Malvern Panalytical
a spectris company

EMPYREAN

The intelligent diffractometer

A REVOLUTION IN THE WORLD OF X-RAY DIFFRACTION

Meet the third generation of the Empyrean multipurpose platform

Listening to users of our renowned system at over a thousand universities, research centers and industries around the world, we have now redefined the concept of a multipurpose X-ray diffraction (XRD) instrument.
The new Empyrean is the first fully automated multipurpose diffractometer that allows the largest variety of measurements without any manual intervention. Our newly designed MultiCore Optics featuring iCore and dCore take care of the work.
The MultiCore Optics do not need any human intervention.

- Prepare batches of samples to run overnight or over weekends and maximize instrument utilization.
- Automate multiple measurement geometries to facilitate a more complete understanding of your samples.
- Simplify training of new students or personnel and lower the barrier to perform advanced X-ray applications.
- Reduce time loss caused by mistakes of inexperienced users.
- Execute subsequent user-independent automated analysis on your samples using software such as our industry-leading HighScore package.

ACADEMIA

Get the best data for your publications with Empyrean; train and inspire your students. Acquisition of comprehensive information about a material is the key for successful research. Empyrean will give you the highest data quality, letting you see the finest details of your precious samples by performing non-destructive, cutting-edge characterization studies.

ENERGY STORAGE / BATTERIES

Get a better understanding of your battery materials. Analysis of battery material using X-ray diffraction provides component phase purity and the crystallite size of anode and cathode compounds. Empyrean equipped with the GaliPIX^{3D} detector also allows ***in situ*** and ***in operando*** measurements of long-lasting cells using hard X-radiation.

PHARMACEUTICALS

Accomplish advanced characterization of your pharmaceuticals. X-ray powder diffraction, a rapid non-destructive analytical technique, is widely applied in drug discovery, formulation, stability testing and final product quality control. The proven and comprehensive method is available with 21 CFR Part 11 Audit Trail support. Empyrean can also perform *in situ* non- ambient analysis without manual intervention and high-throughput measurements on well-plates.

SPECIALTY CHEMICALS

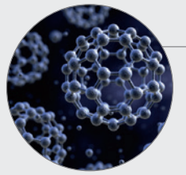
Assess crystal structure or structure-property relationship in crystalline and semi-crystalline compounds. Specialty chemicals, also referred to as effect or performance chemicals, are often custom-manufactured materials with unique properties or performance effects to materials or formulation. Empyrean can be used for a detailed phase identification and understanding of these valuable compounds.

FORENSICS

Reveal the smallest traces of evidence. The use of non-destructive analytical instrumentation plays a key role in today's forensic laboratories where full chain of custody and data control is desired across all stages of the process. Empyrean can provide information that is vital in criminal investigations and forensic science.

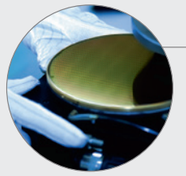
METALS

Determine retained austenite, stress and texture during metal production. Process control and quality control in the metal industry - whether it concerns primary metals or special products - need rapid and accurate chemical analysis as well as microstructural characterization of metals and alloys. Empyrean can take care of these needs.



NANOMATERIALS

Reveal dimensions and structures in all types of nanomaterials. X-ray scattering and diffraction are powerful and versatile nanometrology tools for the determination of nanoscale dimensions, shapes and structures, as well as the analysis of crystalline phases and local atomic structures. Empyrean delivers most accurate scattering data.



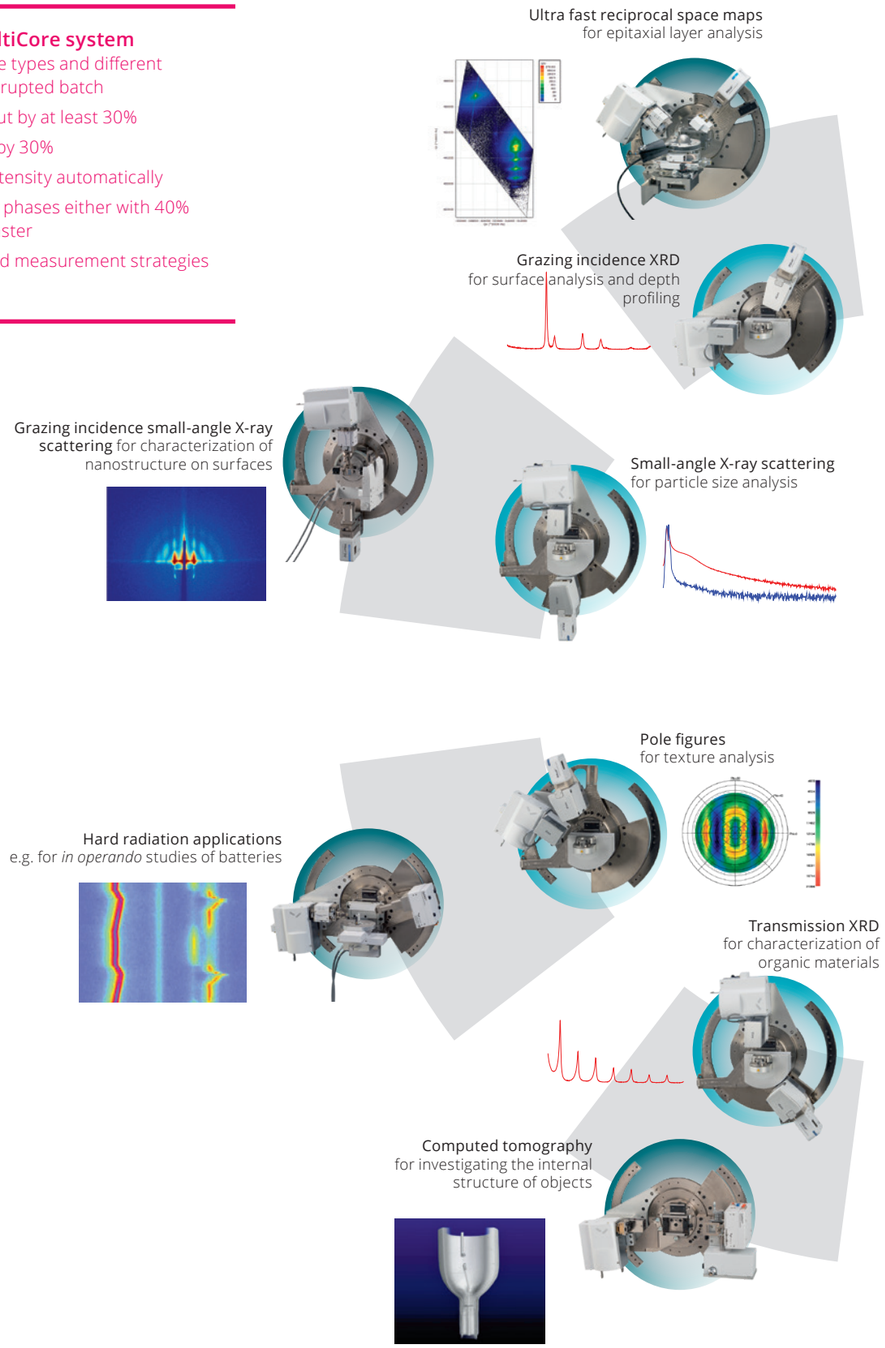
THIN FILM METROLOGY

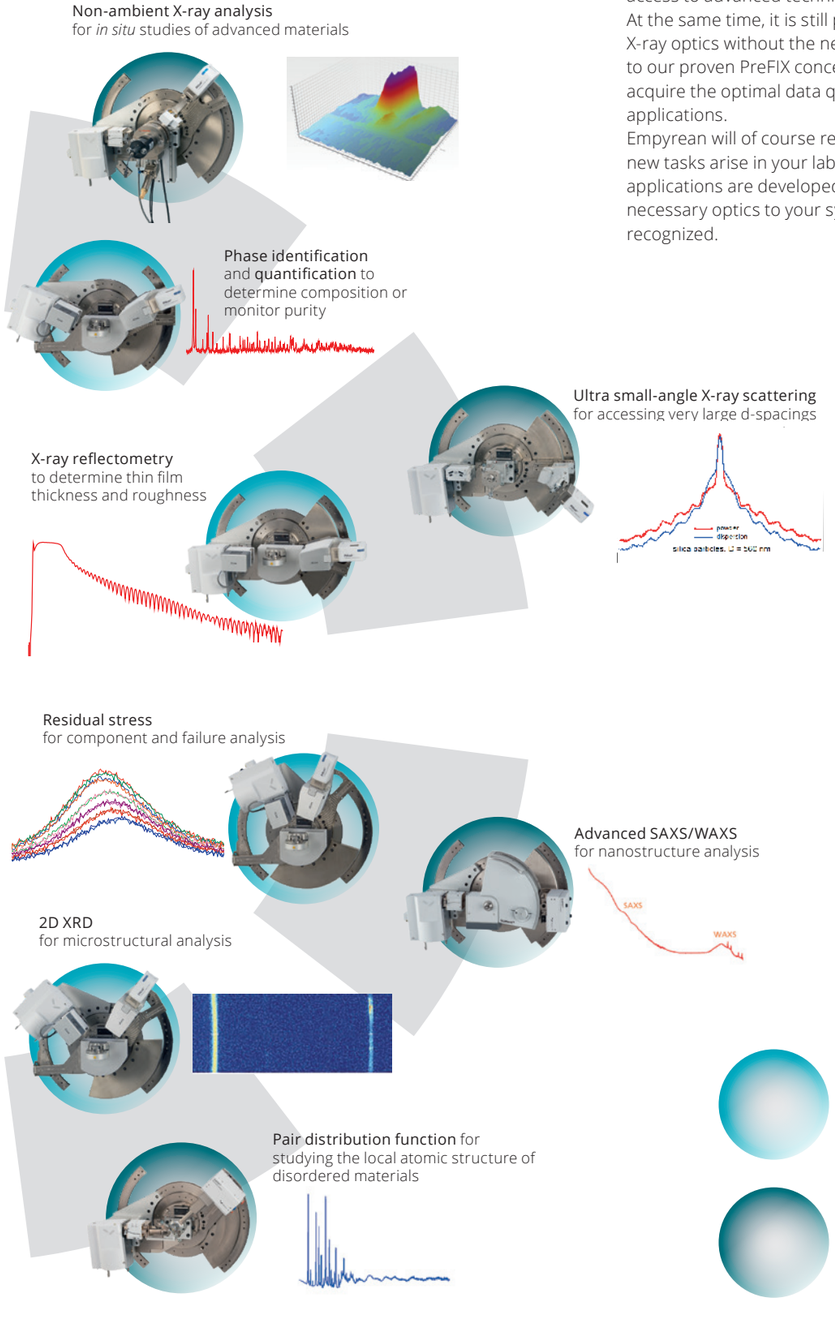
Get access to critical parameters of thin films ranging from ultra-thin single layers to complex multilayer stacks. X-ray diffraction and X-ray reflectivity can provide non-destructive, reliable and accurate data for the characterization of thin films. Empyrean enables the determination of ultra-fast reciprocal space maps, X-ray reflectivity and rocking curve analysis.

AUTOMATED FLEXIBILITY WITH MULTICORE DIFFRACTOMETER

Main benefits of the MultiCore system

- Run heterogeneous sample types and different applications in one uninterrupted batch
- Increase sample throughput by at least 30%
- Reduce user training time by 30%
- Optimize resolution and intensity automatically
- Detect impurities or minor phases either with 40% better sensitivity or 40% faster
- Save time using pre-defined measurement strategies for easy operation





INTUITIVE FOR BEGINNERS, FLEXIBLE FOR ADVANCED USERS

The new Empyrean with MultiCore Optics simplifies access to advanced techniques even for the novice user. At the same time, it is still possible to quickly exchange X-ray optics without the need for realignment, thanks to our proven PreFIX concept. Advanced users can thus acquire the optimal data quality for the most advanced applications.
Empyrean will of course remain future-proof: whenever new tasks arise in your laboratory or when new X-ray applications are developed, you can easily add the necessary optics to your system and they will be recognized.

MultiCore Optics

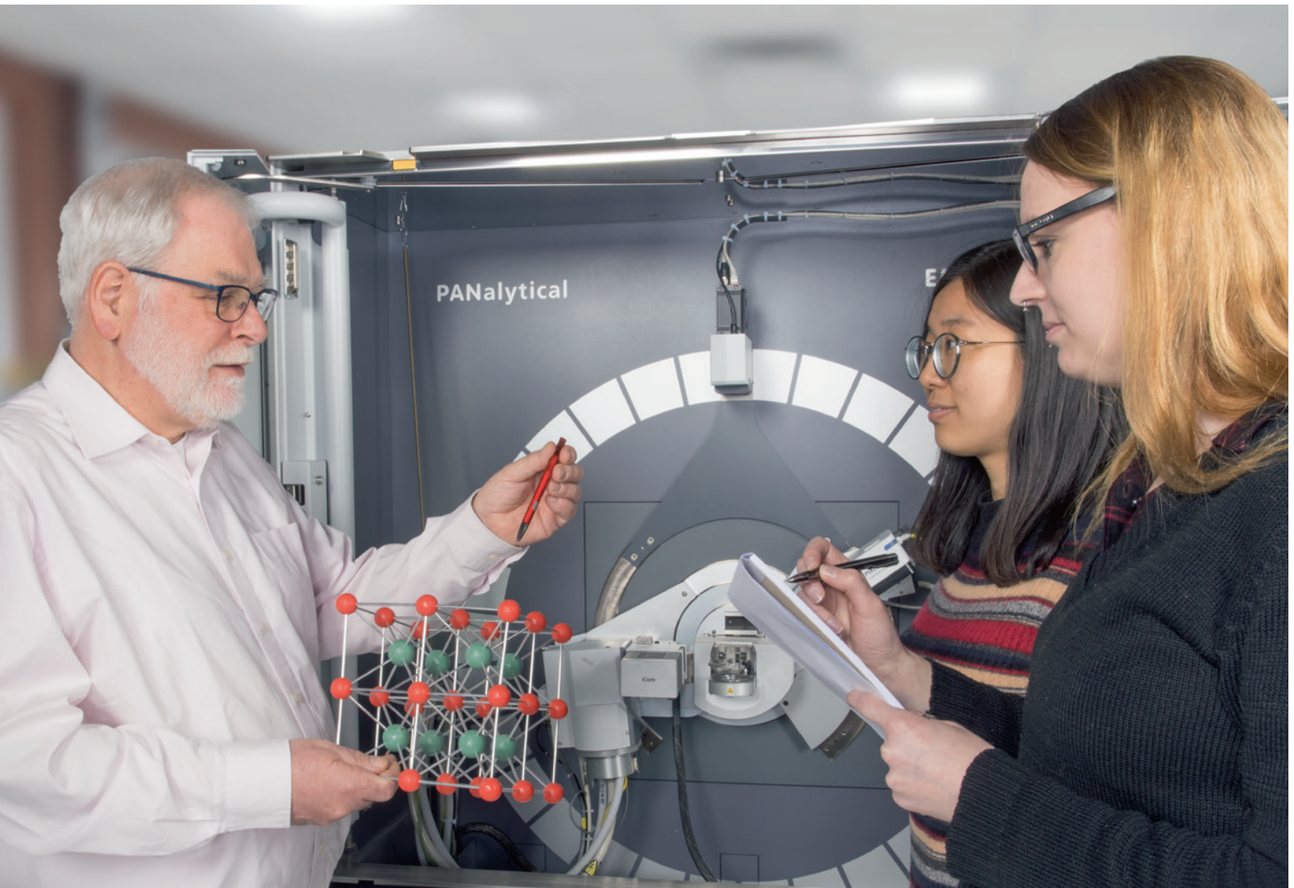
Example of advanced techniques

CUSTOMIZATION POSSIBILITIES

Empyrean is a true multipurpose platform, designed to support a wide range of applications. Yet, our specialists often meet scientists and analysts who would like to extend the possibilities even further, according to their own ideas for their research. Malvern Panalytical listens to your ideas.

Do you need new sample holders, modified stages, optical modules or want advice on analytical techniques? Our creative and motivated development team is happy to work with you on a solution that satisfies your needs. Discuss your requirements with your local Malvern Panalytical sales representative and ask for a tailor-made solution.

Jig for orienting large single crystals prior to cutting and polishing



PRODUCT **SPECIFICATIONS** AT A GLANCE

X-ray generation	
X-ray generator	4 kW (max 60 kV, max 100 mA)
Line/point focus switch	Easy and quick, without tooling
Goniometer	
Maximum usable range (depending on accessories)	-111 < 2theta < 168°
Smallest addressable increment	0.0001°
Angular reproducibility	< 0.0002°
2theta linearity over whole range	Equal or better than +/- 0.01°
Maximum angular speed	15 deg/s
Angular resolution (FWHM on LaB_6)	0.026°
Sample stages	
Ambient sample stages	• Reflection-transmission spinner with optional 45 position sample changer • Capillary spinner • Micro-diffraction spinner • 3-axes (chi,phi,z) cradle with optional manual x,y platform • 5-axes (chi,phi,x,y,z) cradle • Programmable XYZ stage • High-throughput stage • Multipurpose sample stage • Pre-aligned capillary holder stage • Flow cell for *in situ* crystallization research • Modular sample stages (x, y, z) both manual and programmable • ScatterX^{78} (vacuum chamber for SAXS/WAXS) with optional non ambient attachment • Computed tomography stage
Non-ambient sample stages	• Anton Paar HTK1200N (oven); HTK16N and HTK2000 (strip heater) • Anton Paar domed stage DHS1100 (hot) and DCS500 (cold and hot) • Anton Paar TTK600 (low-temperature chamber) • Anton Paar CHC plus+ (cryo and humidity) and MHC-trans (humidity transmission) • Anton Paar XRK900 (reaction) and HPC 900 (high pressure) • Oxford PheniX cryostat and Oxford Cryostream Plus • Flow cell for *in situ* crystallization research
Detectors	
Point detectors	Proportional counter (20 x 24 mm) Scintillation detector (30 mm Ø)
Strip detectors	PIXcel^{1D}, 256 strips of 55 µm 'all live', compatible with Cr to Cu radiation
Area detectors	PIXcel^{3D}, 256 x 256 pixels of 55 µm, compatible with Cr to Cu radiation GaliPIX^{3D}, 501 x 465 pixels of 60 µm, compatible with Co to Ag radiation (with 100% efficiency)
Cabinet	
Exterior dimensions	1400 (w) × 1162 (d) × 1947 (h) mm. The instrument is on wheels. It can pass a 989 mm door opening. For transportation the minimum achievable instrument width is 867 mm.
Accessibility of interior area	1360 (w) × 1100 (h) mm, allowing access to the experimental area by at least four people simultaneously (ideal for teaching)
Radiation level	Radiation level less than 1 microSievert per hour, measured at 10 cm distance, determined with a Mo source @ 60 kV, 50 mA. No power restrictions with all anode types
Cooling water supply	4 - 6 liters/min, pressure up to 8 bar, temperature 15 to 35 °C > dew point
Compressed air supply	House line, compressor or air bottle; 2-5 bar (0.2 - 0.5 MPa)
Power supply	Single phase 210 – 230 V (with +/- 10% grid variations); 50/60 Hz
Maximum power consumption*	4.6 kVA

* without controllers for optional equipment

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WHY CHOOSE **MALVERN PANALYTICAL**?

We are global leaders in materials characterization, creating superior, customer-focused solutions and services which supply tangible economic impact through chemical, physical and structural analysis.

Our aim is to help you develop better quality products and get them to market faster. Our solutions support excellence in research, and help maximize productivity and process efficiency.

Malvern Panalytical is part of Spectris, the productivity-enhancing instruments and controls company.
www.spectris.com

SERVICE & **SUPPORT**

Malvern Panalytical provides the global training, service and support you need to continuously drive your analytical processes at the highest level. We help you increase the return on your investment with us, and ensure that as your laboratory and analytical needs grow, we are there to support you.

Our worldwide team of specialists adds value to your business processes by ensuring applications expertise, rapid response and maximum instrument uptime.

- Local and remote support
- Full and flexible range of support agreements
- Compliance and validation support
- Onsite or classroom-based training courses
- e-Learning training courses and web seminars
- Sample and application consultancy

www.malvernpanalytical.com/empyrean

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