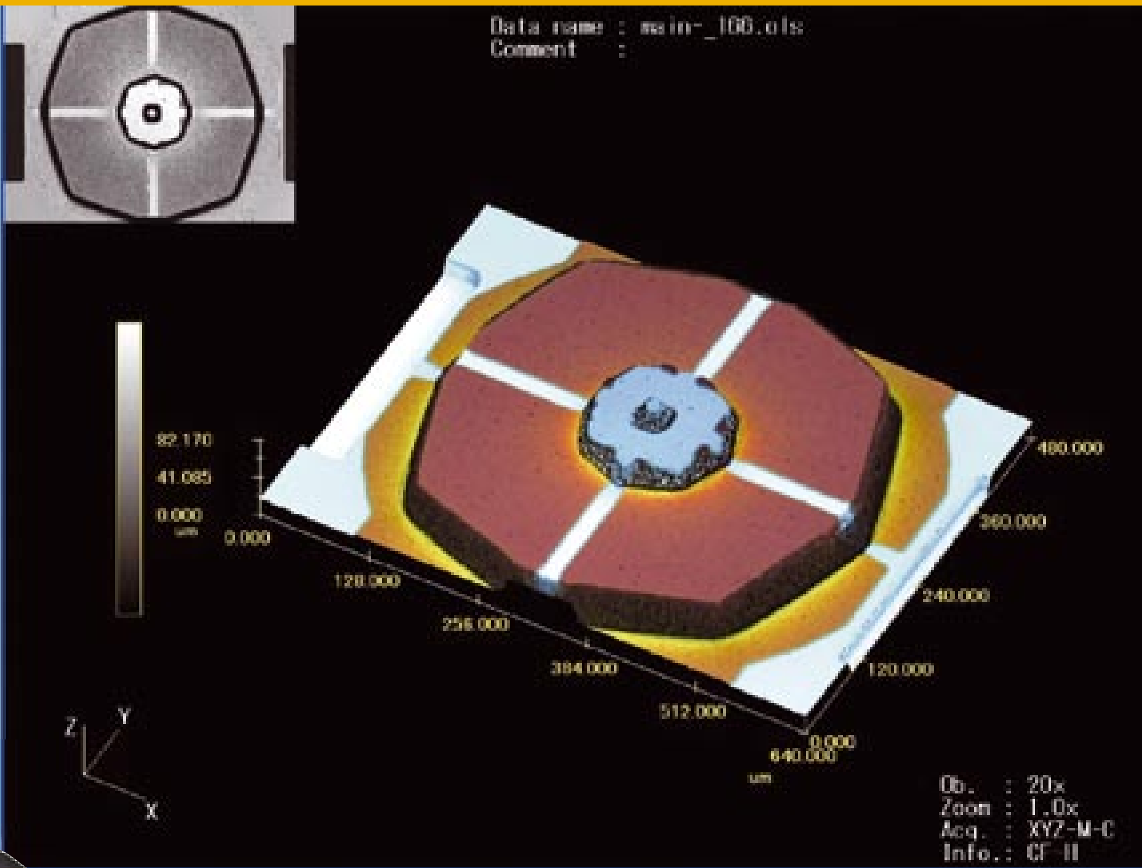
OLYMPUS
Your Vision, Our Future

Issue 4

# ILLUMIN8

The newsletter for microscope users




*A 3D colour image of a typical MEMS component generated by the Olympus LEXT system*

## Welcome

This issue of Illumin8 is specifically for material scientists and for future issues we would like to know what you want to read about. Moreover if you are doing any interesting research, or have a great microscopy tip, then send an email to

**microscopy@olympus.uk.com**

or fill in the reply paid card. You can also use these to request your own copy of 'Illumin8'. We hope you enjoy this issue and don't miss our competition to win a pair of Olympus DPS I binoculars.

## IN THIS ISSUE

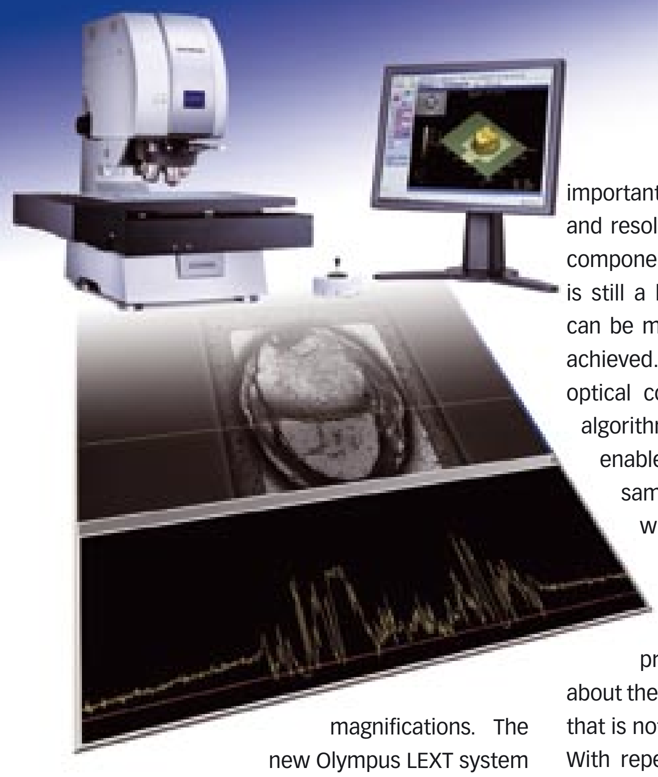


# Don't destroy it **LEXT it!**

***Of the technologies that have shaped our world, reciprocating engines and computers would feature at numbers one and two in many people's lists. There are technologies though that are essentially silent i.e. most people don't think about them on a daily basis, but our lives would be considerably different without them. One such advance is the laser (Light Amplification by the Stimulated Emission of Radiation). Seen by many as a lethal weapon, in reality they are used everyday – to play and record CD/DVDs, for precise cutting and welding, as well as for surgery and communication. Lasers have also made a huge difference to microscopy, since they provide a controllable and coherent, monochromatic light source which can be finely focused. A new metrology technology from Olympus now takes laser scanning microscopy one step further.***

### From Macro- to Micro-inspection

Although laser-based 3D scanning has been used for many years to measure large objects, detailed microscopic analysis and surface roughness measurements use destructive and time-consuming processes such as SEM and contact profilometery. General surface inspection is often carried out at lower magnifications with stereo microscopes (such as the SZ2 series from Olympus) or specialised light microscopes (such as the BX metallurgical series). This is a relatively quick process since microscopes are non-contact, so a sample can be placed directly on the microscope stage with little or no processing. For more detailed inspection, SEM on the other hand requires extensive, destructive preparation and contact profilometers leave marks on surfaces. Therefore there is a real need in industrial microscopy for a non-contact instrument capable of complex analysis at SEM resolutions and



magnifications. The new Olympus LEXT system was designed to fit this need and excels at both 2D/3D surface analysis and profiling, even on large items.

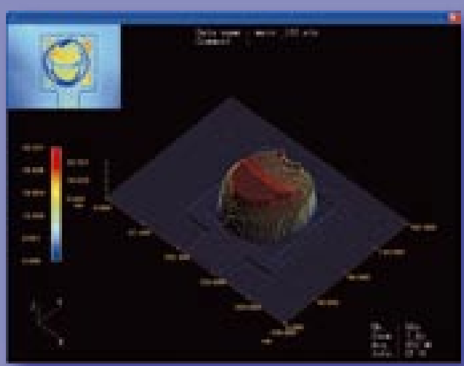
### Depth perceptions

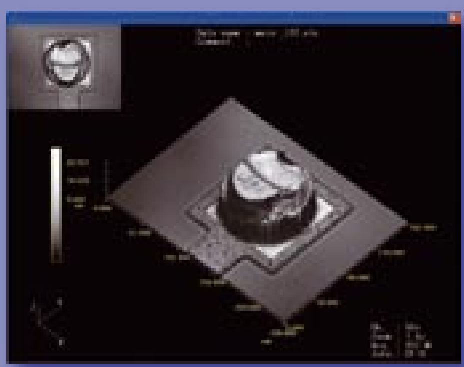
The majority of components analysed using microscopes have specific 3D facets. It is important to be able to visualise these surface elements using high magnifications in real-time 3D. Above a relatively low magnification though, it is not possible to produce stereo images using optics alone. This is because the depth of focus is far too small and it is also impossible to maintain two separate light paths. To view the 3D nature of surface elements at high magnifications, the LEXT takes images from different focal planes. These are then combined using the software into either deconvoluted 2D images (where all the in-focus sections of each plane are combined into one image) or into a 3D representation. The laser scanning confocal components of the LEXT are designed to work at very high speeds and can therefore produce real-time 2D or 3D images, which without LEXT are not normally possible to achieve. What is more, the images can be displayed in colour since the brightfield output can be combined with the confocal observations (which are monochromatic). The dimensions of the object being analysed can be calculated by selecting specific areas or cross-sections. Lengths, angles, volumes and roughness can all be accurately displayed with the images, which can also be modified to show wire/mesh frames and contour lines.

### The LEXT generation

At high magnifications, the quality of an optical system becomes ever more important. Aspects such as magnification and resolution depend on the use of the best components in the correct configurations. There is still a limit though to how much a sample can be magnified and what resolution can be achieved. Pioneering technical advances in the optical components, laser and mathematical algorithms employed on the LEXT have enabled it to exceed these limits. As a result, samples can be viewed and fully analysed without preparation at magnifications up to 14,400x and plane resolutions of 120nm (X/Y) and 10nm (Z). Such fine detail at high magnifications provides comprehensive information about the surface of the component, something that is not directly possible using SEM.

With repeatability and traceability key to the auditing of most manufacturing and R&D procedures, it is essential that any measuring instrument can store the correct information about each and every procedure. This must also be available in printed reports. The LEXT has repeatability figures of $3\sigma_{n-1} = 0.02\mu m$ and $3\sigma_{n-1} = 0.05 + 0.002L\mu m$ (L = measurement length). Furthermore, all analyses conform to international standards such as the United Kingdom Accreditation Service (UKAS), the Japan Quality Assurance Organisation (JQA) and the Physikalisch-Technische Bundesanstalt (PTB). Bespoke standards can also be programmed into the system, without limiting its operability. Comprehensive reporting via a built-in facility provides users with the flexibility to include all of the data required in a consistent format.





### Little and large

Components are now being manufactured in a huge range, from nanometres through to metres in length. Measuring instruments need to be able to cope with this range and measure heavy components with the same accuracy and precision as delicate devices. The LEXT is designed with an antistatic frame, which disperses any charge build-up very quickly, as well as a controllable laser, both of which allow it to be used on sensitive items such as micro electro-mechanical systems (MEMS). At the other end of the scale the strengthened stage can handle items up to 10kg in weight and 100mm in height.

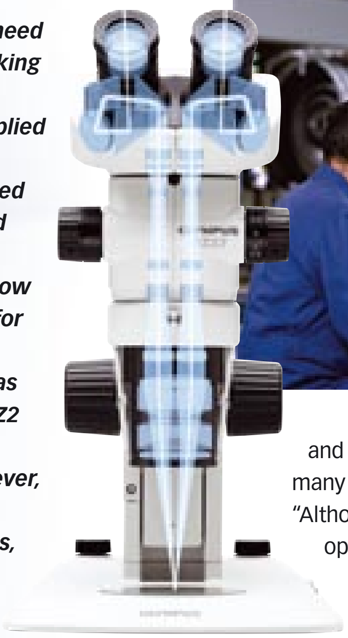
### Industrial superpower

Even though the LEXT may sound at first quite a specialised tool, it has applications within many different industries. For example, the electronics industry has expanded immensely over the last decade and increasingly complex components are produced at very fast rates. Components such as semiconductors, integrated circuits, printed circuit boards, liquid crystal displays and MEMS can now all be comprehensively analysed without destruction at both R&D and production stages. The same applies to larger objects such as automotive components, which need to be closely analysed for surface roughness or production defects.

**As part of the LEXT Roadshow, Olympus is offering you the chance to see the LEXT in your laboratory analysing your samples. To find out more please contact us using the reply paid card or via email: microscopy@olympus.uk.com**

# A zoom with a comfortable view

*We are all aware of the need to avoid strain when looking closely at things. This principle needs to be applied at all levels, from basic inspection using the naked eye through to magnified processes. Magnifying glasses can be used for low level magnification, but for anything more a stereo zoom microscope (such as one from the Olympus SZ2 range) is generally used. Some microscopes however, can greatly increase the strain on the eye muscles, and lead to decreased efficiency and headaches.*



## Look into my eyes

Stereo zoom microscopes require specialisation in lens design, since two separate light paths must be maintained and focused into two eyepieces. Olympus has designed its stereo eyepiece optics to allow more comfortable long term use. "Stereo microscope users often report tension headaches and nausea, after using a microscope for a number of hours" said Gunnar Schroeder of Olympus. He continued "This also causes difficulties in forming a proper 3D image."

By allowing a stereo image to be formed by the user at more than one fixed point, the Olympus eyepieces enable more eye, head and neck movement and thus reduce many strain issues. Gunnar commented "Although the eye does not detect any optical difference in the image quality, it feels different, allowing the user a more relaxed eye position than with some stereo microscopes."

Other small changes have also made a big difference: Gunnar explained "Essentially, we have bought the eyepieces closer together. This allows a much more natural view and enables easier 3D image formation."

## A closer look

Olympus produces a number of stereo zoom microscopes including the SZX and SZ2 series. With an extensive range of accessories including suspension stands, auxiliary lenses, light sources and stages, Olympus can fulfil any standard or bespoke requirements for stereo inspection microscopy. For further information, fill in the reply paid card or email **microscopy@olympus.uk.com.**

*Researchers being demonstrated the new Olympus LEXT system*

# The **LEXT** Roadshow

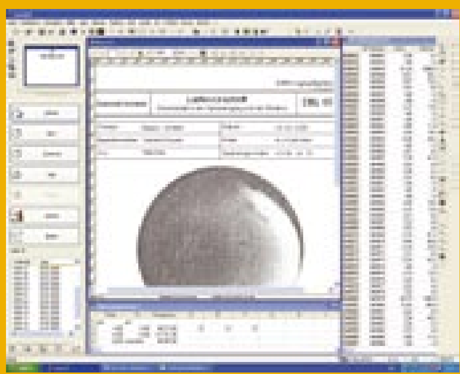
The new Olympus LEXT system, as mentioned in the first article, has been on its first ever tour of the UK. This unique laser scanning confocal microscope has been designed to meet the need for a non-destructive, high magnification metrology system. It has been on show at various locations, including:

The National Physical Laboratory; Airbus UK; Oxford Materials; Birmingham University; The Welding Institute and Manchester Material Science Centre. "The event was a big success. There was a great buzz amongst the attendees – everyone wanted to view their samples on the LEXT" enthused Dr Martin Loftus from the University of Birmingham. "The Olympus staff were brilliant; we kept them all busy with requests and questions, which they answered with great aplomb."

As part of the LEXT Roadshow, Olympus is offering you the chance to see the LEXT in your laboratory analysing your samples. Please contact us using the reply paid card or via email: **microscopy@olympus.uk.com.**

# **Fully automated** residue analysis system

The new analySIS FilterInspector is a residue analysis system for fully automated investigation, classification and documentation of filter residues. The system is designed for the full inspection of circular filters up to 47mm in diameter at high speeds and resolutions down to 0.8µm.



# **MX61:** semiconductor inspection microscope for 200/300mm wafer

The new Olympus MX61 improves inspection efficiency, resulting in higher failure detection rates and more reliable inspection results. This is achieved through automatically optimised contrast for any desired magnification and easy access to sophisticated contrast methods. In addition the intuitive operation concept minimises errors and increases repeatability both within and between operators.

# **Win a pair of** Olympus DPS I **binoculars**



With each issue we offer the chance to win a different product from the Olympus range. This time, by correctly answering the three questions below on the reply card and returning it, you can enter the draw to win a pair of Olympus DPS I 10x50 binoculars.

***We are pleased to announce that the winners of the five Olympus 512MB xD memory cards from the last issue of 'Illumin8' are: Richard Arnold, Rolls Royce plc, Bristol; Peter Gothard, RAGT Seeds Ltd, Cambridge; Neil Cobb, Rotherham NHS Foundation Trust; Joy King, Nevill Hall Hospital, Abergavenny; Elspeth Milne, University of Edinburgh, Roslin.***

***Question 1:***
What is the maximum magnification possible on the LEXT system?

***Question 2:***
What is the maximum plane (X/Y) resolution of LEXT?

***Question 3:***
At what wavelength does the laser on LEXT operate?

# **Einstein** and the **Barcode Scanner**

**1917:**
Albert Einstein laid the foundations for stimulated emissions in a ground-breaking re-derivation of Max Planck's law of radiation.

**1953:**
Charles Townes, James Gordon and Herbert Zeiger produced the first non-continuous 'maser' (microwave amplification by the stimulated emission of radiation).

**1954:**
Nikolay Basov and Aleksandr Prokhorov of the Soviet Union created first continuous 'maser'.

**1957:**
Townes and Arthur Schawlow began work on an 'optical maser' or laser.

**1959:**
Gould's paper "The LASER, Light Amplification by Stimulated Emission of Radiation" appears

**1960:**
The first working lasers were produced by Theodore H. Maiman (solid state – ruby crystal) and Ali Javan (gas laser – neon/ helium)

**1962:**
The first laser diodes were demonstrated by Robert N. Hall (N-IR light) and Nick Holonyak, Jr (visible light). Both lasers needed liquid $N_2$ cooling

**1964:**
Townes, Basov and Prokhorov shared the Nobel Prize for Physics
&
In one of the most memorable film clips ever, James Bond is almost sliced in half by Auric Goldfinger's laser. Lasers then featured heavily in a number of other Bond films.

**1970:**
Zhores Alferov, Hayashi and Panish developed the heterojunction structure, allowing non cooled diode lasers

**1974:**
Lasers first used in supermarket barcode scanners

**1978:**
Lasers first used in laserdisc players

**1982:**
The compact disc player becomes the first truly common laser in peoples homes

## SHORT TIPS

# Keep it **clean** boys!

***You can have the best optics available, but unless they are clean you won't get the best images. Here's a few tips for regular lens cleaning.***

- Only clean lenses with proper lens tissue - other materials can scratch the coatings. Use each lens tissue once then dispose of it.
- External lens surfaces (such as the bottom lens of an objective) can be cleaned regularly. Other surfaces (e.g. inside an eyepiece) may have softer coatings so avoid cleaning them.
- Firstly, use air from a rubber bulb or compressed air source to remove loose dust and dirt.
- Next use a folded lens tissue wrapped around a pointed wooden stick (not metal). Dip into a suitable cleaning fluid and clean the lens surface in a circular motion, starting from the centre. Repeat if necessary.
- Suitable cleaning agents include a 50:50 mixture of ethanol and ether. Do not use pure alcohol. For water soluble dirt (e.g. salt deposits) use distilled water. In some cases simply breathing on the lens then wiping is sufficient.
- Don't dismantle optical components to clean inside!
- Finally, always put a dust cover on the microscope when not in use.

Use the reply-paid card or email **microscopy@olympus.uk.com** to request a leaflet on Cleaning and Maintenance.

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**To request further information:**

Olympus UK Ltd
Microscopy Division
Dean Way
Great Western Industrial Park
Southall
Middlesex
UB2 4SB

Phone: 020 7250 0179
Fax: 020 7250 4677

Email: microscopy@olympus.uk.com
Web: www.olympus.co.uk

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My answers to the competition are:

(1)

(2)

(3)

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Olympus UK Ltd
Microscopy Division
Dean Way
Great Western Industrial Park
Southall
Middlesex
UB2 4BR

BUSINESS REPLY SERVICE
Licence No. KE 5773

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Olympus UK Ltd
Microscopy Division
Dean Way
Great Western Industrial Park
Southall
Middlesex
UB2 4BR