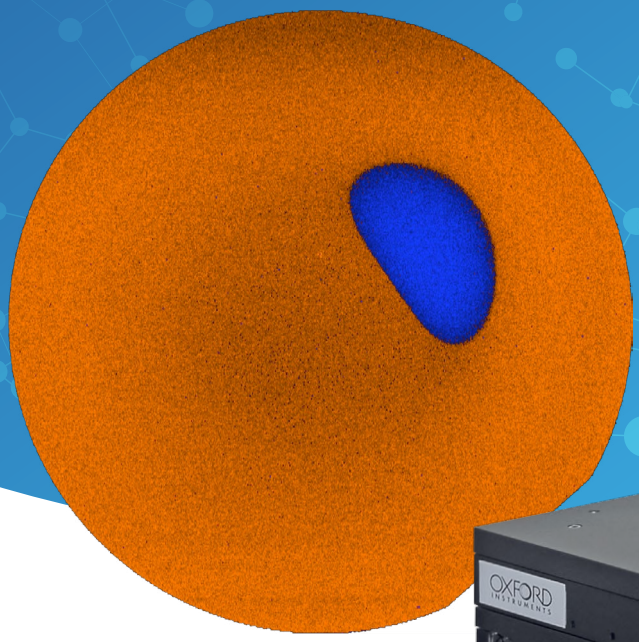
OXFORD INSTRUMENTS

witec360

Semiconductor Edition

Wafer characterisation & inspection from microstructures to full wafers

- Maximise yield through early defect detection
- Accelerate material development and process optimisation
- Non-destructive wafer-scale inspection up to 300 × 350 mm² (12'' wafer)
- Reveal strain and crystal quality by Raman
- Optoelectronic characterisation by photoluminescence
- Rapid detection of defects and non-uniformities
- Enhanced measurement stability through vibration isolation



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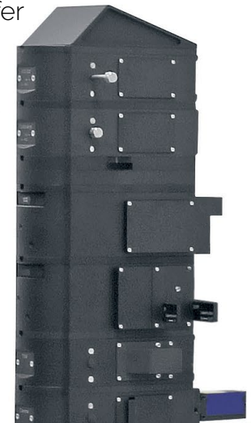
witec360 Semiconductor Edition

Large-area wafer inspection for the semiconductor industry

Whether analysing an entire wafer or measuring micron scale features, the witec360 Semiconductor Edition delivers fast and non-destructive insights into semiconductor defects, crystal structure quality, stress, doping concentration, and material consistency. Users can perform comprehensive wafer mapping to localise rare defect structures and understand spatial distributions over large areas, or acquire statistically relevant point spectra across predefined sampling locations. Correlative Raman and photoluminescence imaging further connects structural defects with their electronic information, enabling faster material development, process and product optimisation.

Key features

- Industry leading confocal Raman & Photoluminescence microscopy
- Future-proof, scalable platform
- Full-wafer scanning up to 300 × 350 mm with integrated wafer chuck
- Active vibration isolation & focus stabilisation
- High-throughput, user-friendly workflows
- Designed for enclosure (laser class 1M) integration with automated, software-controlled remote operation
- Fast, automated calibration & alignment

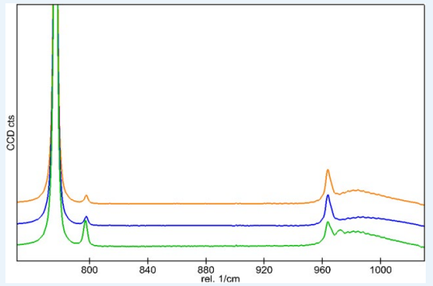


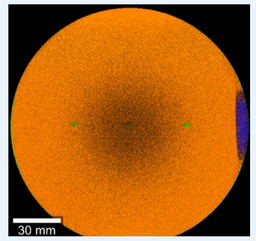
Full-area wafer inspection

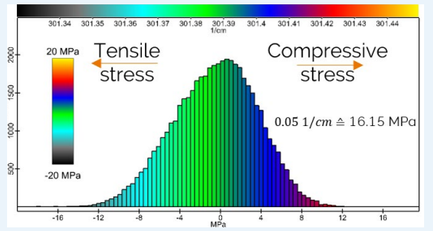
The microscope's extended-range scanning stage enables the inspection of up to 300 mm (12 inch) wafers.

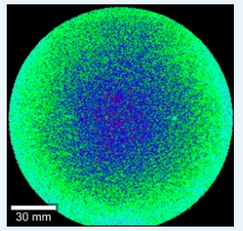
TrueSurface™ technology keeps the surface in focus in order to obtain sharp Raman images of large areas.

In this example, regions of strain and inhomogeneous doping in a 150 mm (6 inch) silicon carbide (SiC) wafer are revealed.









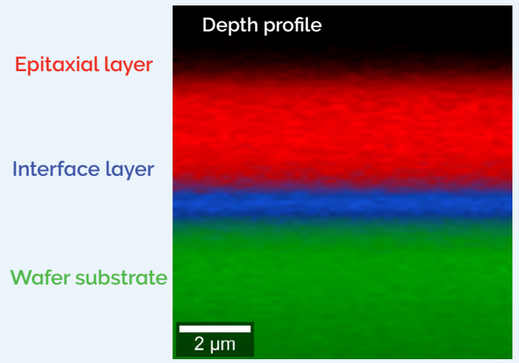
Benefits

- Full inspection of up to 300 mm (12 inch) wafers
- Characterisation of crystallinity, defects, strain and doping
- Surface analyses, depth scans and 3D imaging
- Accelerated and automated workflows
- Analysis of conventional and wide-bandgap semiconductors
- Uniformity, topography and warpage
- Always in focus with real-time TrueSurface™ analysis

Use automated Raman workflows with witec360 Workflow Manager and connect third-party tools via Python, LabVIEW®, C#, for a more streamlined semiconductor material characterisation.

See beyond the surface

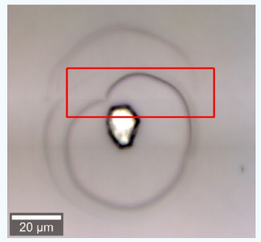
With outstanding confocality, throughput and sensitivity, the witec360 Semiconductor Edition clearly resolves substrate, buffer, and epitaxial layers in e.g., 4H-SiC wafers. High-resolution depth profiling enables rapid verification of layer interfaces, epitaxial thickness, and doping variations for enhanced process control and quality assurance.



SiC wafers were provided courtesy of the Fraunhofer Institute for Integrated Systems and Device Technology IISB, Erlangen, Germany.

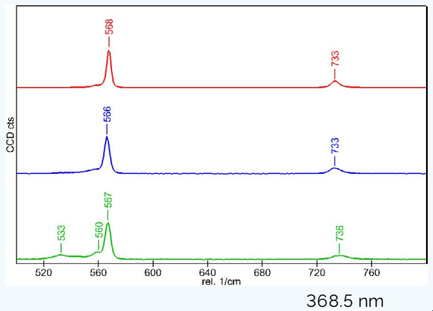
3D stress analysis in wide-bandgap materials

The witec360 Semiconductor Edition enables the combination of **Raman and photoluminescence (PL) microscopy in one instrument.** This hybrid approach is applied here investigating stress induced by a Frank-Read source in the wide-bandgap semiconductor gallium nitride (GaN). A 3D Raman image visualises the distribution of stressed and unstressed GaN. The PL emission wavelength serves as an indicator for the bandgap and 3D imaging shows that it is changed within the Frank-Read source.

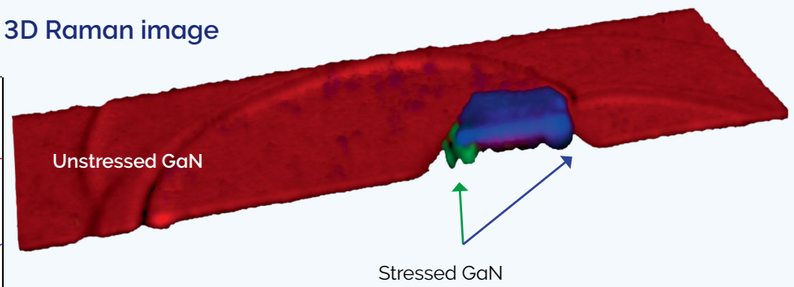


White-light image of a crystal dislocation (Frank-Read Source)

Raman spectra



3D Raman image

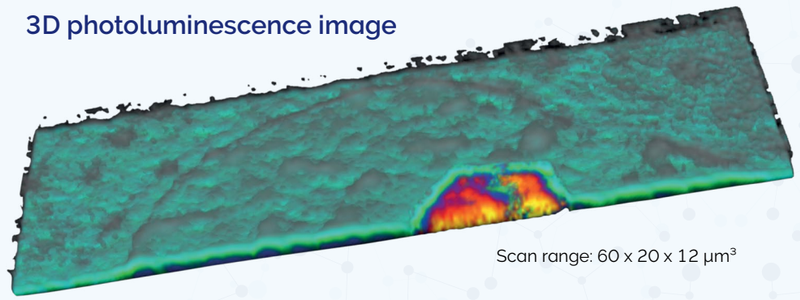


368.5 nm

PL peak position

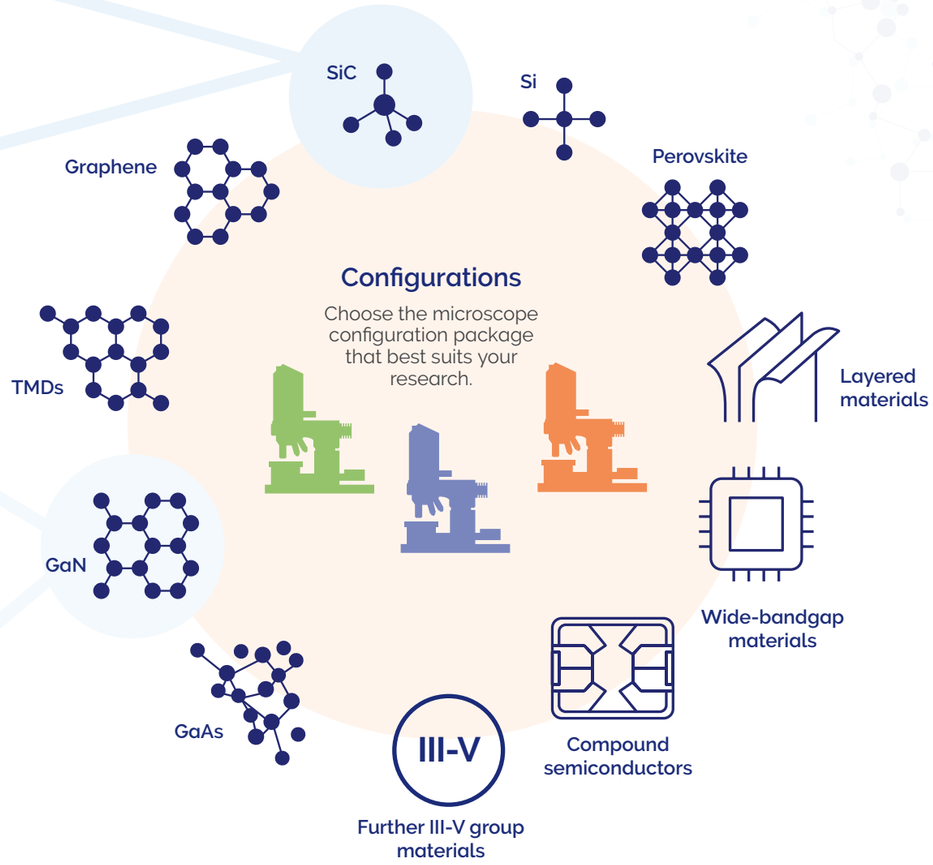
361.2 nm

3D photoluminescence image



Scan range: 60 x 20 x 12 µm³

Optimised for your application



Early detection of crystal defects and stacking faults

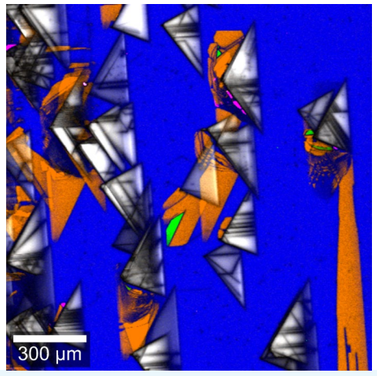
Correlative Raman and photoluminescence analysis support quick localisation, understanding and mitigation of wafer defects.

Raman imaging reveals structural information and traces defects to their origin within the wafer, while PL reveals defect-related variations in electronic and bandgap properties.

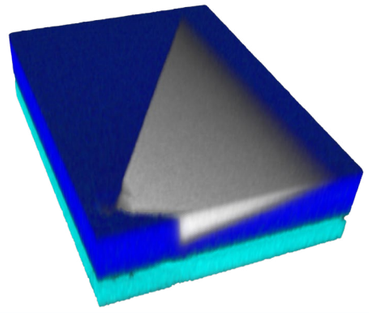
Benefits

- Fast, non-destructive wafer inspection
- Structural and electronic characterisation in a single workflow
- Improved process control, yield and device reliability

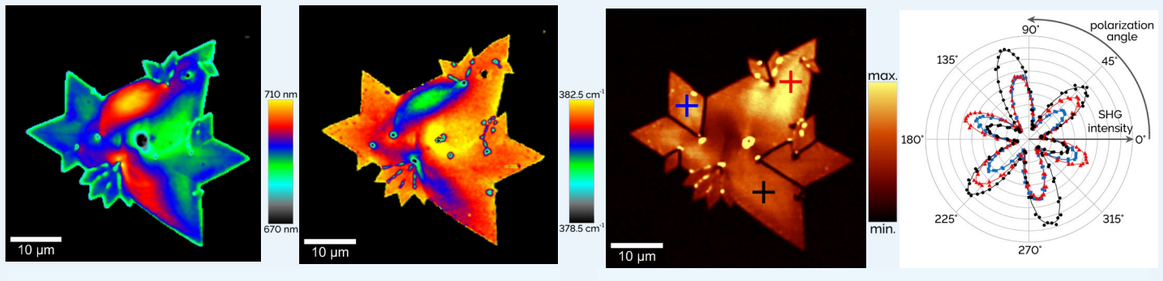
Choose from a wide range of laser excitation wavelengths with motorised switching and automated power control by TruePower to analyse diverse bandgap properties. The high-resolution Hexalight spectrometer, with up to 6 gratings, provides the optimal grating selection for high resolution Raman and diverse PL measurements, enabling seamless, hands-free operation and maximum efficiency.



PL image of defects with different bandgap properties in a 4H-SiC wafer, showing spectral characteristics of 4H-SiC (blue), 4H-SiC with stacking faults (orange, green) and 3C-SiC (grey).



3D Raman representation of a defect (grey) in an epitaxially overgrown (blue) SiC wafer (cyan). Dimensions: 180 x 245 x 7 µm³.



Shifts of the PL wavelength and the Raman E_2g mode reveal areas of doping and strain as well as edge effects.

The SHG image (left) shows grain boundaries (low intensity). Polarisation-dependent SHG intensity measurements reveal different strain levels for the three measurement positions (right).

Thermal Mapping of GaN HEMTs

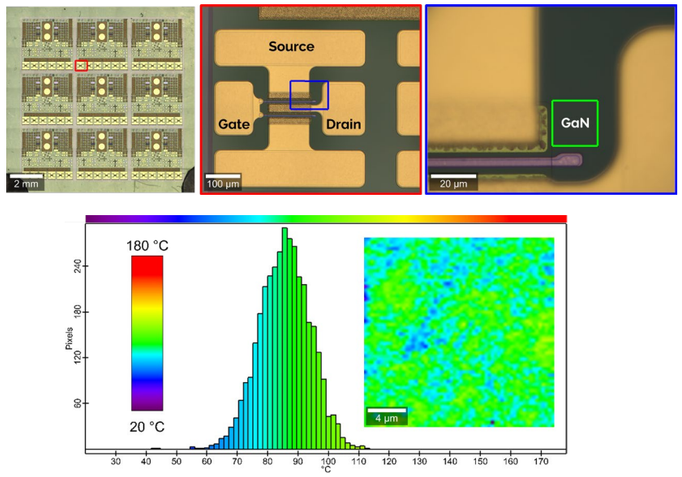
Temperature-induced phonon peak shifts reveal local thermal hotspots, stress distribution and device reliability risks during development and failure analysis.

The approach provides direct insights into heat dissipation mechanisms without modifying the microscope.

Benefits

- Reliability assessment and failure analysis
- Non-destructive thermal mapping of active devices
- Identification of thermal hotspots
- Simultaneous heating-cooling kinetics and defect characterisation
- Fast, automated Raman imaging workflows

Typical applications: GaN HEMTs, power electronics, SiC-MOSFETs, 5G Amplifiers, Power conversion devices, wide-bandgap semiconductor development (SiC, InP, GaAs)

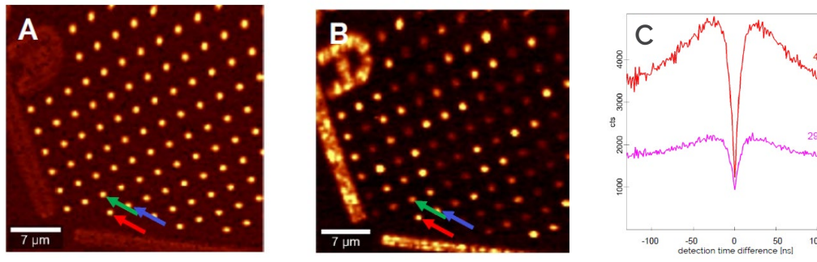


Top: Bright-field images of the microchip and investigated ROI at increasing magnification, from a stitched image overview to a 100× view highlighting the ROI. *Bottom:* Thermal map of the GaN layer on the HEMT device together with the corresponding temperature distribution histogram.

Correlative Characterisation for Next-Generation Materials

Oxford Instruments collaborates with researchers from academia to industry to provide the best tool for the research and development of advanced materials. Correlative measurements enable comprehensive characterisation of next-generation materials. Combine your Raman microscope with correlative options in a single setup.

- Polarisation-resolved analysis: crystal orientation, anisotropy and process-induced material variations
- Second Harmonic Generation (SHG): layer thickness, grain structure and boundaries in 2D materials
- Antibunching experiments: single-photon emitters, color centers and quantum technology development
- Combine Raman, PL, SHG, Polarisation workflows easily at the same sample location, even at cryogenic temperatures



Raman PL Antibunching

Finding potential single-photon emitters by Raman and PL (A,B) and antibunching confirmation of a single-photon emitter at room temperature and cryogenic temperatures (C).

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Our Raman microscopes are manufactured at our facility in Ulm, Germany, and we have offices and support centres located worldwide.

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Cover image
Full 150 mm (6-inch) wafer inspection with confocal Raman microscopy. Areas of different doping.

Note
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