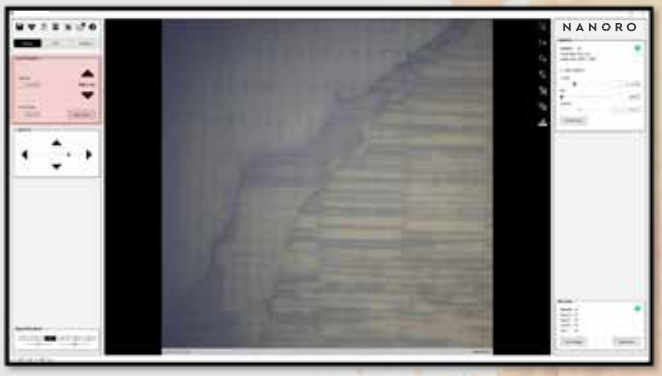




Explore the sample in super-resolution

Using SMAL is a simple process. First you find the area of interest using the wide-field 100x view of the SMAL lens (1). Once the area of interest is found, you adjust focus so that you are focused on the sample through the sphere (2). Once the area is in focus you adjust the light intensity to bring the area into high contrast (3) and you are then ready to perform a scan of the area (4).

1



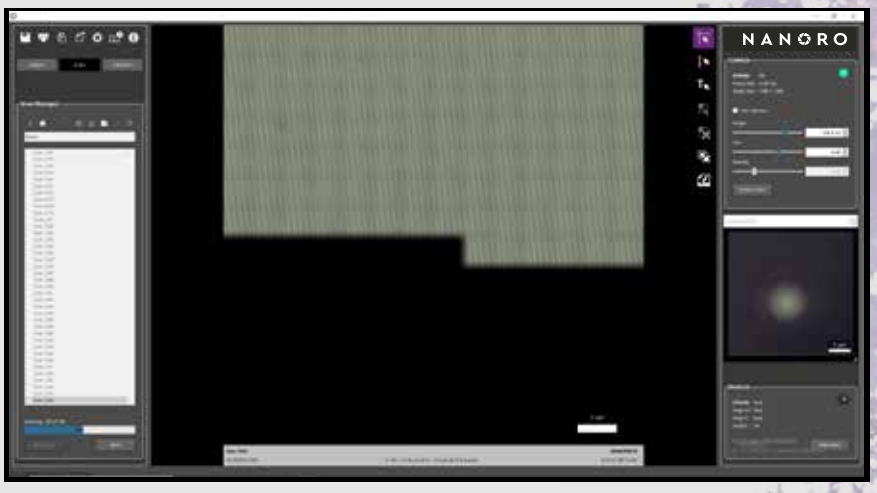
2

3

Real-time Scanning

At any time you can cancel and adjust the scan. And you can see the scan as it happens live, in the pop-out scanning window.

4

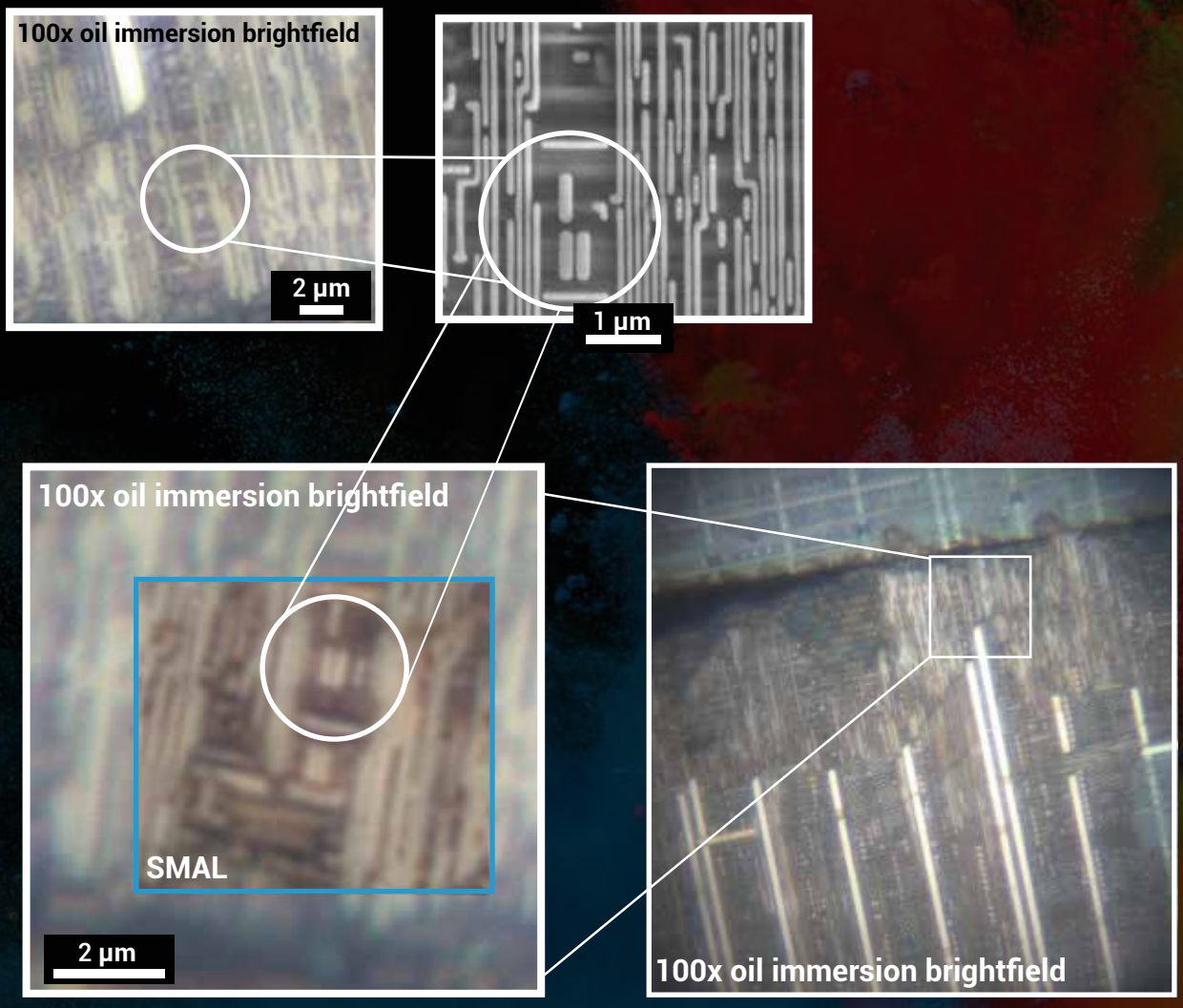


Case Studies

Superior Lateral Resolution

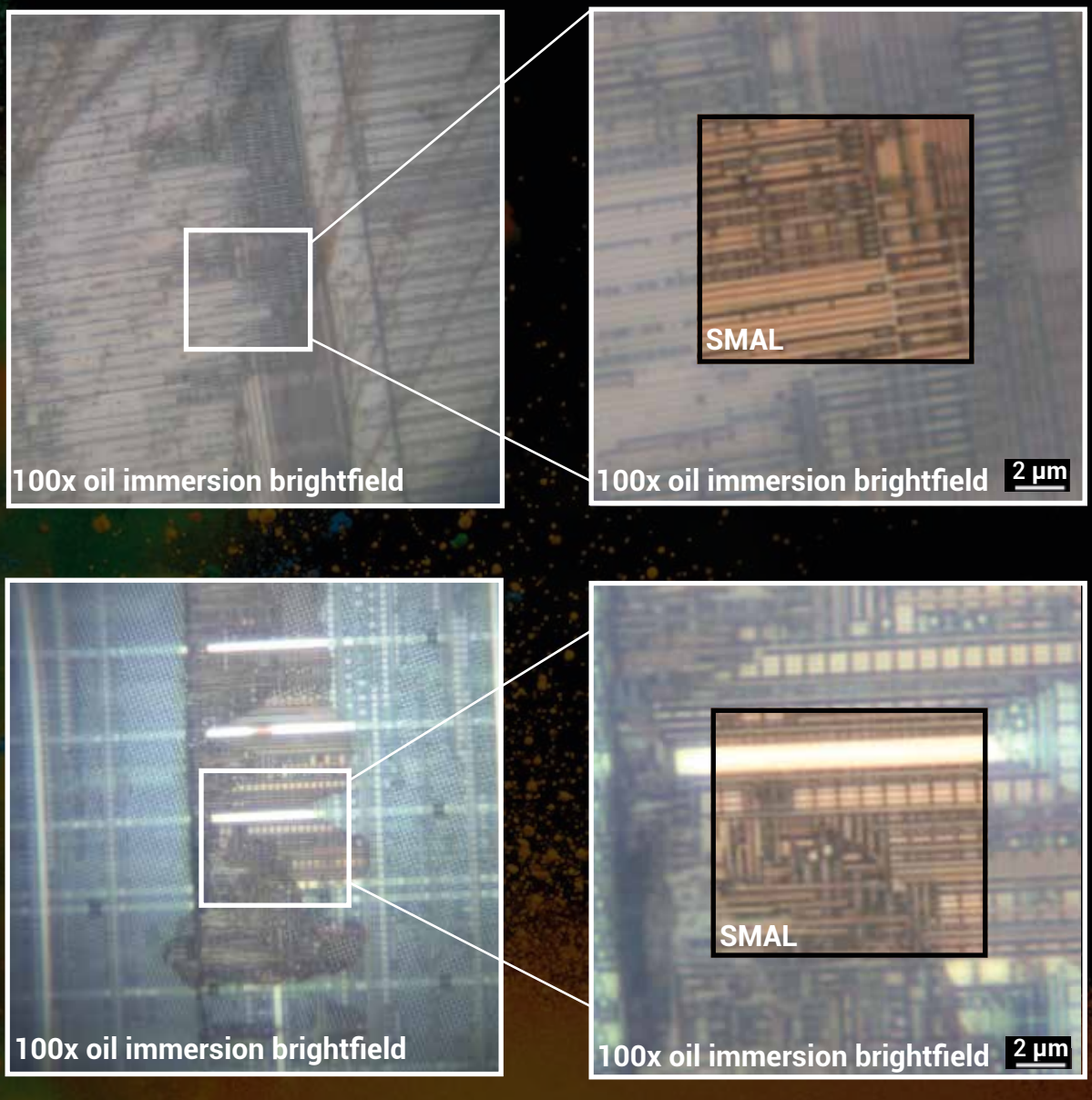
Unlike conventional optical microscopy SMAL can resolve features below 150 nm, down to 50 - 70 nm depending on the sample. This superior resolution allows for the optical inspection of otherwise invisible features, faults, and electrical defects.

In the integrated circuit below, you can see that SMAL is able to resolve the 50 nm gap between the two 'cigar-shaped' features (measured using an SEM). On a standard optical set up the gap is invisible. With SMAL, we are able to observe it.



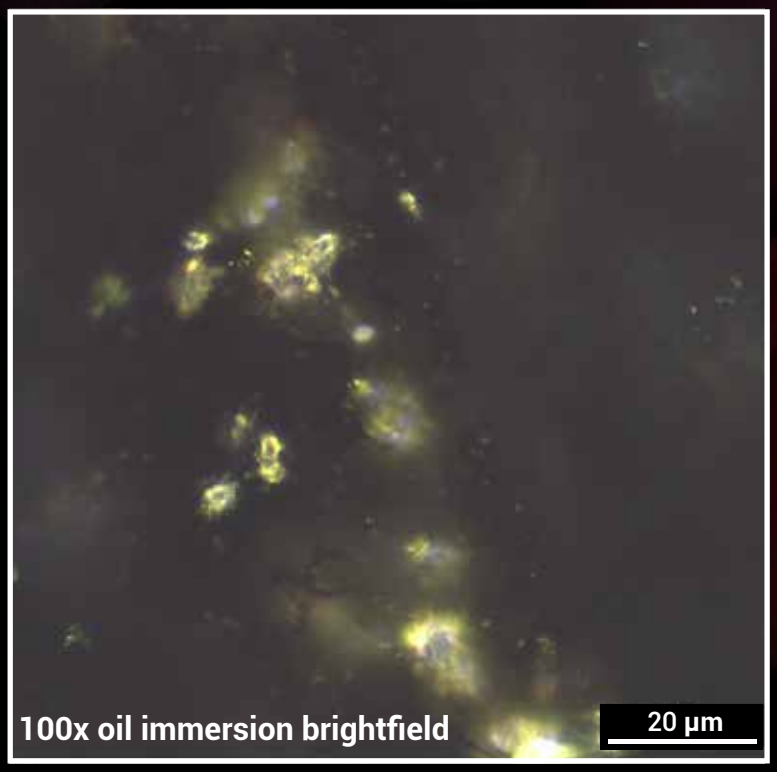
Full Colour Semiconductor Imaging

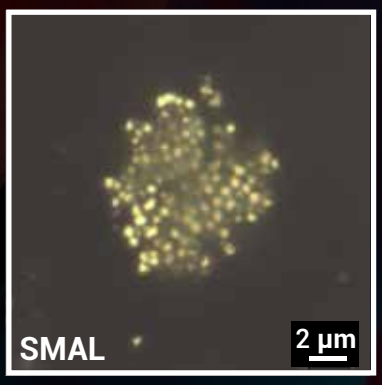
Below you can see a comparison between standard optical microscopy and SMAL microscopy on an integrated circuit. The SMAL images are overlayed on the digitally zoomed 100x images of the same area of the sample. SMAL produces images with a higher resolution than standard optical microscopy and with higher contrast.



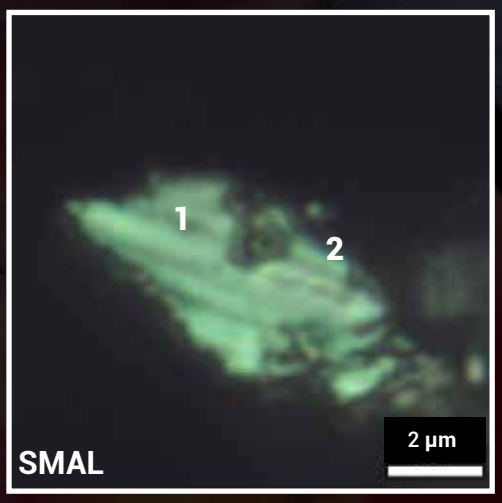
Case Studies

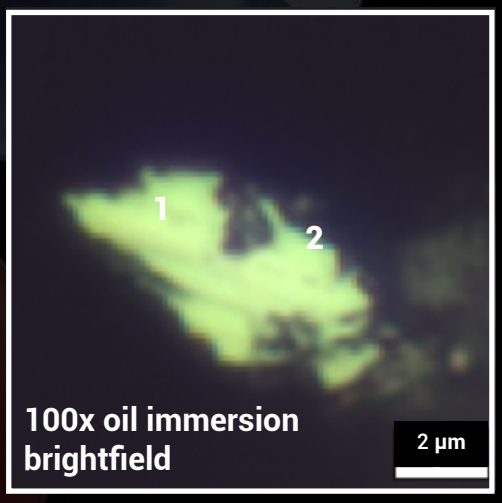
Geological Samples



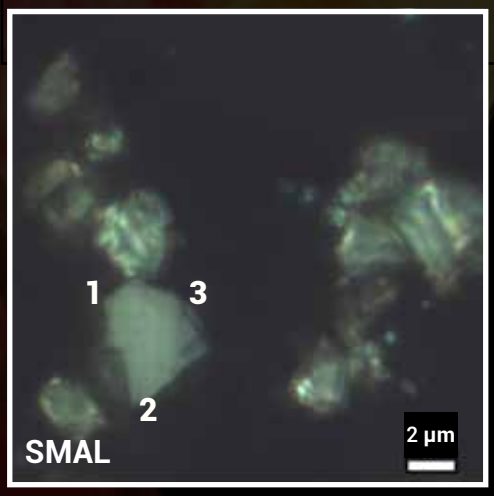


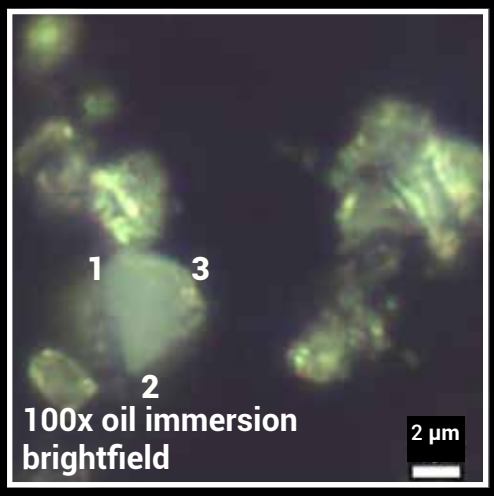
Above is a 20 x20 µm image of a geological deposit taken with a 100x oil immersion lens. With standard optical microscopy you cannot make out the details of the specific deposits. In the SMAL images you can see the greater level of detail that SMAL yields. (Square added for scale reference and does not represent the same location on the sample.)





Above is the same area of the geological sample imaged with SMAL (on the left) and 100 x oil immersion in brightfield mode (on the right). The improved resolution of SMAL allows you to see the features on the face of the sample (1,2) which are undetected by conventional optical microscopy.

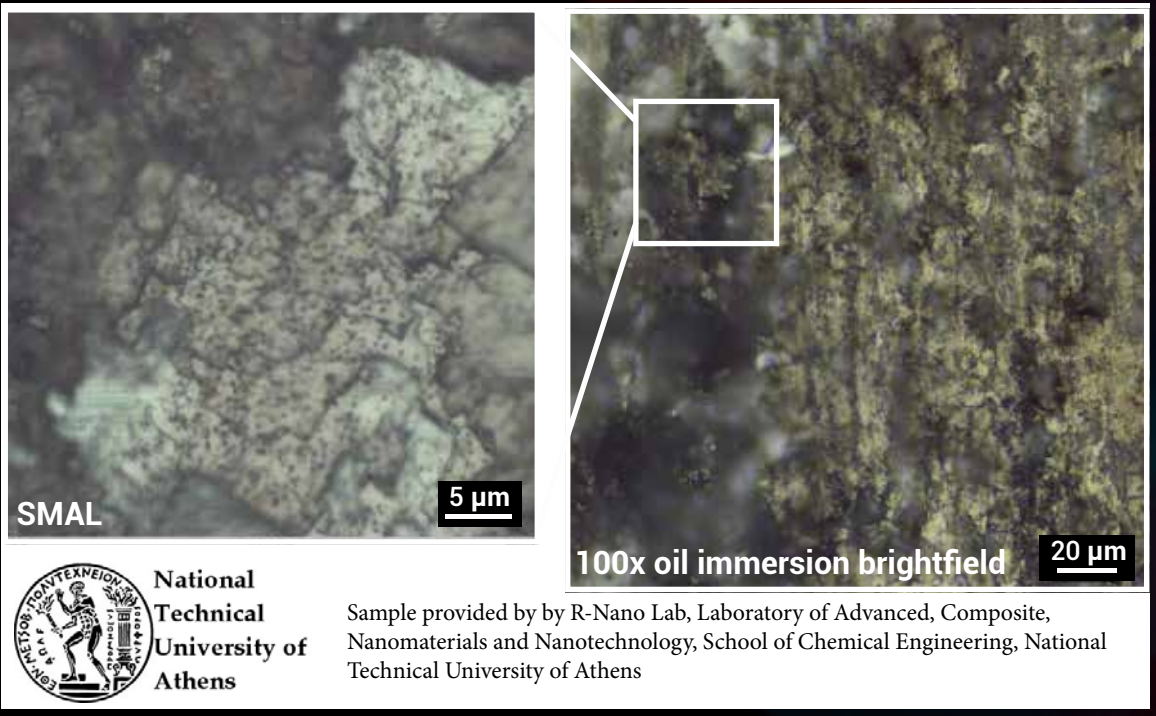




Above is the same area of the geological sample imaged with SMAL (on the left) and 100 x oil immersion in brightfield mode (on the right). The improved resolution allows SMAL to resolve the edge of the deposit (1,2,3) where it is blurred with conventional optical microscopy.

Case Studies

Corroded Metal



National Technical University of Athens

Sample provided by by R-Nano Lab, Laboratory of Advanced, Composite, Nanomaterials and Nanotechnology, School of Chemical Engineering, National Technical University of Athens

Above, the corroded metal is visible in the 100x image however the details of the oxidation are not resolved. In the SMAL image you can see the increased magnification and resolution reveal more details around the layers and points of corrosion. (Square added for scale reference and represents a similar area on the sample.)

Get in touch

We can help solve your imaging needs

By expanding the range of optical microscopy we have enabled researchers to access new information about the samples they work with. As microsphere imaging is a new, novel technology we offer a free imaging service to see if microsphere imaging can provide an advantage in your imaging area.

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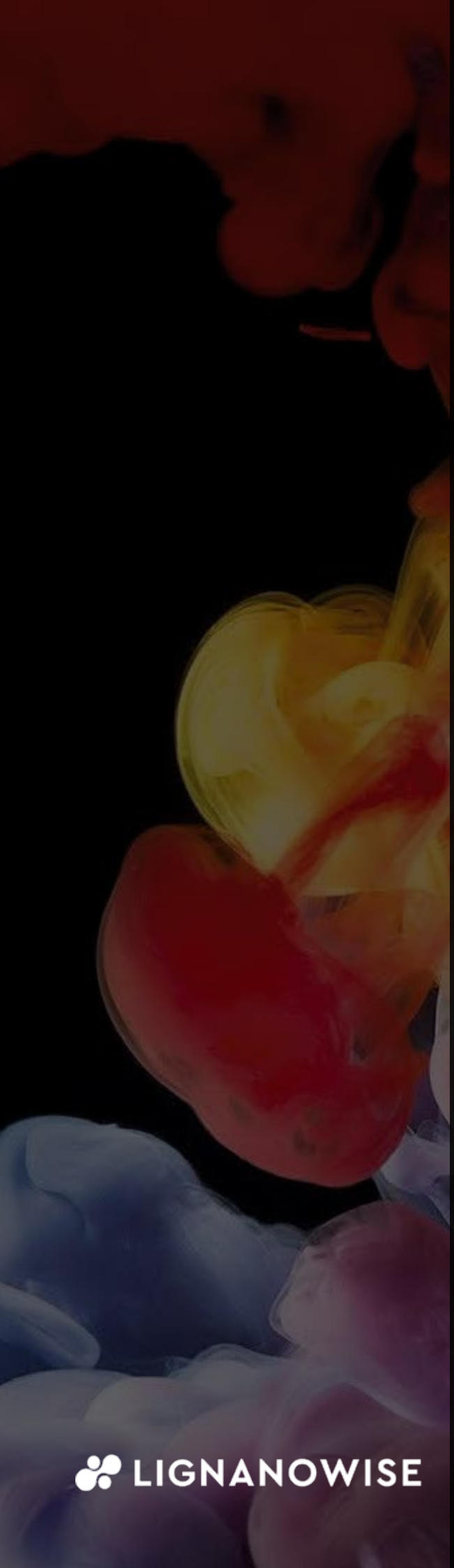

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