SPECTRUM

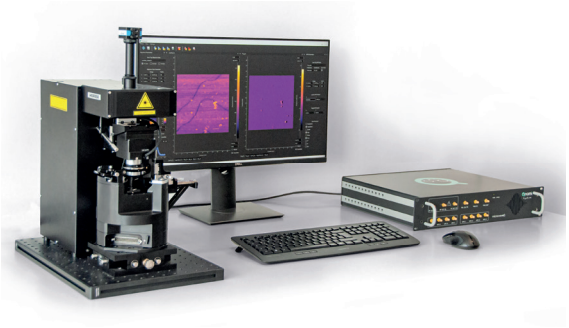
News from Quantum Design Europe

Edition 44 | August 2025

ProteusQ - New approach to magnetic microscopy using quantum technology

In the world of nanotechnology and materials science, the precise analysis of materials at the atomic level is crucial. Qnami's ProteusQ microscope is a significant advance in magnetic microscopy. It combines magnetic measurement using a nitrogen-vacancy (NV) center — a very powerful but sophisticated technology — with high reliability and ease of use.

The ProteusQ microscope uses the principles of quantum mechanical magnetic resonance (QMR) to enable high-resolution measurements of magnetic properties on the nanoscale. It uses an NV center, a loose nitrogen atom bound in the diamond lattice. A laser is used to raise the electrons of the nitrogen to a higher energy state. Normally, the electrons fall back to the ground state after a short time by emitting a photon. However, if the ground state is degenerated by excitation with microwaves, a second transition occurs without the emission of an optical photon. The energy of this transition depends both on the applied microwave frequency and on the magnetic field in which the NV center is located. The latter generates two slightly different energy levels due to Zeeman splitting. When scanning the microwave frequency - and thus



the microwave energy - two non-optical transitions are obtained in the field. These cause a steep drop in the photoluminescence of the NV center. From the microwave energy at which this drop can be observed, the applied field can be calculated with extremely high accuracy using Zeeman splitting. In contrast to con-

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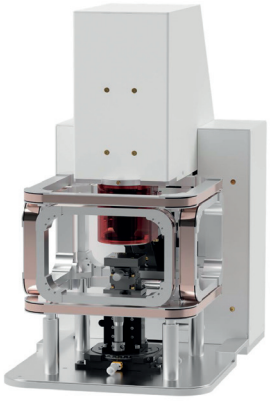
Quantum diamond microscope for geology

Modern paleomagnetic studies are often based on the measurement of rock samples in the centimeter range, as this size offers a good balance between handling, accuracy, and sufficient magnetic moment strength. However, natural rocks with complex geological histories often contain different generations of magnetization in the submillimeter range. For example, sedimentary rocks, including chondritic meteorites, can contain millimeter- or submillimeter-sized fragments with different magnetizations. In igneous rocks, small



sub-areas may have more stable magnetizations than the surrounding material. Obtaining information about magnetic fields

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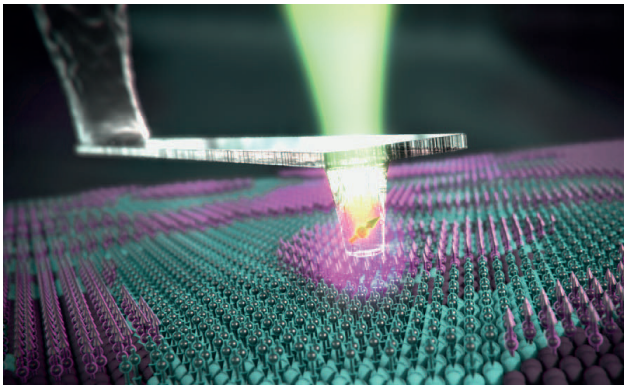
Content

Quantum Design EUROPE

ProteusQ – New approach to magnetic microscopy using quantum technology

» ventional techniques such as magnetic force microscopy (MFM), the ProteusQ offers superior sensitivity and resolution, allowing even very weak magnetic signals to be detected precisely. This capability is particularly valuable for the investigation of materials with complex magnetic structures, such as those found in modern electronics and spintronics applications.



An outstanding feature of the ProteusQ microscope is its user-friendliness. The system was developed with the aim of facilitating access to advanced magnetic microscopy even for less experienced users. The intuitive software interface enables easy operation and fast data analysis.

Specifications

- Sensitivity: 2 µT/√ Hz
- Spatial resolution: nanometer range
- Drift: < 2 nm/hour

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How do you successfully measure samples with high resistances?

The measurement of samples or test specimens with particularly high resistance requires a different procedure compared to the measurement in the usual resistance range. Resistances greater than 10 MΩ are referred to as high resistances. The greater the resistance, the more the points discussed below come into play.

The suggestion

From an instrumental point of view, it is usual to use a current source and measure the voltage applied. With high resistances, however, only a small current flows and the capacitance of the lines becomes noticeable. It is therefore better to use a voltage source and measure the current. This point leads us directly to the next modification; instead of the usual 4-point contacting, 2-point contacting is preferable. Since the resistances of the cables are very low compared to the sample, the influence can be neglected. A DC voltage is preferable because of the time effects that can occur with an AC voltage. It should be noted that there is often a shift in the zero line. An additional measurement with a different sign is therefore necessary. The resulting resistance is the mean value. This is shown schematically in Fig. 1.

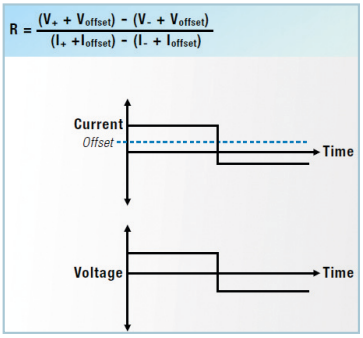

Fig.. 1

Cable & earthing

The cables deserve special attention. They exhibit parasitic capacitance and/or leakage currents. Both effects are undesirable and should be minimized. Triax cables are a sensible choice as they reduce these effects by providing a medium protective shield at the same potential. The cable lengths should be limited to what is actually required. If various components are involved in the measurement setup, e.g. a cryostat in addition to the measuring device, you should think about earthing. Many independent earths lead to ground loops, which increase the noise. Ideally, there should be a point at which different masses converge ("star point").

Calculation example

Our test object has a resistance of 10 GΩ. We use the M81-SSM with the new SMU module, which is also shown, as the measuring equipment. The SMU module can be used in the voltage source and ammeter configuration, among other things. We start with 10 V DC voltage. Using I = U / R results in a current of 1E-9 A or 1 nA, which can still be measured very well; the accuracy of the ammeter function is specified as ±(0.5% + 300 fA) or in this example this is approximately ±6 pA.

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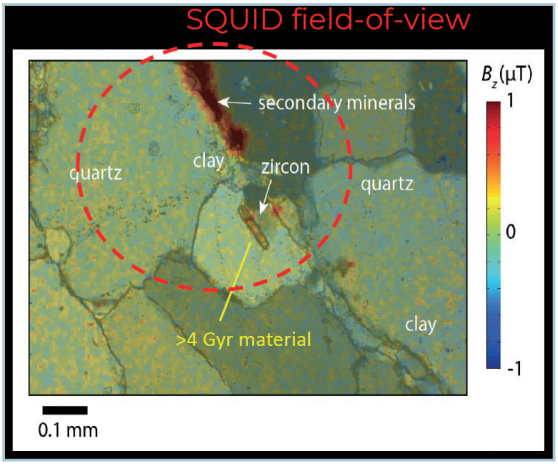
Quantum diamond microscope for geology

» from such samples depends on the accurate measurement of the net moment. Due to their small size, many of these samples have net moments that cannot be detected with instruments commonly used in geology.



QDM measurement of a four billion year old zircon surrounded by much younger material

The need to measure samples with very low magnetic moments has led to the development of magnetic imaging techniques such as the SQUID microscope and the quantum diamond microscope (QDM). Both instruments typically produce maps of a single magnetic field component in the vicinity of the sample, with the QDM also capable of producing complete vector maps of the magnetic field. The QDM offers a whole range of additional advantages: it has a significantly larger field of view, shorter measurement times, and does not require a cryostat to cool the sensor. This makes the QDM a new, powerful measurement system for the magnetic characterization of geological samples.

Sensitivity:

- < 200 nT/Hz½ (at 10 micrometer spatial resolution)
- < 5 µT/Hz½ (1 micrometer spatial resolution)
- Spatial resolution: ≤ 1 micrometer
- Field of view: 4 x 4 mm²

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This keeps your Flexus device precise – maintenance for maximum service life

The Flexus film tension measuring devices from Toho Technology impress with their longevity - many systems have been in use for over 20 years. Regular maintenance and annual recalibration are crucial for this.

Calibration with a certified standard ensures precise measurement results, ISO conformity and extends the service life. Vibrations, frequent use or changes of location can affect the laser alignment - both lasers should therefore be checked annually. From the age of five years, we also recommend replacing the rubber bushings to ensure movement accuracy.

These points should be checked once a year — many of them can be carried out by the user:

Calibration and mechanics:

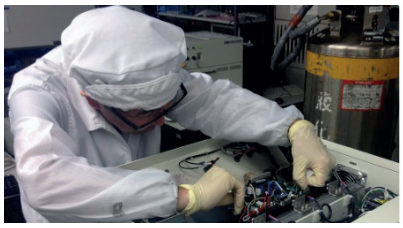
- Voltage test with certified wafer pair (tolerance < 5 %)
- Function test with wafer voltage pair
- Mirror radius control with certified mirror set (tolerance < 5 %)
- Checking the flat value (target value > 3000 m)

System and components:

- Visual inspection inside and outside
- Checking all connections (gas, electricity, air)
- Checking accessories, cables and circuit boards
- Voltage test of the amplifier card
- Test of the laser safety interlock
- Measurement of the power supply voltage

Software and function:

- System startup check
- Installation of available software updates
- Adjusting and updating the calibration coefficients
- Software diagnostics



Optics and care:

- Testing laser intensity and alignment
- Cleaning and lubricating the translation platform
- Replacement of laser and rubber bushes if required

A wafer voltage pair and a calibration mirror set are suitable for self-testing. Spare parts such as lasers, ribbon cables or sockets are available on request.

This maintenance routine ensures that your Flexus system remains precise and reliable over the long term.

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Woollam Newsletter – Issue 24 has been published

The new Woollam newsletter is here. In issue 24 you will once again find interesting articles on the subject of spectroscopic ellipsometry and all about Woollam. One article describes "Optical Critical Dimension Metrology" with spectroscopic ellipsometry (SE).

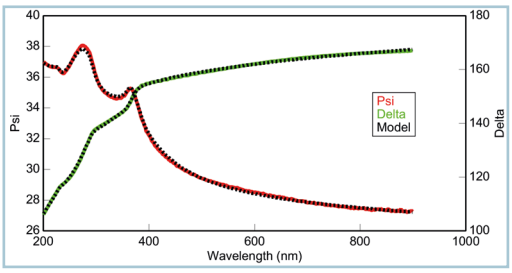
Further topics:

- 30 years with J.A. Woollam Japan
- Portrait: Prof. Rüdiger Goldhahn, University of Magdeburg
- New, extended functions of the Gen-Osc model in CompleteEASE
- New development in infrared ellipsometry through the use of quantum cascade lasers - higher intensity, significantly faster measuring time and options for smaller measuring spots
- Outlook for the next ICSE-10 in Boulder, Co. from June 8-13, 2025

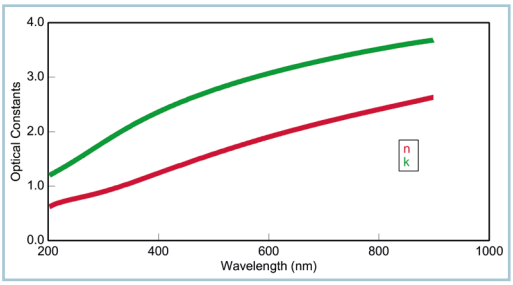
We would particularly like to draw your attention to the article "Minimizing artefacts when modelling ellipsometric measurement data".

Introduction

SE is primarily used in the semiconductor industry. While SE data can usually be collected quickly, analyzing data from unknown, complex materials can be difficult and challenging.



Ψ- and Δ-spectra (SE raw data) of a silicon wafer coated with a thin metal layer

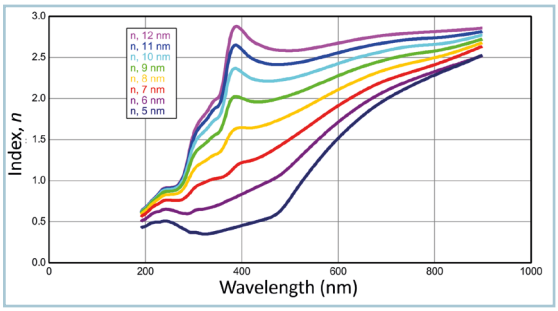


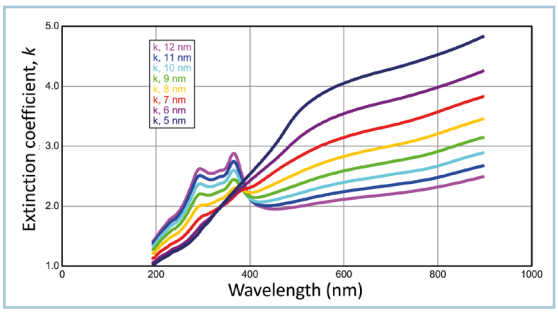
The optical constants for the metal film in the model

SE can only provide limited information about a sample. An SE measurement determines two unique pieces of information at each wavelength, which can be represented as Psi (Ψ) and Delta (Δ). If it is a thin film that absorbs light at all wavelengths (most metal films fall into this category), both its optical constants at each wavelength (n and k or ε1 and ε2) and its thickness must be determined. The problem is therefore underdetermined.

Minimization of artefacts

One solution is known as "artefact minimization". In 1984, Hans Arwin and David Aspnes proposed an approach to uniquely determine the thickness and optical constants of very thin films. The strategy works if the Ψ- and Δ-SE data have sharp spectral features that are not present in the optical constants of a thin film. Different layer thicknesses are considered/modeled to determine the corresponding thin film optical constants that best match the data.





n(λ) (top) and k(λ) (bottom) for a metal film on a silicon substrate, where the thickness of the metal film was recorded at different values

If the optical constants of the thin film have the same (often sharp) spectral structures as the raw data, the thickness is probably incorrect. Incorrect thicknesses force the model to translate these structures into the optical constants of the layer. In describing this strategy, Hans Arwin recently remarked (and we quote): "It's like trying to cut the top layer of frosting off a cake with a knife. If you cut too low, you get part of the cake; if you cut too high, you get frosting, i.e. negative frosting on the knife. So with this approach we can decouple the thickness of a thin film from its optical constants, which is often difficult to achieve with other methods."

The minimization of artefacts can be applied to any absorbing layer, but especially to thin metal layers.

Further information on this topic and a detailed description of the "Interference Enhancement" method can be found in the corresponding article in the new newsletter.

You can find the complete Woollam newsletter and further information on our website.

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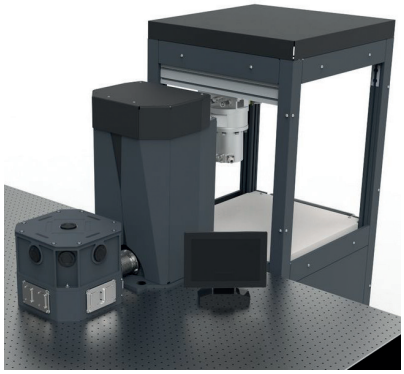
New Cryostat with High Cooling Power and Large Sample Space

Montana Instruments (MI) has introduced a new cryostat that combines the spacious sample chamber of the s200 model with a powerful pulse tube cooler.

The result: a cooling power of 250 mW at 4.2 K and a cooldown time from room temperature to 4.2 K in just six hours.



Thanks to vibration stability of less than 30 nm (peak-to-peak), the system enables optical experiments on nanostructures without compromise.

A total of six vacuum feedthroughs provide space for up to 100 RF or DC lines. This makes the system ideal for applications with higher thermal loads—whether due to a large number of feedthroughs or dissipated heat during measurements.

As with all MI cryostats, the cooldown and warm-up processes are fully automated via the proprietary Galaxy software.

This makes the system perfectly suited for rapid pre-characterization of components for superconducting quantum computers or ion trap systems.

Specifications:

- Base temperature: 3.6 K
- Vibration (peak-to-peak): < 30 nm
- Sample chamber diameter: 200 mm

For more information, please scan the QR code.

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Optical Cryostat with Vector Magnet – The New OptiCool Vector

For many optical applications — especially in the field of quantum technologies — cryostats with integrated vector magnets are essential. Until now, there were few effective solutions: users often had to compromise either on vibration isolation or optical access.

The new OptiCool Vector was purpose-built to overcome these limitations, combining ultra-low vibrations, high-NA optical access, and vector magnetic fields in a single, integrated system.

The system is mounted directly on an optical table. A sophisticated vibration isolation system almost completely decouples the cold head from the table, ensuring mechanical stability.

The compact vector magnet allows optical access from the sides, from above, and optionally from below. A working distance of just 3 mm can be achieved for objectives mounted outside the sample chamber, or alternatively, a high-NA (0.9) objective can be integrated directly into the cryostat.

Since the objective remains at room temperature, users are not limited to the restricted range of cryo-compatible optics.

A 4-1-1 vector magnet enables precise magnetic field control at the sample position. The large sample space (89 mm in diameter) provides ample room for complex experimental setups — for example, integrating multiple positioners for experiments using scanning parabolic mirrors or fiber probes. Several impressive publications have already demonstrated the system's capabilities.

With the OptiCool Vector, experiments that were previously impossible are now within reach.

Specifications:

- Temperature range: 1.7 K — 350 K
- Vibration levels: 4 nm peak-to-peak (Z) / 10 nm peak-to-peak (XY)
- Magnetic field strength: 4 T (Z), 1 T (XY)

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LE-XRF in semiconductor measurement technology: Experiments & results with Sigray AttoMap™ – Part 2

Experiments and results

The AttoMap-310 was developed for high-precision µXRF analysis (Al, F, Ge, Mo, N) in semiconductor research. The combination of Sigray's patented SiC anode and axially symmetrical X-ray mirror lenses enables unprecedented signal quality for measurements in the low energy range.

I. Aluminum:

Aluminum is an essential material in modern transistors. To accurately measure Al thicknesses in the sub-angstrom range, a system must efficiently excite Al. Previous LE-XRF methods are limited because Al-based sources do not excite Al, and higher energies (e.g., Cr-Kα, 5.4 keV) generate Al fluorescence but also cause interfering background noise due to Si fluorescence (1.74 keV) and inelastic scattering.

The AttoMap-310 uses a silicon-based X-ray target that generates a nearly monochromatic 1.74 keV beam—ideal for Al excitation without stimulating the Si substrate (absorption edge: 1.84 keV). This amplifies Al fluorescence (Kα: 1.56 keV) by >700 times compared to Mo-Kα.

A leading semiconductor manufacturer provided four samples for testing, including a ladder-shaped series of ultra-thin Al layers. Although the exact thicknesses were not specified, the measurements corresponded to the expected spectral trends (Fig. 1).

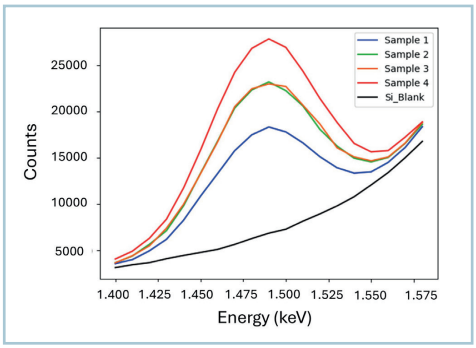

Fig. 1

II. Fluorine:

Fluorine is used in semiconductor manufacturing for etching and cleaning processes, but must not leave any residues as it can cause defects, doping effects, and corrosion. A sample with staggered F concentrations up to 0.3 At% was examined with AttoMap and supplemented with XPS analysis.

Fig. 2 shows the raw spectra of the F peak (0.677 keV). To determine the net counts, a Gaussian fit was performed and the background was subtracted. The linearly correlated net counts (R^2 = 0.956) demonstrate the high sensitivity of the system to F.

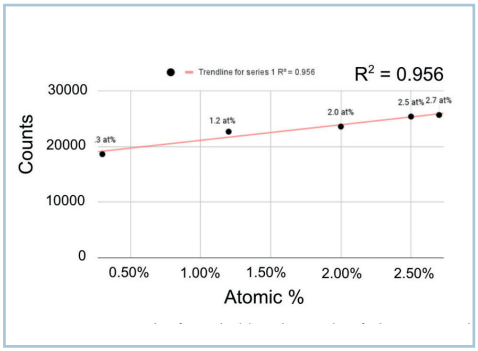

Fig. 2

III. Germanium:

Ge is relevant in high-speed electronics, optoelectronics, and for gate-all-around transistors (GAA). In measurement technology, SiGe layers are removed by etching, which is why precise residual analysis of Ge is important.

Conventional high-energy µXRF techniques use Ge-Kα (9.8 keV), but lower energies increase the Ge fluorescence signal due to stronger absorption (Fig. 3). Thanks to the high brightness of the Si source and the larger collection angle optics of AttoMap, a >100-fold improvement in sensitivity and speed is achieved compared to conventional high-energy µXRF methods.

IV. Molybdenum nitride:

Thin MoN films are essential for semiconductor technology, including as gate electrodes and diffusion barriers. Properties such as work function, specific resistance, and thermal stability can be optimized by varying the Mo/N ratio. Three samples with different Mo/N dosages were scanned with Atto-

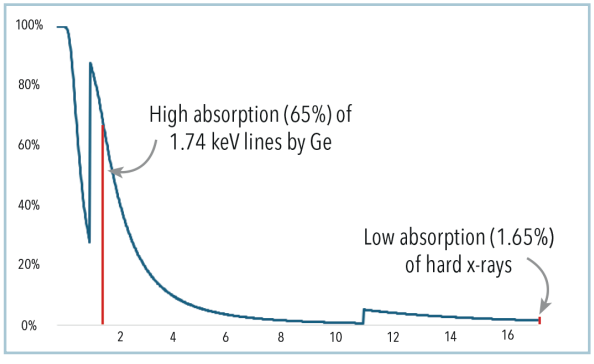

Fig. 3

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» Map. For maximum sensitivity, Mo Lα (2.292 keV) was used instead of Kα (17.4 keV), which enables a >57-fold increase in sensitivity. In addition, N Kα (0.392 keV) was detected.

Summary:

- The AttoMap-310 µXRF system sets new standards in semiconductor analysis and enables:
- Ultra-high-precision Al measurements down to the sub-Å range
- Highly sensitive fluorine residue analysis for quality control
- Efficient Ge characterization in SiGe/Si layers
- Precise MoN thin film measurements with maximum sensitivity

Thanks to high signal strength, minimal background noise, and innovative X-ray optics, AttoMap offers a superior solution for demanding semiconductor investigations.

For more information and the complete user report, please scan the QR code.

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Sensitive Detection of Higher Harmonics Using Quantum Light – Single-Shot Resolved Measurement with sCMOS Camera

Higher Harmonic Generation (HHG) is a fundamental phenomenon in strong light—matter interaction and the basis of attosecond physics [1]. Traditionally, HHG has been generated using classical light sources. However, recent research by Andrei Rasputnyi and Maria Chekhova (FAU Erlangen-Nürnberg & Max Planck Institute for the Science of Light) employs a nonclassical quantum state with unique statistical properties, known as Bright Squeezed Vacuum (BSV) [3,4].

Because BSV exhibits strong pulse-to-pulse fluctuations, the resulting spectra must be measured individually for each laser shot to extract information such as variance and cross-correlations. This places high demands on the detector: sensitivity to ultraviolet light, low noise, wide dynamic range, and high frame rate.

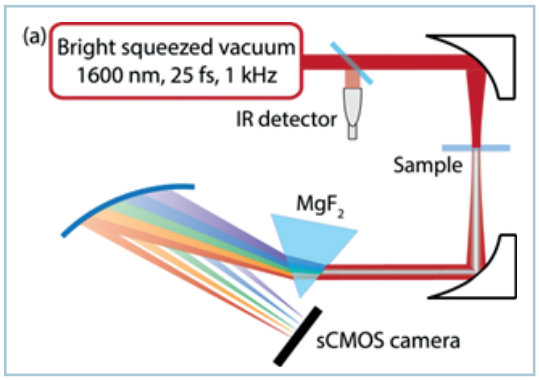

Fig.1 a: Experimental setup for HHG, driven by BSV

In their experiment, Rasputnyi and Chekhova used 25 fs BSV pulses at 1600 nm directed onto a lithium niobate crystal (Fig. 1a). A custom-built spectrometer consisting of a magnesium fluoride prism and an Andor Marana sCMOS camera recorded 120,000 spectra at a frame rate of 1 kHz. The camera was synchronized with an IR photodiode to capture the pump statistics of the BSV. By selecting a specific image region (2048×40 pixels) and applying vertical binning, the necessary speed was achieved.

The 4th to 7th harmonics (400 nm to 228 nm) were recorded. Spectral analysis revealed a blue shift with increasing photon number of the BSV, indicating plasma-induced effects in the sample (Fig. 1b).

This setup enabled the authors to, for the first time, visualize the statistical structure of HHG generated by quantum light in detail—a significant advance for quantum optics and ultrashort light pulse research.

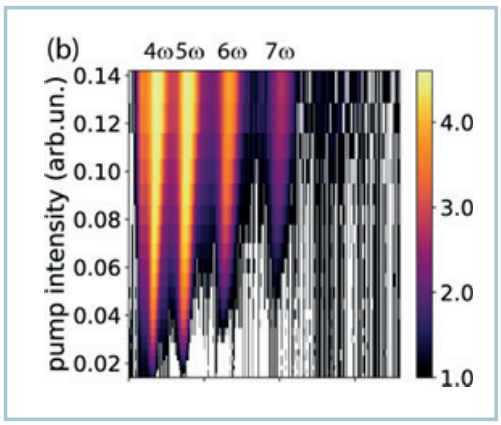

Fig. 1 b: Spectra of the high harmonics, recorded with the sCMOS camera, synchronized with the pump photon number.

References:

[1] Krausz & Ivanov, Rev. Mod. Phys. 81, 163—234 (2009)

[2] Popmintchev et al., Science 336, 1287—1291 (2012)

[3] Gorlach et al., Nature Physics 19, 1689—1696 (2023)

[4] Rasputnyi et al., Nature Physics 20, 1960—1965 (2024)

The full report is available on our website.

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Mechanical characterization of zirconium-doped hafnium membranes with the FusionScope

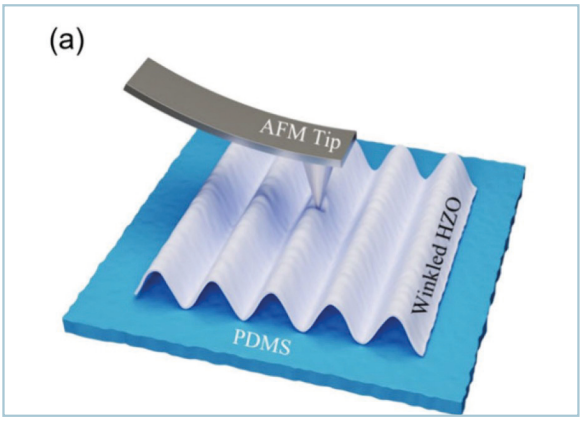
In a recent study at South-east University in Nanjing, China, free-standing hafnium zirconium oxide (HZO) membranes transferred onto flexible substrates were investigated. The correlative atomic force and scanning electron microscope FusionScope made a decisive contribution to understanding the mechanical behavior of these ultra-thin, ferroelectric membranes.

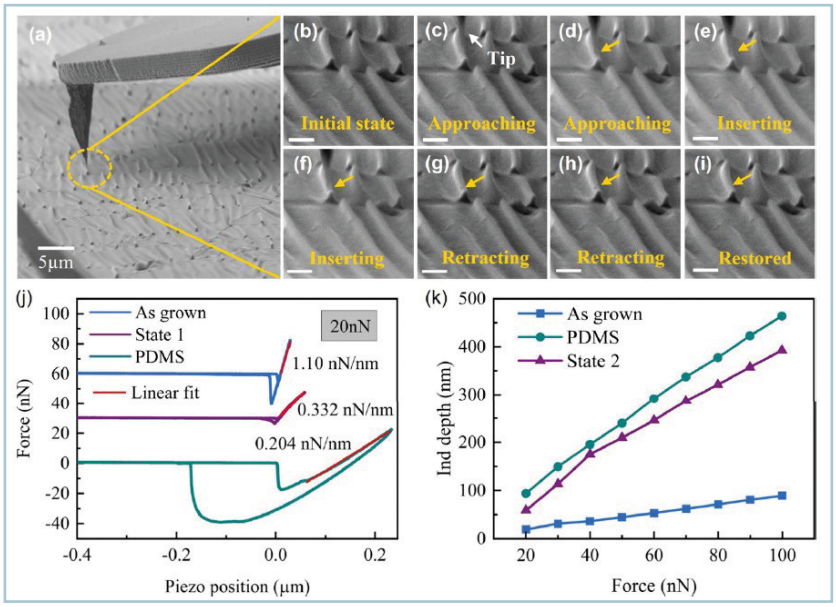
The unique combination of AFM and SEM in the FusionScope allowed the interaction of the AFM tip with individual folds in the free-standing hafnium membranes to be observed in situ and in real time in the SEM.

The approach of the cantilever to the folds, the penetration into the structure as well as the retraction and subsequent restoration of the fold profile were visualized using SEM. This direct view of the process, combined with the simultaneously recorded force-distance curves, made it possible to precisely analyze the elastic restoring forces and mechanical resilience of the ultra-thin membranes.

The correlative measurement revealed a delayed reset of the folds after removal of the AFM tip, which can be attributed to the mechanical structure of the folds and the dynamic reorientation of electrical dipoles under mechanical tension. In addition, force-indentation curves were recorded, from which spring constants were extracted. These quantified the elastic behavior of HZO films in the original state and in the folded state: The folded membranes showed an average stiffness of 0.332nN nm.

Overall, the publication impressively demonstrates how the FusionScope's capability for nanoscale, correlative, real-time observation of mechanical processes provides new insights into the behavior of free-standing, functional thin films - particularly with regard to their potential application in flexible nanoelectronics.





Do you have exciting samples? We have the right system! Contact us and discover the full potential of the FusionScope together with us.

Interested? You can find more information on our website.

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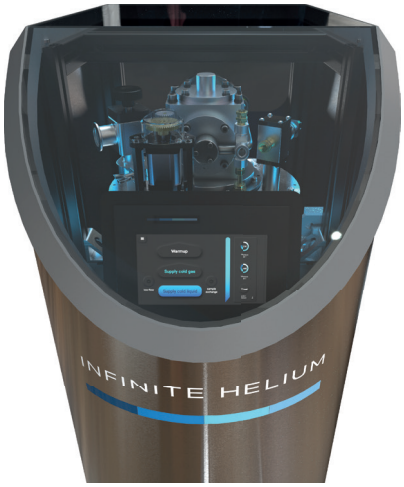
Infinite Helium

We present: Infinite Helium - an automated solution that makes your LHe cryostat cryogen-free.

With the Infinite Helium, our partner Lake Shore has developed a new solution to expand existing flow cryostats with a closed cooling circuit. Similar to the Recirculating Gas Cooler, the Infinite Helium replaces the supply of liquid helium from Dewar vessels and regulates the collection of the warm helium. The helium circulates in a closed circuit so that no gas needs to be refilled and the system becomes a genuine closed-cycle system.

Typically, the Infinite Helium is used with the ST-500 cryostat for microscopy, the ST-400 cryostat for UHV and beamline applications and the ST-FTIR or ST-NMR cryostats. In addition, the system is compatible with Lake Shore's entire range of flow cryostats and also with many flow cryostats from other manufacturers. Lake Shore has focused on three key aspects during development: Automation, low base temperature and very low vibration.



The automation functions ensure consistent, optimum performance regardless of the cryostat. Thanks to the comprehensive sample detection, the system automatically recognizes which flow rate of helium is required for optimum adjustment depending on the heat load for a low base temperature. It also determines which base temperature can be achieved with the respective sample.

With the Infinite Helium, base temperatures of less than 2.2 K can be achieved. In typical applications with an ST-500, the base temperature is below 3.4 K with a cooling capacity of 450 mW at 5 K.

At the same time, the Infinite Helium introduces hardly any vibrations into the system. In a setup for microscopy applications, vibrations < 2 nm from 5 Hz can be achieved reproducibly.

Thanks to the automation of the system, samples can be exchanged without the cold head having to be warmed up. If tests or applications take longer, this is also not a problem. The Infinite Helium can operate continuously for six months or more without the need for maintenance. Other solutions often need to be warmed up and serviced every few weeks.

The Infinite Helium is available in two versions: Infinite Helium and Infinite Helium Plus.

Properties:

- Fully automated - no manual valve adjustment
- < 2.2 K base temperature
- Low thermal drift
- Low vibration
- Over 6 months continuous operating time
- Automated safety warnings
- Intuitive touchscreen user interface

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Quantum Design presents: Our Expert for SEM and AFM

My name is Simon John, SEM and AFM Product Specialist at Quantum Design.

As a PhD physical chemist with a strong focus on microscopy techniques, I support R&D professionals in finding the right solutions for their applications. What drives me is developing sustainable, precisely tailored solutions through close collaboration with our customers.

Long-term customer satisfaction is my top priority — with an open ear for new ideas and a clear eye on future challenges. Because I firmly believe: efficient, purpose-driven collaboration leads to real progress.

— Simon John, Product Manager at Quantum Design Europe

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High-performance detectors for SEM and TEM systems

Our supplier Advacam/Advascope presents two high-performance detectors for electron microscopy (SEM & TEM): the ePix and the ePix EFE. The detectors can be configured for almost all common applications. These include:

- 2D/4D STEM in SEM/TEM
- EBSD
- EELS
- Ptychography
- µED
- µCT and nanoCT

The ePix detectors are based on the third generation of Timepix technology. Advacam is a founding member of the CERN Medipix Consortium and the only company to hold a license for every generation of Timepix.

ePix detectors use data-driven readout, whereby each electron is assigned a time stamp with precise position and energy information. The detectors offer a virtually unlimited dynamic range and sensitivity that is orders of magnitude better at low keV values compared to indirect electron detection. ePix combines a powerful readout architecture with an innovative and robust detector design to create the ultimate detector for high-throughput, high-resolution, and high-sensitivity electron microscopy applications. Key advantages include:

- Single electron sensitivity
- Large solid angle in a small space
- High spatial resolution
- Ultra-fast readout speed

The detectors can be quickly and easily integrated into existing SEM or TEM systems and integrated and read out via an open SDK into existing software solutions. A standalone software solution is also available.

The energy range of the detector is 2.5-300 keV and the pixel size is

55 µm x 55 µm. With a pixel matrix of 256 x 256, this results in a sensor size of 14 mm x 14 mm. The thickness of the Si sensor can be varied in the range of 100-500 µm depending on the desired application. Each detector is developed in close consultation with our customers to achieve the best possible result.

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New – SMU module for the M81

The M81 is a universal device family for a wide range of electrical measurement tasks. The central unit can control or read up to six independent channels, up to three as source channels and three as measurement channels. One of the M81's key features is its ability to perform low-noise and sensitive measurements, even with small currents. Small currents are important for electrical characterization at low temperatures in order to minimize Joule heating, or for nanoscale samples such as 2D materials or nanostructures.

The new SMU module makes the M81 even more versatile. SMU stands for "Source Measure Unit." It therefore includes both the source and the measurement capability.

Since the user can choose between AC, DC, and lock-in, each with current or voltage excitation, the M81-SMU combines the capabilities of six instrument pairs! Possible samples range from conductors to insulating materials.

Specifications

- Modes: AC, DC, and lock-in
- Excitation: current or voltage
- Measurement sensitivity (DC): <100 fA
- Measurement sensitivity (LIA: nanovolts
- Frequency: up to 100 kHz
- Resistance range: ~milliohms to 100 GΩ
- Special feature: MeasureSync (patented). Synchronization across multiple modules possible

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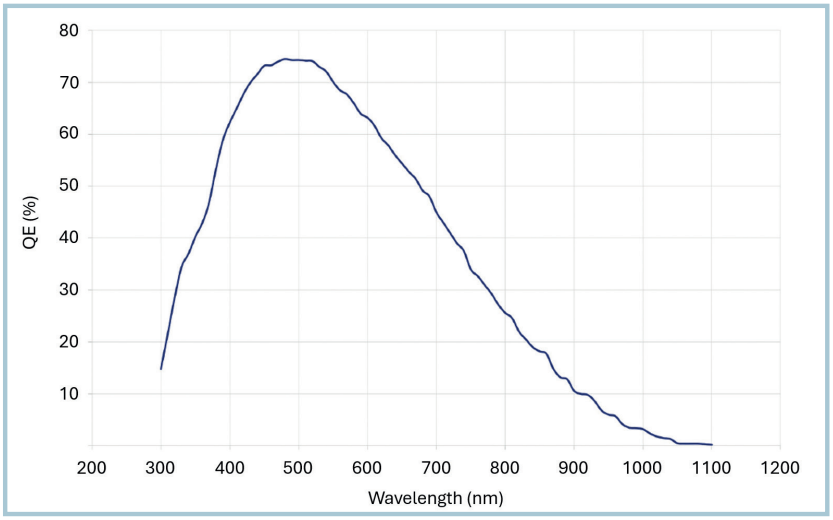
Andor CB2: More pixels than stars in the night sky

The Andor CB2 is a high-resolution sCMOS camera that is characterized by its flexibility and performance. With a sensor resolution of 24.5 megapixels, the CB2 is the highest-resolution Andor camera. The pixel size of 2.74 µm can be expanded to 5.48 µm by on-chip 2x2 binning. The 2x2 binning allows a dynamic range of 16 bit and takes place on the sensor without doubling the readout noise, as is the case with CMOS technology to date. This optical adaptability considerably expands the camera's application possibilities.



In fluorescence microscopy, for example, the native pixel size is ideal for imaging large samples at low magnification. The pixels enlarged by binning offer greater sensitivity with high-resolution objectives. In astrophotography, the pixel flexibility enables adaptation to different telescopes and observation conditions.

The Andor CB2 supports both CoaXPress 2.0 and 10 GigE interfaces, which enable stable data transmission with low latency even over longer distances. It is equipped with a C-mount in the standard configuration, but can be fitted with a TFL mount for applications with larger optical apertures on request.

The camera combines high quantum efficiency (see illustration) with a high speed of up to 74 full frames per second and a global shutter. With a very low dark current of 0.0015 e/pixel/s and sensor cooling down to -20°C, the Andor CB2 is also suitable for long exposure applications. The ability to operate in low light conditions makes it an ideal choice for applications where minimal noise and high resolution are critical.

Right from the start, the Andor CB2 is compatible with the FLI Vision software and µManager. An SDK for C, C++, C#, Python, MatLab & LabVIEW is also available.

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Model 346 cryogenic temperature controller

Temperature control with 400 W heating power down to 300 mK.

Lake Shore's new controller for cryogenic temperatures, the Model 346, sets new standards above demixing cooler temperatures. The combined heating power of 400 W ensures twice as fast heating as usual. The up to 26 inputs for RTDs (Resistance Temperature Detector), diodes and thermocouple temperature sensors leave nothing to be desired when measuring the temperature.

The front panel consists of a user-friendly touchscreen and displays error messages in real time. These include the new "Broken Leads" function, which detects cable breaks and notifies the user. Extended system control is possible via two digital inputs that can be used for external triggers, as well as two relays for process control, and the controller is supplied with new software, ColdSync. This simplifies the control of the sensors and the collection of temperature data.

The core specifications at a glance

- Temperature range 300 mK to 1,500 K
- 8 heaters, 4 with 100 W and 4 with 1 W heating power each
- 10 sensor inputs, expandable to up to 26 inputs
- RTDs, diodes and thermocouple sensors
- USB, Ethernet and optional GPIB control

You can find more information here:

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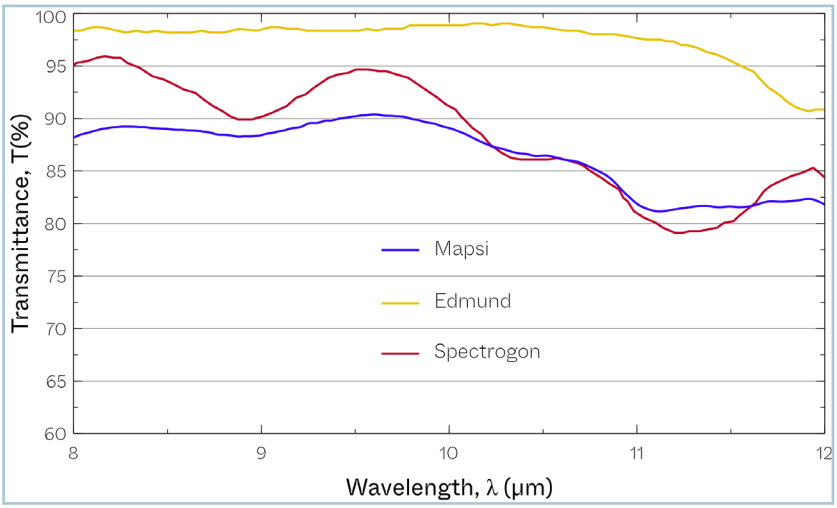
Full silicon IR windows

Infrared windows are used to protect optical components from environmental influences while ensuring high transmission. They are typically used in front of thermal imaging cameras to protect the lenses or in front of pyrometers to prevent corrosive particles from entering and damaging the electronics.

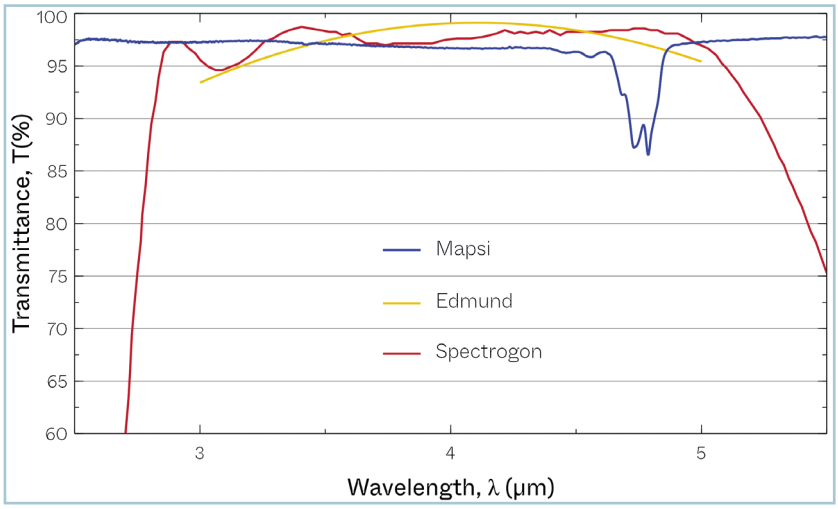
Infrared windows are also frequently used in detectors to hermetically seal CMOS circuits, as these require a low-pressure environment for operation.

Silicon substrates are typically used for the mid-infrared range (MWIR) and germanium for the long-wave infrared range (LWIR). However, due to their high refractive indices of 3.4 and 4, respectively, an anti-reflective coating is usually required. However, this is not without its problems. It can peel off at fluctuating temperatures, produces a strong angle dependence, and is sensitive to corrosive materials or in a salty environment. One solution is to additionally coat the window with DLC (diamond-like carbon), a material with mechanical properties that make it slightly more resistant. However, this makes the product more expensive and still does not offer a complete solution.

Mapsi Photonics is taking a different approach, based on the principle of "less is more." Instead of applying layers of different materials to a substrate, they texture silicon using a chemical process that offers significant time and cost savings compared to the use of multiple layers. In addition, Mapsi avoids the use of exotic materials of high geostrategic relevance. Their import can be subject to political fluctuations and have social and environmental impacts in the countries where they are produced. The mechanical properties of silicon, which are even far superior to those of DLC, are retained and the optical properties are improved.



Comparison between Mapsi and other recognized BBAR manufacturers (LWIR)



Comparison between Mapsi and other recognized BBAR manufacturers (LWIR) [1,2]

In SWIR and MWIR, Mapsi windows achieve up to 97% transmission. The T-curve is flat over a wide range and does not exhibit any valleys or peaks, as is common with multilayer windows. In the LWIR range, the spectral sensitivity is slightly lower than that of germanium. However, the potential unavailability of the material (germanium is currently subject to severe export restrictions) and the significantly lower price compared to other options are strong arguments in favor of Mapsi windows in this wavelength range as well.

In summary, Mapsi BBARs are of high optical quality, ideally suited for corrosive environments, very cost-efficient, and have a much lower environmental footprint.

Need more reasons to try this innovative technology? Contact us. Don't miss the opportunity to improve your product!

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Optical Filters in the Fight Against Wildfires: Technological Solutions from Andover Corporation

Wildfires are among the most devastating natural disasters of our time. To detect them early, monitor their spread, and combat them effectively, advanced optical systems are playing an increasingly important role.

Andover Corporation, a specialist in precision filters and optical coatings, supplies key components for modern detection and monitoring technologies.

Early Warning Through Precision Filter Spectra

Andover's optical filters are integrated into infrared cameras, multispectral sensors, and remote sensing systems. They enable the selective detection of specific wavelength bands, enhancing the accuracy of identifying heat sources, smoke, and air pollutants. This results in faster and more reliable responses to emerging fires.

Applications in Wildfire Management

- Early Detection: Narrowband filters improve the identification of small ignition sources in ground-based, aerial, and satellite-supported systems.
- Fire Monitoring: Thermal sensing is enhanced by specialized coatings, enabling precise tracking of fire dynamics.
- Air Quality Analysis: Tailored filters support the measurement of smoke development and pollutant concentrations.
- Technology with Social Responsibility

At Andover Corporation, innovation means more than just technical advancement — it's also a commitment to protecting people and the environment. The company actively supports disaster response initiatives and research in wildfire prevention and expresses its deep appreciation for all first responders.

Conclusion

With its high-performance optical filters, Andover Corporation makes a vital contribution to the effective detection and management of wildfires. The combination of technical precision and social responsibility strengthens resilience against one of the greatest challenges posed by climate change.

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Solution-oriented, customer-focused and a team player

"As a product manager with extensive practical and technical experience, I really enjoy supporting our customers and finding the right solutions from our diverse range of light and laser products. As a team player, a supportive environment is particularly important to me - and that's exactly what I felt right from the start at QD! I am passionate about fulfilling our mission: to build and maintain long-term and satisfied customer relationships." *— Uwe Schmidt Produktmanager at Quantum Design Europe*

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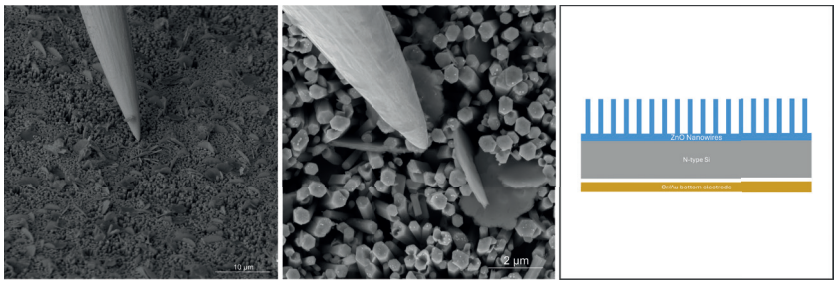
FusionScope & Kleindiek micromanipulators: Precise nano characterization

The growing demands on nanoanalysis require innovative methods for high-resolution, in situ, and multimodal characterization. The FusionScope, a combination of atomic force microscopy (AFM), scanning electron microscopy (SEM), and energy dispersive X-ray spectroscopy (EDX), enables comprehensive analysis of nanoscale materials. The integration of high-precision Kleindiek micromanipulators allows samples to be manipulated, electrically contacted, and precisely positioned—an ideal solution for applications such as nanowire characterization, electrical probing, and electrochemical investigations.

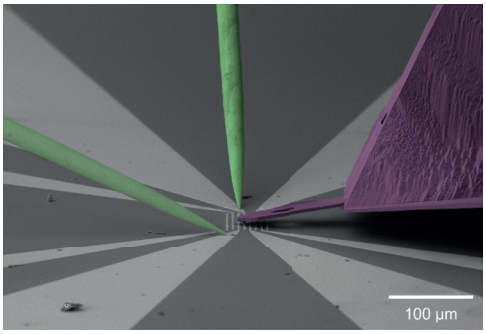
Innovative measurement options for nanowires

Nanowires play a key role in modern nanoelectronics. Their mechanical and electrical properties determine their suitability for use in components.

In an experiment, a free-standing ZnO nanowire was precisely placed and positioned under the AFM cantilever. The FusionScope Profile View option (80° tilt function) enabled precise adjustment of both the AFM and the manipulators on the sample surface



The electrical conductivity was determined using IV curves — the wire exhibited ohmic behavior with a resistance of 230 kΩ.

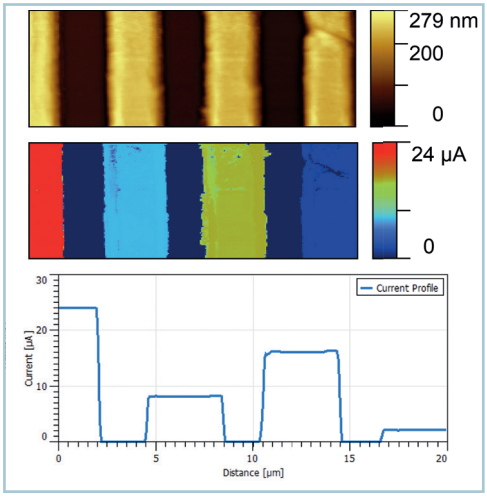


Combined electrical probing & EFM analyses

The parallel use of micromanipulators and AFM enables complex electrical measurements to be performed:

Targeted electrode contacting with two micromanipulators in a multi-electrode probe for simultaneous C-AFM measurement.

Electrostatic investigations (EFM) of an isolated gold area on a silicon sample showed clear contrasts between contacted and non-contacted areas.



Advantages of the FusionScope micromanipulator combination

- Multimodal analysis — AFM, SEM & EDX in one platform for comprehensive material characterization
- Nanometer precision — Controlled manipulation & exact placement
- High efficiency — Fast switching between mechanical, electrical & chemical measurement methods

The FusionScope in combination with Kleindiek micromanipulators offers unique possibilities for high-precision nanoanalysis — from the development of nanoelectronic components to the analysis of complex material properties.

Find out more! Scan the QR code for the application note or contact us directly.

Please contact us
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New X-Ray Tubes and X-Ray Detectors

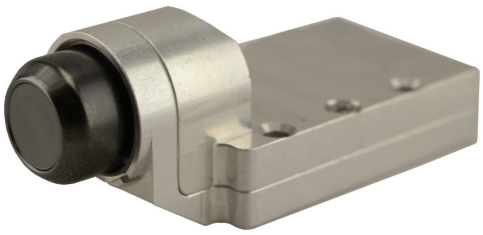
In 2019, we decided to expand our portfolio beyond Moxtek's wire grid polarizers to also include their X-ray products.

Since then, the range of X-ray sources, detectors, and windows has been continuously expanded.

X-Ray Tubes

The HPC series represents a new generation of air-cooled, high-performance X-ray tubes. They operate at tube voltages of up to 60 kV with a continuous power rating of up to 150 W.

The HPC150 (see image with power supply) is designed for both X-ray fluorescence (XRF) and imaging applications. Its forced-air cooling ensures efficient heat dissipation. These tubes feature additional elements such as integrated radiation shielding and vacuum sealing at the base. Their robust design ensures consistent performance and reliability even under harsh industrial conditions — for example, in recycling facilities.



SDD Detectors

The new SDD detector is a compact, cost-effective energy-dispersive X-ray fluorescence (EDXRF) detector.

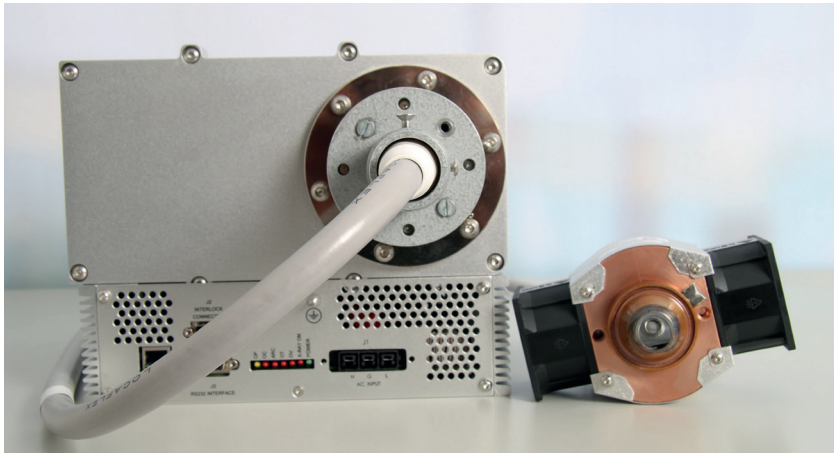
It combines a CUBE CMOS front-end with a powerful two-stage thermoelectric cooler (TEC) to deliver excellent resolution and high X-ray sensitivity.

The XPIN preamplifier provides a low-noise signal output to a digital pulse processor (DPP) or a shaping amplifier for high count rate applications. No external cooling is required.

This SDD package is ideal for benchtop and portable applications that do not require integrated temperature regulation.

We're happy to answer any questions you may have.

www.qd-europe.com



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Optical Filters – Standard and Custom AR Coating Solutions

Andover Corporation specializes in advanced anti-reflection (AR) coatings that enhance the performance of optical systems across a variety of industries. Our AR coatings reduce reflections and increase light transmission, ensuring optimal clarity and efficiency.

- Single-layer Magnesium Fluoride: For essential anti-reflective performance
- V-Coating: Optimized dual-layer coating for specific wavelengths
- W-Coating: Multi-layer coating for broader wavelength ranges
- High-efficiency AR Coatings: For applications in the UV, visible, and near-infrared regions
- Broadband (BBAR) Coatings: Wide-range coatings from UV up to 15 µm

Why choose AR coatings from Andover?

- High laser damage thresholds: Withstands pulses up to 85 J/cm² and beyond
- Advanced coating processes: State-of-the-art low-temperature methods for high-efficiency coatings on mounted optics and fibers
- Custom solutions: We provide AR coating services tailored to your specific needs—with no minimum order quantities and full scalability for high-volume production

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Always on the move: Our team at the 2025 Merck Company Run

With great energy, team spirit, and a healthy dose of fun, our team once again took part in the annual Merck Company Run in Darmstadt.

The route around the Merck Stadium at Böllenfalltor was tackled with athletic ambition and plenty of good vibes. The Merck Run is one of the sporting highlights of the year and once again offered a fantastic opportunity to get colleagues moving — beyond the usual office routine.

A big thank-you goes out to the Merck Group for the excellent organization of this event — and of course to all the runners and supporters who helped make this day such a special experience!

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Editor: Anne Kast

Please note that not all products are available in every country.