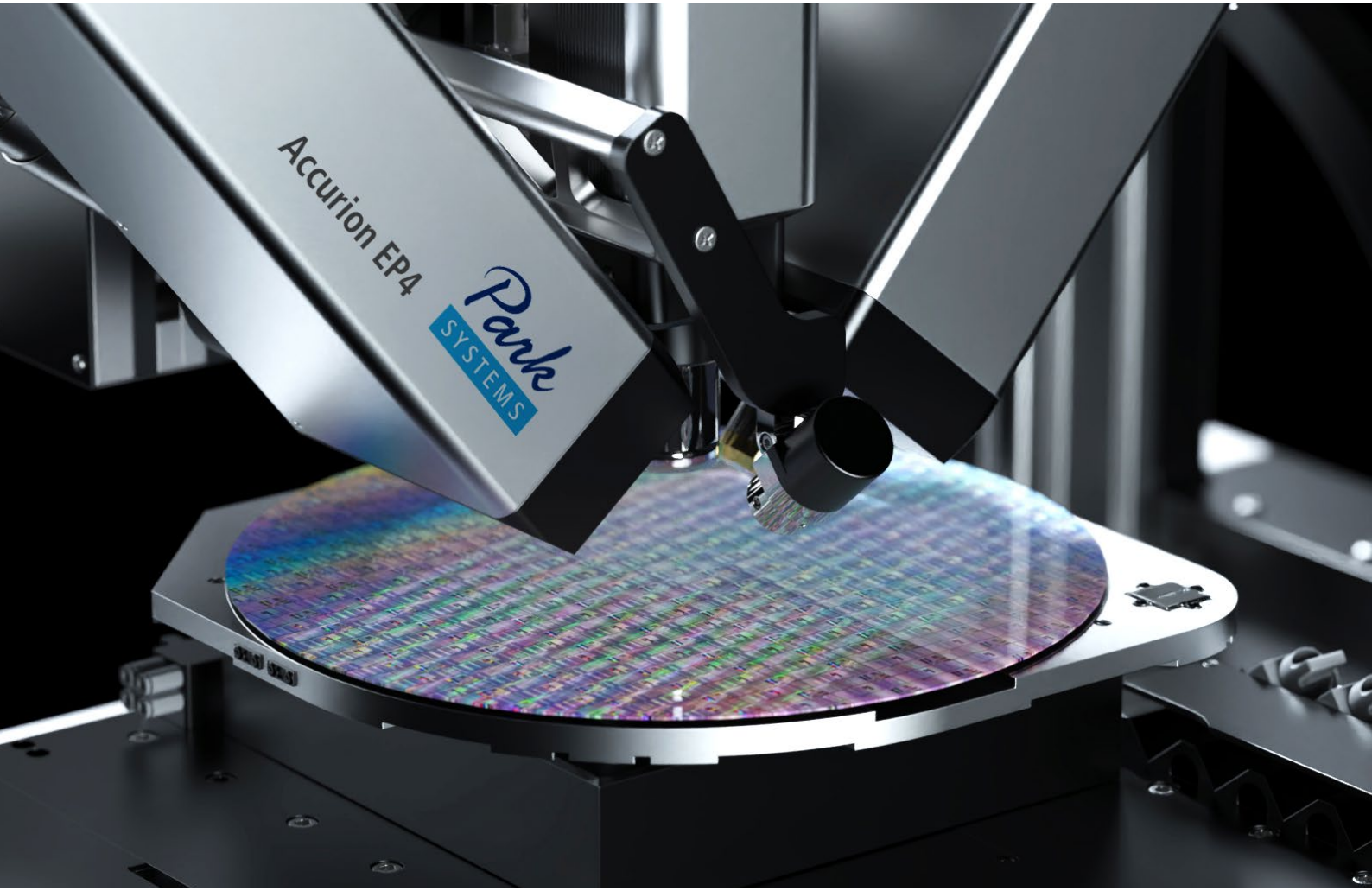
Accurion EP4

Microscopic Thin Film Metrology and Visualization



Park SYSTEMS

The Accurion EP4, developed and manufactured by Park Systems' Accurion Division in Goettingen, Germany, is an advanced Imaging Spectroscopic Ellipsometry (ISE) platform for the quantitative characterization of thin films, surfaces, and advanced materials.

Combining ellipsometry, microscopy, and spectroscopy in a single instrument, the EP4 delivers unparalleled sensitivity, spatial resolution, and analytical versatility. With micrometer-scale lateral resolution and sub-nanometer vertical sensitivity, it enables detailed visualization and quantitative mapping of layer thickness, refractive index, and extinction coefficient – even on microstructured or heterogeneous samples.

What is Imaging Spectroscopic Ellipsometry (ISE)?
Unlike conventional ellipsometry, which measures only a single point on the sample, Imaging Spectroscopic Ellipsometry captures many measurement points simultaneously within the camera field of view. Each pixel acts as an individual detector, generating spatially resolved maps of film thickness and optical properties with microscopic resolution. This transforms ellipsometry from a point-based method into a true imaging technique – revealing variations and features that conventional systems cannot detect.

Like all Park Systems metrology solutions, the EP4 is designed for stability, precision, and intuitive operation. Knife-edge illumination, long-working-distance objective lenses, and a high-stability sample stage work together to minimize measurement artifacts and ensure accurate, reproducible measurements across a wide range of applications.

Supported by the powerful EP4 software suite, the instrument provides a seamless workflow from acquisition to analysis. The integrated software environment unifies system control, data acquisition, quantitative analysis, and advanced modeling capabilities. Together, these tools deliver a complete solution for Imaging Ellipsometry – from experiment to interpretation.

With its advanced imaging capabilities, quantitative precision, and intuitive user interface, the Accurion EP4 offers a versatile and reliable platform for Thin Film Metrology and materials research, setting a new standard for Imaging Spectroscopic Ellipsometry worldwide.

EP4 – Key Features

Superior Performance

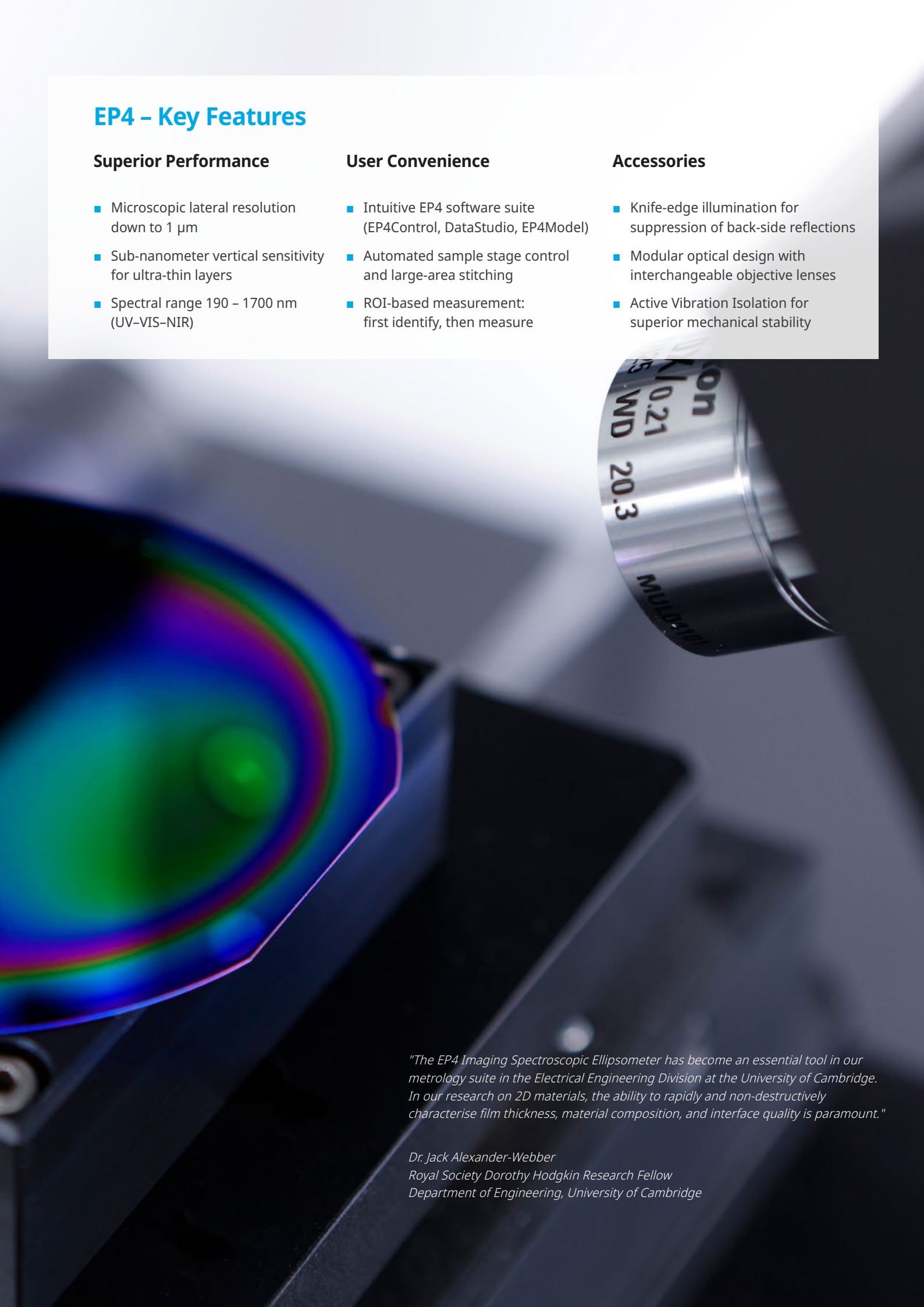
- Microscopic lateral resolution down to 1 µm
- Sub-nanometer vertical sensitivity for ultra-thin layers
- Spectral range 190 – 1700 nm (UV–VIS–NIR)

User Convenience

- Intuitive EP4 software suite (EP4Control, DataStudio, EP4Model)
- Automated sample stage control and large-area stitching
- ROI-based measurement: first identify, then measure

Accessories

- Knife-edge illumination for suppression of back-side reflections
- Modular optical design with interchangeable objective lenses
- Active Vibration Isolation for superior mechanical stability



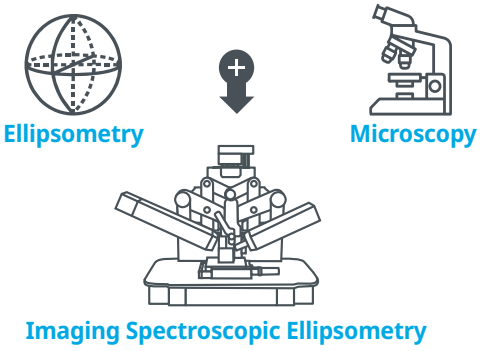
"The EP4 Imaging Spectroscopic Ellipsometer has become an essential tool in our metrology suite in the Electrical Engineering Division at the University of Cambridge. In our research on 2D materials, the ability to rapidly and non-destructively characterise film thickness, material composition, and interface quality is paramount."

Dr. Jack Alexander-Webber
Royal Society Dorothy Hodgkin Research Fellow
Department of Engineering, University of Cambridge

Accurion EP4

Concept of Imaging Ellipsometry

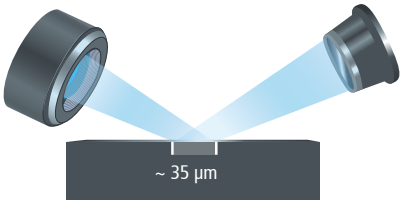
Imaging Ellipsometry combines the polarization sensitivity of ellipsometry with the spatial resolution of optical microscopy. A microscope objective lens and a camera replace the single-spot detection system of conventional ellipsometers – each pixel becomes an individual measurement point.
This pixel-based detection enables quantitative 2D and 3D mapping, real-time contrast imaging, broadband spectroscopic analysis, and precise selection of Regions-of-Interest (ROI).



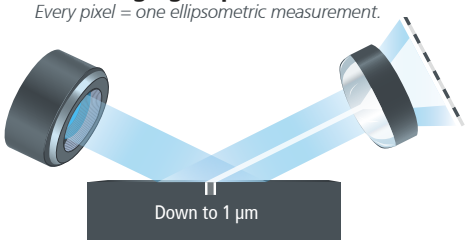
From Single-Spot Measurements to Imaging Ellipsometry

This evolution from point-based to imaging-based ellipsometry marks a paradigm shift in Thin Film Metrology.
Imaging Spectroscopic Ellipsometry reveals what was previously invisible – local variations of optical properties or film thickness, defects, hidden features etc. The Accurion EP4 sets the benchmark for precise, imaging-based Thin Film Metrology.

Conventional Ellipsometer
One spot = one averaged result.

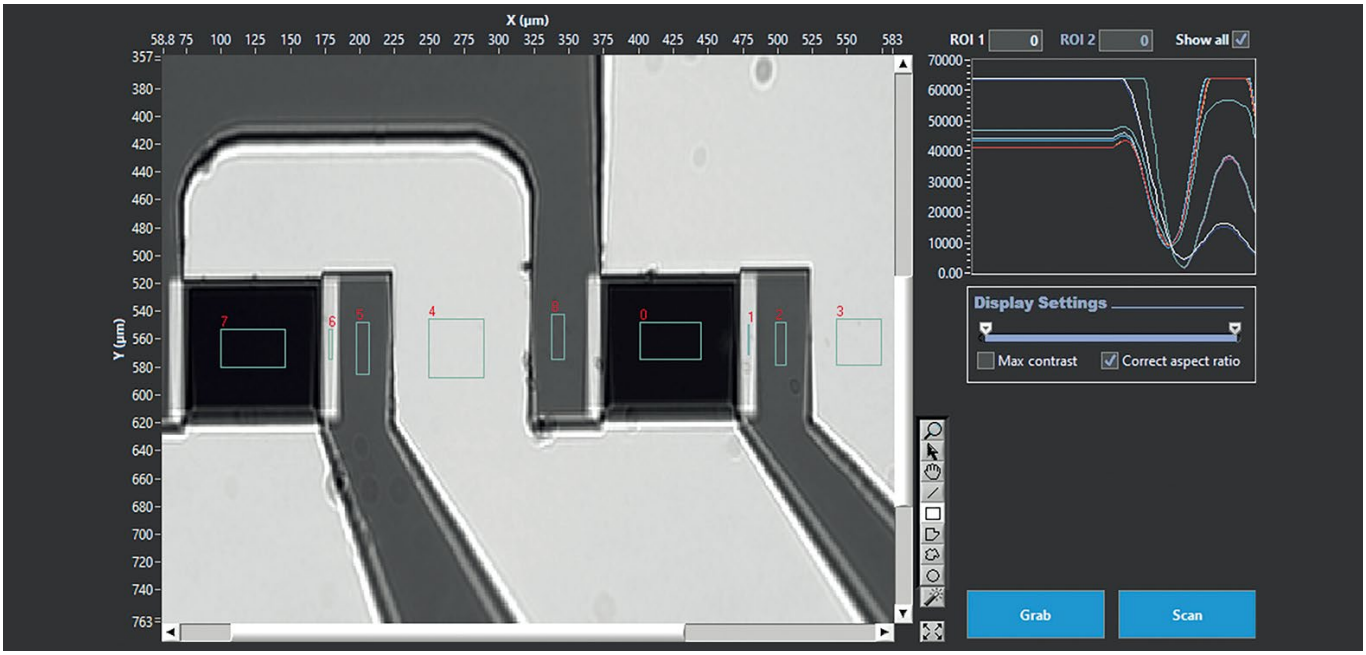


Imaging Ellipsometer
Every pixel = one ellipsometric measurement.



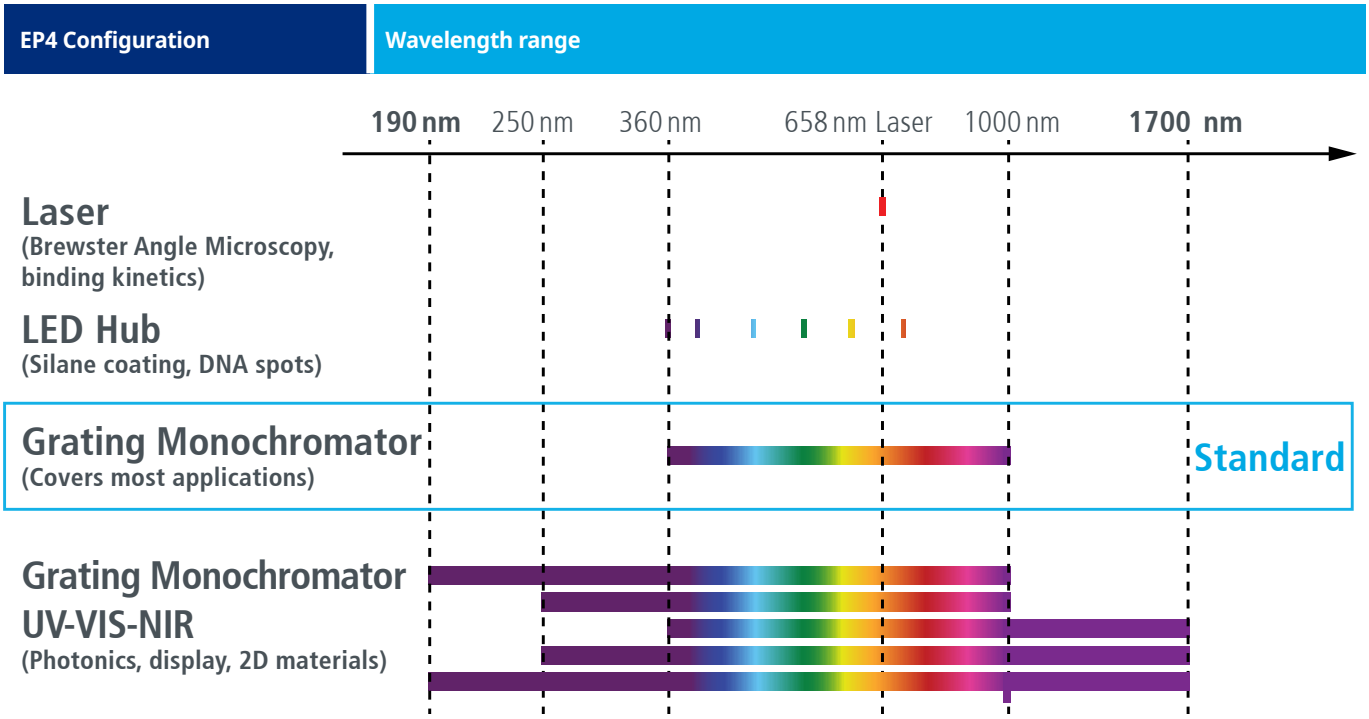
Real-time Ellipsometric Imaging

The EP4 provides a real-time ellipsometric contrast image, enabling intuitive sample navigation and direct ROI selection. With lateral resolution down to 1 µm, users can quickly identify features of interest and define precise measurement areas within the live view. Imaging Ellipsometry allows "first find, then measure": relevant microstructures and thin film variations become visible instantly, even before quantitative Δ/Ψ or thickness mapping is performed.



Accurion EP4

Light Sources and Configuration Possibilities



Objective Lenses

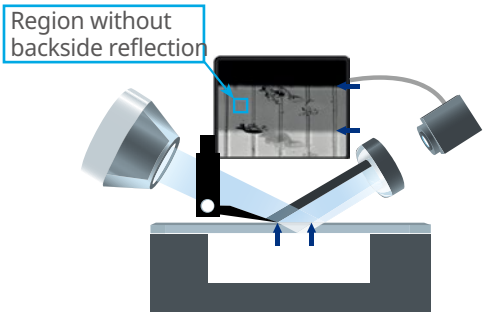
The EP4 uses individually calibrated long-working-distance objective lenses with high numerical aperture: Multiple magnifications are available to ensure the perfect trade-off between resolution and size of field-of-view (FOV). All objective lenses cover a spectral range from 360 nm to 1700 nm and can be quickly exchanged. A special UV microscope Objective Lens for wavelengths < 360 nm is available as well.

Stages

A range of manual and motorized sample stages is available to ensure precise sample positioning. Motorized stages allow accurate movement, multi-position pattern measurements, and stitched maps of larger areas, with different stage sizes offered to accommodate various sample dimensions.

Beam Cutter

Transparent substrates, such as glass or silicon at near-infrared wavelengths, can produce unwanted backside reflections that distort ellipsometric measurements. The unique Beam Cutter provides a non-contact optical method to suppress these reflections in a selected region.

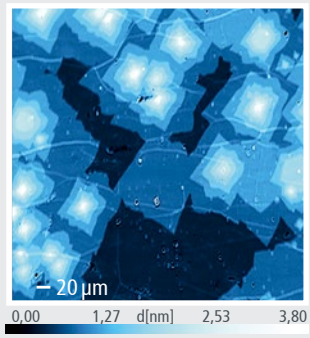


Accurion EP4

Selected Applications

2D Materials

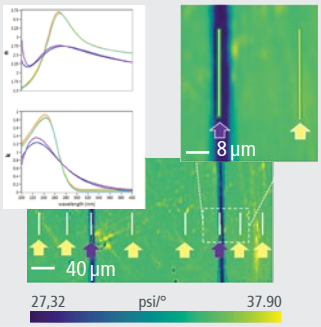
Direct visualization as well as characterization of
2D-material flakes on various substrates on micrometer lateral scale.



Microscopic thickness map of graphene islands reveals different number of layers

Photonics, Electronics

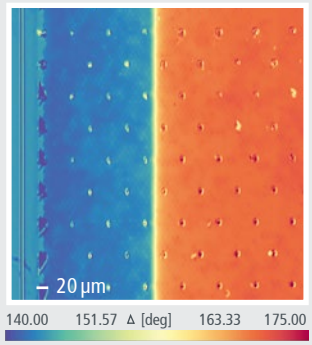
Spectroscopic characterization of refractive index and film thickness on very small regions of only a few microns, using the ROI (Region-of-Interest) concept.



Optical properties of microscopic waveguides

Surface Engineering

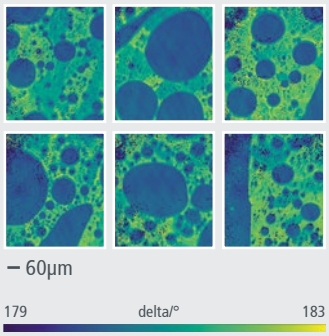
Direct visualization,
characterization and quality control of thin films like
silane or ALD depositions of only a few nm thickness.
2D maps instead of single point measurements.



ALD coated $AL_2 0_3$ into a horizontal high aspect ratio structure (LHAR chip from Chipmetrics)

Air/ Water or Liquid/Liquid Interface

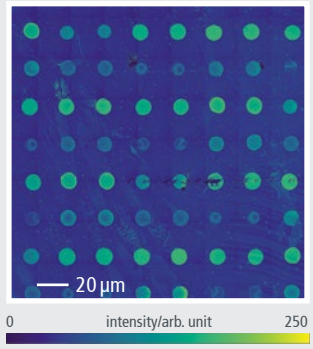
Brewster Angle Microscopy (BAM) is a powerful technique that allows for real-time visualization of Langmuir-Blodgett Monolayers.
The optional Light Guide Setup allows measurements at Solid/Liquid and Liquid/Liquid Interfaces.



Microscopic Delta Map of Lipid-Layers at the Air/Water Interface

Bio Interfaces

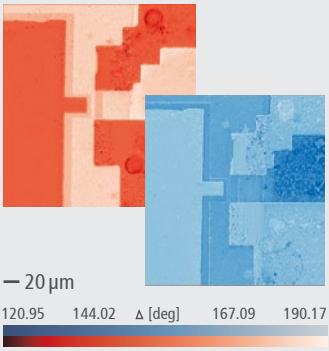
High sensitive thickness or surface coverage detections of mono- and sub-monolayers as well as DNA and protein spots with microscopic resolution.



Ellipsometric Enhanced Contrast Map of Protein Spots Array

Organic Electronics, Solar Cells

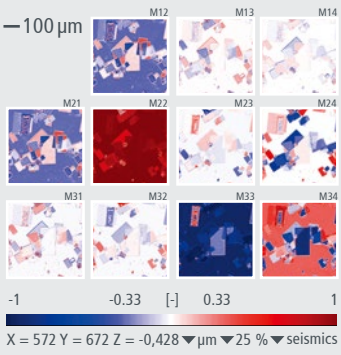
Determination of optical properties of thin conductive polymers such as in OLEDs or solar cells.



Delta and Psi maps of Perovskite Devices

Anisotropic Materials

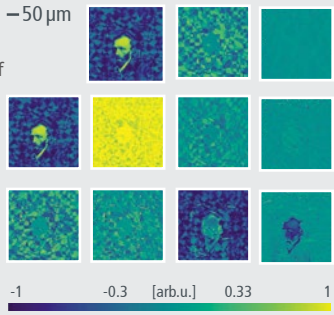
Visualization and Refractive-Index (RI)-measurement of anisotropic materials like micro crystals by Imaging Mueller Matrix Ellipsometry. Patented curved surface correction.



Mueller Matrix Map Uric Acid on Si/SiO_2. Organic micro-crystal

Other Applications

A wide selection of samples with structures can be visualized and measured with the unique technique of Imaging Ellipsometry.
If you do not find your application in the overview, feel free to contact us for specific information.



Laser induced phase change visualized by Imaging Mueller Matrix Ellipsometry

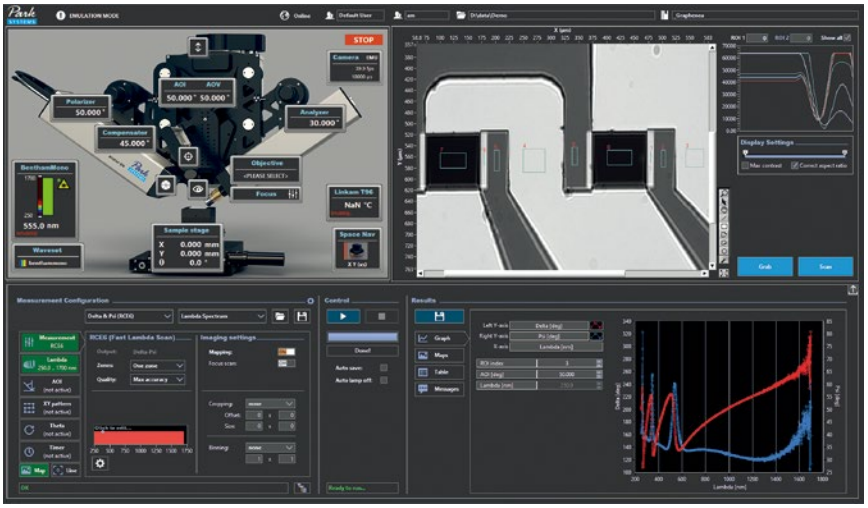
Accurion EP4

The Software

Separate software modules simplify instrument operation and enable parallel or offline analysis of collected data.

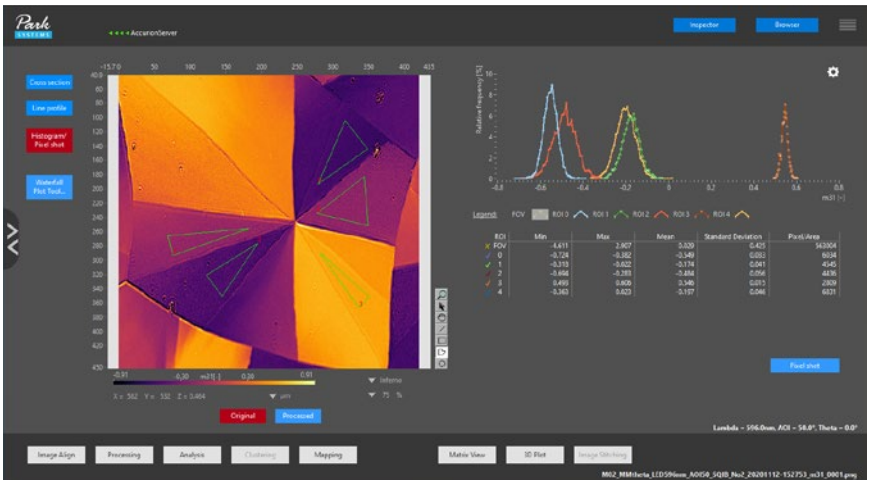
EP4Control

- Instrument control
- Defining measurement parameters and Regions-of-Interest (ROI)
- Performing measurements
- Recording ellipsometric maps



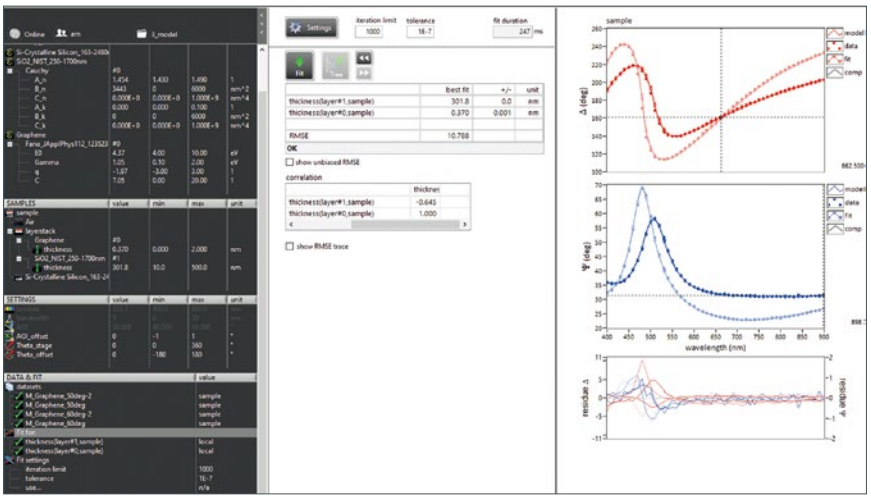
DataStudio

- Visualization of measured data
- Processing of measured data
- Map calculation and analysis
- Spectral clustering



EP4Model

- Optical simulation and modelling of thin films and layer stacks
- Fit for desired parameters (n, k, thickness,...)
- Effective-medium approximation
- Modelling of anisotropic materials (based on 11 elements of Mueller Matrix)
- Large material database included



Accurion EP4

Technical Specifications

Performance Specifications	
Spectral range	▪ Max. 190 nm – 1700 nm
Lateral resolution	▪ Down to 1 µm (using 20x objective lens or higher magnification)
Field-of-View (FOV)	▪ Typ. 400 µm x 400 µm (10x objective lens) ; max. 2 mm x 2 mm (2x objective lens)
Measurand	▪ Delta (0° – 360°) ▪ Psi (0° – 360°) ▪ Mueller Matrix: 11 normalized elements
Film thickness range	▪ 0 nm – 15 µm*
Measurement repeatability (100 nm SiO_2 on Si)	▪ Film thickness: 0.005 nm ▪ Refractive index n: 0.0002

**Depending on sample and spectral range*

Imaging Spectroscopic Ellipsometer in PCSA Configuration		
Goniometer	▪ Motorized goniometer ▪ Max. Angle-of-Incidence (AOI) range: 38° – 90° ▪ Angle resolution: 0.001°	▪ Accuracy: 0.01° ▪ Speed of motion: ~ 5°/s
Sample Stage	▪ Max. travel range: 100/200/300 mm (X/Y)	▪ Accuracy: ≤ 1 µm (X/Y) ▪ Precision: ≤ 1 µm (X/Y)
Z-axis	▪ Motorized Z-axis to adjust the height of the optical head with respect to the sample surface ▪ Max. vertical travel range: 100 mm	▪ Accuracy: 1 µm ▪ Precision: 1 µm
Tilt alignment	▪ Automatic tilt alignment with respect to the plane of incidence ▪ Max. tilt range: 5°	▪ Accuracy: 0.001° ▪ Precision: 0.001°
Vibration Isolation	▪ Built-in Active Vibration Isolation System	
Power supply	▪ Voltage: 100 – 240 V~ ▪ 50/60 Hz ▪ Current: 10 A (max.)	
Environment	▪ Temperature: 15°C – 40°C ▪ Humidity: 0 % – 60 % rel. ▪ Floor vibration: VC-A	
Dimensions	▪ 1300 mm x 750 mm x 900 mm (standard configuration)	
Weight	▪ 160 kg (standard configuration)	

Radiation Safety

Enabling Nanoscale Advances

150, Gwacheon-daero 12-gil, Gwacheon-si, Gyeonggi-do, Republic of Korea

Park SYSTEMS
www.parksystems.com