



Edition 40 | July 2023

QCM-D for Industrial Users Faced With Complex Challenges – QSense Omni

In recent years, the use of quartz crystal microbalances in scientific research labs has increased tremendously. Thanks to better availability of suitable sensors, applications for polymers, biological systems, lipid bilayers, electrochemistry and many other areas have become possible.

With QSense Omni, the new and enhanced instrument by the pioneers of QCM-D, this technology is now ready to support industrial users in solving the most complex problems. Omni is based on the proven QSense technology that has helped to develop a deeper understanding of molecular interactions

at surfaces for decades. Of course, Omni offers frequency and dissipation measurement at seven-harmonics, as used from QSense systems.

Omni combines the ability to increase the sensitivity of the QCM-D with clever automation of the measurement – from installation of the sensor to evaluation of the data. This allows measurements to be performed quickly and reliably and with little manual effort.



reddot winner 2023
industrial design

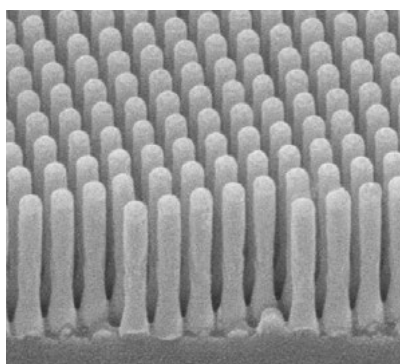


Omni's sample feeder is designed in such a way that the sample containers are placed directly above the sensor. The distances

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Metasurfaces and Metalenses

Lenses are widely used as a basic optical element in everyday life. They are used in cameras, eyeglasses, microscopes and many other devices. In this context, the lenses



Beam shaping/collimation (Metalens)

are developed on the basis of classical refractive optics, which leads to unavoidable imaging errors such as chromatic and spherical aberration and coma. To minimise these errors, conventional imaging systems usually use multiple lenses with different powers and different materials.

Metasurfaces and metalenses offer high potential as substitutes for many classical optical components. They are a fundamentally new method of light manipulation that is based on scattering in nanostructures instead of conventional

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» to the sensor are very short, thus providing for well-defined change-over between samples. Cross-contamination or mixing between the individual measurement steps is largely eliminated.

The hardware has been designed and optimised so as to provide a very low-noise signal (4x better than the QSense analyser) for a significantly improved detection limit. Thanks to the high degree of sensor handling automation, a reproducibility of the frequency value of ± 2 Hz can be achieved at installation, thus further improving the use of externally coated sensors.



One consideration in developing Omni was to make sure that the system can be used with as many media (aqueous or organic) as possible to enable a broad range of applications.

QSense Omni can be connected to the external platform QSense Orbit, that can be used with all known QSense combination modules (e.g. the QEM401 electrochemistry module, the QWM401 window module or the QOM401 open module) and also benefits from the improved Omni electronics and the autosampler.

The QSense Omni measurement software controls the measurement and the autosampler. The measurement steps are defined by simple drag & drop handling. These steps may also be changed during the measurement and, as a matter of course, the script can be saved as a template.

Finally, we would like to provide you with some interesting technical details:

The temperature range is 4-70°C with a stability of $\ll 0.01$ K, which means excellent long-term stability of the measurement.



Omni can be fitted with 1-4 measurement channels (upgrade is possible), with each of these channels having a measurement rate of 300 Hz.

An online demo of QSense Omni may be arranged at any time.

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Product Training – finally live again!

After a long break due to the Corona pandemic, the product training finally took place again in April on our premises in Darmstadt. The last trainings, where we could exchange



news, the latest products and even private things with all employees of our European offices, unfortunately took place exclusively online during the last 3 years. Despite the possibility of virtual exchange, it was a great feeling for all of us to finally see everyone live again and to be able to talk to each other in person.

During the individual sessions and the dinner afterwards, we were able to talk animatedly, clarify open questions, coordinate and plan upcoming projects or inform ourselves about new products. It was just great to fi-

nally be in direct contact with each other again after such a long time.

All in all, the product training was a great experience that not only provided us with new knowledge, but also strengthened our bond with each other. We are already looking forward to the next training.

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Metasurfaces and Metalenses

» refraction, thus allowing efficient phase, polarisation and emission control.

They are able to precisely influence the wavefront of light, thereby producing impressive optical phenomena. Moreover, they are usually significantly smaller and less expensive than conventional solutions. With multidimensional metasurfaces, novel functions can be achieved that are difficult or impossible to achieve with conventional lenses.

Our partner Moxtek has been producing nanostructured optical components for over 20 years, with high-volume manufacturing capabilities for the most different structures on Ø200mm wafers.

The range offered includes the production of functional nanostructures such as microlens arrays, waveguides, patterned metasurfaces, diffractive optical elements (DOE), photonic crys-



tals and biosensor arrays. These components for imaging, illumination and display systems are used for a variety of applications, including automotive, medical and dental imaging, camera systems and many others.

Prototyping samples can be created based on our own in-house developed design master shuttle. This NIL (NanoImprint Lithography) design master shuttle provides space for multiple (different) design structures,

allowing multiple designs to be tested in a single shuttle iteration. This dramatically reduces development time and cost. These design shuttles are created several times a year.

We will be happy to discuss your metalens or optical nanostructure needs. Feel free to contact us any time

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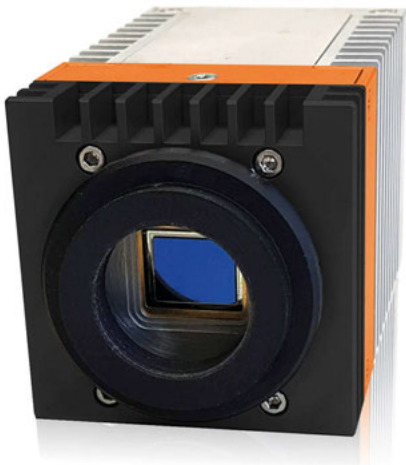
New NIR Camera from Xenics with High Sensitivity and Low Noise

With its new InGaAs camera, Xenics, as a manufacturer of detectors and cameras, responds to the needs of our customers. Wildcat+ 640 features Xenics' in-house developed and pro-

duced 640 x 512 pixel, 20 µm pixel pitch InGaAs sensor. This detector offers particularly high sensitivity with low noise, thus allowing for much shorter integration times or less extraneous light. Thanks to this detector with a readout noise of less than 45 electrons and a high full-well, a high dynamic range of up to almost 70 dB is achieved. For camera control and data output, either a CameraLink may be used or a USB3 vision interface. Wildcat+ 640 is compatible with GenICam, which provides for easy integration. The Wildcat+ 640 series offers a high frame rate. Full frame rates of 300 fps can be achieved. In the windowing mode, in which the number of pixels read out can be reduced, the camera even

achieves readout rates of more than 7000 frames per second.

For versatile use in research, the Wildcat+ 640 operates in two readout modes: "integrate while read (IWR)" and "Integrate then read (ITR)". In addition, the camera is equipped with 2 trigger inputs and 2 trigger outputs for optimised use in experiments or industrial processes.



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FusionScope project meeting

In December Quantum Design US hosted a FusionScope project meeting at the QD headquarters in San Diego. Included were visitors from QD Germany and QD Microscopy, along with the sales, marketing, and R&D teams from San Diego.

The first day was used to discuss the FusionScope launch that took place back in September including the first three conferences at which we exhibited the FusionScope.



On the following days, the R&D lab and production site of the FusionScope were toured, which was a great opportunity for the QDM development team to experience first hand how their US counterpart operates.

The tour was followed by an extensive discussion on next steps in

terms of project development and upcoming technology milestones.

We cannot wait to share these new FusionScope features with you in the next months.

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Cryogenic temperature measurement – sensor installation techniques for success

Lakeshore Cryotronics is well known for their low-temperature measurement products, like the Cernox sensors and the model 336 temperature controllers. If you are new to this world or simply want to see our experts install a sensor in a cryogenic application, please follow the link below. It conleads to tains the recording of a webinar on the correct installation of a sensor in a cryogenic application and on how to avoid common installation errors, all presented by Lakeshore scientist Scott Courts.

The Webinar topics include:

- Considerations for choosing a sensor (including resistance to magnetic fields, ionizing radiation, UHV, and others)



- The role of packaging and adapters for shielding, mounting, stability, and optimal thermal contact
- Considerations for sensor installation (placement, mounting method, materials, electrical connections, heat sinking, thermal contact medium, etc.)
- A look at the choices for fastening materials, wire leads, thermal mediums and adhesives

The webinar can be found at the following link: bit.ly/3wWRE1V

If you have a special application and would like support in selecting the right sensor, please do not hesitate to get in touch with us.

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DENSsolutions celebrate their 10th anniversary

There is no need to introduce supplier of high-end in situ TEM systems DENSsolutions electron microscopists around the world. In the market of MEMS-based, ultra-stable in situ TEM systems, they are one of the few big players. For years, they have been awarded regularly for their high quality products and innovations, the last award being the MSA Microscopy Today Innovation Award 2021. We are the proud



sales and support partner for Germany, Austria, Switzerland, UK and Italy and are send a heartfelt Happy Anniversary.

Well-known for their innovative spirit, DENSsolutions not only threw parties in their home regions Delft and Rotterdam, but also invented a unique drink: A handmade gin made from 10 selected ingredients forms the basis, which is mixed with tonic water, ice and a thin slice of cucumber to finally become

The GIN Situ!

The image of an atomically resolved gold nanoparticle at 1000 °C



adorns the bottle label. This image is one of the first to have been taken with the DENSsolution in situ sample holder Wildfire about 10 years ago. It gives a great impression of the ultra stable performance of their systems. The positions of the gold atoms on the label have been overcoated with gold foil so that the microscopic world becomes macroscopically tangible. A dignified gift — We say thank you!

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May I introduce myself?

My name is Miriam Wendel. I have been part of the accounting team at Quantum Design since November 2020. Previously, after training as a hotel manageress, I worked for many years as a receptionist for various large hotel chains and, after parental leave with my twins, spent some time in the order processing department of a measuring equipment manufacturer. After work, I like to spend my time at the riding stable, where I have had a

riding partner for several years. Otherwise, I enjoy relaxing with yoga, reading a book in the garden, or being out and about with the family. At the beginning of the year, I successfully completed my part-time further education to become a certified financial accountant. In addition to the day-to-day business of Quantum Design, which we take care of as a team, I am also responsible for the accounting of Quantum Design Microscopy. I also handle

the intercompany reconciliation between the European subsidiaries and our parent in the US and process travel expenses. I am happy to be a part of this great team and look forward to what the future will bring.



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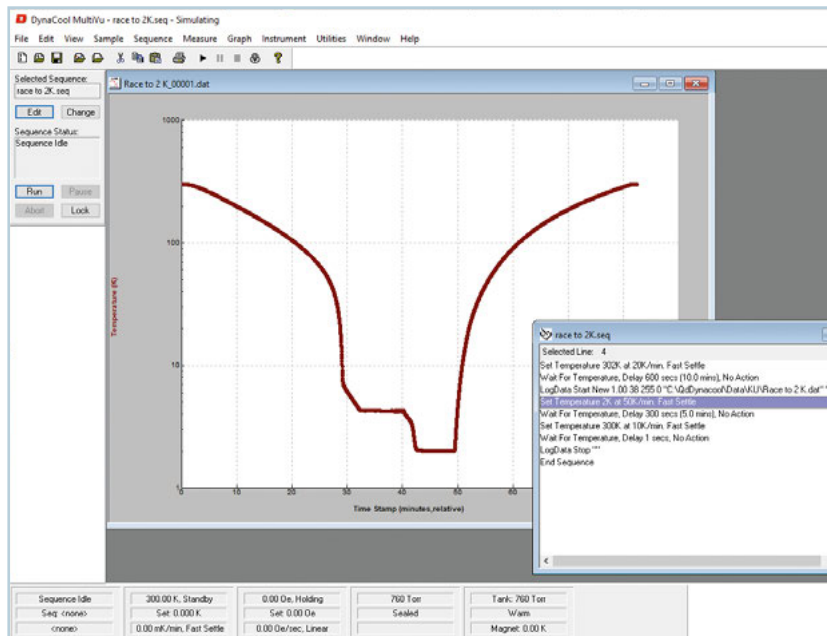
Counting down to 2 Kelvin – the clock is ticking...

This article depicts the fastest way to reach a sample temperature of 2 K or -271°C with the Quantum Design DynaCool. We start at 302 K, which is about normal ambient temperature. The DynaCool, or, more precisely, the PPMS-DynaCool, is a system for measuring physical properties at high magnetic fields and low temperatures. Depending on the available options, measured parameters can be magnetic, electric or thermal behavior. The system is operated by a sequence in the professional Windows software, where the user can manu-

ally determine the order of the executable commands. Coding knowledge is not necessary. The sequence is shown in the figure.

This is how we proceed: We start a logfile for the data that interests us and, above all, the temperature and temperature status. After that, DynaCool starts controlling the temperature. The maximum possible value is 50 K/min, which we do not fully achieve. Our highest speed is around 30 K/min. After approx. 29 minutes, we fall below a sample temperature

of 10 K, which means we have operated at an average speed of about 10 Kelvin per minute. Once the temperature drops below 10 K, the DynaCool temp control automatically switches the cooling mode to the so-called "Low Temperature Flow". The system's cooling is now slower, but cooler. To achieve this, the system software changes the flow rate or the two capillaries which are the core of the temperature control. Below 10 Kelvin, the base temperature of 1.85 K must be reached and stabilized. The system can remain at 1.85 K for an unlimited period of time.



With 2 Kelvin, our goal is a bit higher. All in all, it hasn't even taken 45 minutes to reach 2 Kelvin. The temperature stabilizes quickly. No variations, no oscillations and the noise stays in the milli-Kelvin range. The full temperature curve is depicted in the figure. The temperature is plotted on a logarithmic scale.

According to our sequence, DynaCool stays at 2 Kelvin for 5 minutes and then heats up to 300 Kelvin again.

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Model 372 – Resistance Bridge and Temperature Controller

The video link below give a detailed insight into the Lakeshore resistance bridge and temperature controller model 372. In the video, Senior Product Manager Ryan Oliver

discusses the features and functionality of the instrument, including the Model 372's powerful impedance measurement capabilities such as quadrature measurements and

its patented noise-rejection technology.

The ability to increase the number of measurement channels

to a maximum of 16 with the optional 3726 scanner is also highlighted.

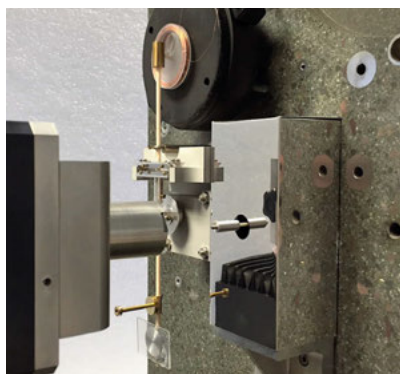
<http://bit.ly/3X9WrYA>



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Dynamic Mechanical Compliance Testing (DMCT) for depth profiling and viscoelastic properties

MicroMaterials have developed a new loading head for dynamic compliance testing. This new module allows measurements of depth profiles and viscoelastic properties. In conventional indentation, the load on the indenter is increased continuously to a maximum value before being reduced to produce an unloading Depth vs. Load curve. A single value of contact stiffness can be derived from this curve.



Standard load head on the left, DMCT load head on the right

In DMCT, a sinusoidal signal is superimposed on the load ramp such that, in effect, multiple nano unloading steps may be observed during the loading phase. The final unloading curve is not utilized for this measurement. The behavior of the oscillating indenter is

described by a forced harmonic motion model. A calibration procedure characterizes the system properties: damping, spring stiffness, and mass of the loading head. These system characteristics, together with measured values of oscillation amplitude for a given oscillatory force or displacement allow the determination of contact stiffness

By monitoring the phase difference between the applied oscillatory force and the resulting indenter displacement, it is also possible to measure the storage and loss moduli of polymers. In the DMCT module, Micro Materials have developed an improved approach using an additional 0-500 mN loading head with software and hardware features enabling a greater control of oscillation parameters which produce more reliable data.

The DMCT module can be used for:

- Depth profiling of the mechanical properties like hardness, elastic modulus, H/E, contact stiffness.
- Viscoelastic property measurements (storage modulus, loss modulus, tan delta) at chosen frequencies and test temperatures.

Important new developments include:

- A novel procedure (patent pending) for optimizing indenter oscillation control at low loads.
- An option for non-constant oscillation amplitude, where the oscillation force varies with load to achieve a fixed oscillation depth and therefore elastic modulus measurements on metallic materials.
- A new head design with the option of variable damping for optimized polymer analysis. The new loading head is again horizontal and maintains a significant advantage for high temperature testing.

Click here <http://bit.ly/3YKsgZw> for 3 case studies on the various options enabled by the DMCT-module: metallic materials, thin films, and viscoelastic nanocomposites.

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Quantum Design's FusionScope at Conferences and Trade Shows Worldwide

In September 2022, Quantum Design's latest product FusionScope was presented to the public at the Micros and Nano Engineering (MNE) Eurosensors in Leuven.

FusionScope is an easy-to-use correlative microscope designed from the ground up to combine the benefits of SEM imaging with a wide range of AFM measure-

ment techniques. MNE is one of the largest international conferences on micro and nano fabrication and applications. The FusionScope was met with great interest and we discussed how it can benefit their research. Following that, visitors of the MS&T conference in Pittsburgh, the MRS conference in Boston and the Advan-

ced Materials Show in Birmingham had the opportunity to experience for themselves the unique capabilities of our FusionScope.

See you next time

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Janis cryostats

More than two years ago, Janis Research has become part of Lake Shore. Since then, Lake Shore Cryotronics has merged the portfolios to offer comprehensive cryostat solutions for a broad range of applications.

One major development has been the integration of calibrated temperature sensors in the cryostats so that they now feature the advantages of calibrated silicon diodes and Cernox sensors as standard. Lake Shore temperature controllers thus offer perfect temperature control.

The Lake Shore cryostat portfolio comprises a range of types from simple liquid nitrogen models like the VPF-100 for temperatures from 70 to 500 Kelvin to superconducting magnetic systems like the DryMag with a magnetic field of up to 12 T and sample temperatures of 1.5 - 700 K. The larger measurement platforms with magnet also use Lake Shore's proprietary Measu-

reLINK software. This way, measurement routines can be created for each user in a tree structure, using drag-and-drop or scripting.

Cryostats are available for a wide variety of applications. To select the right system, it is good to answer a few questions up front:

- What type of cooling do you want to use: An open system, cooled with liquid helium or nitrogen? A closed cycle?
- Which temperature interval is to be covered by the cryostat?
- Which vibration level is necessary?
- Which atmosphere will the sample be in - vacuum or replacement gas?
- How fast do samples need to be exchanged?
- Is a compact design required? For example for microscopic applications?
- Will the cryostat be placed in a magnet?
- Are electrical feedthroughs or cables needed?



Check out our website for an overview of our standard cryostats: www.qd-europe.com.

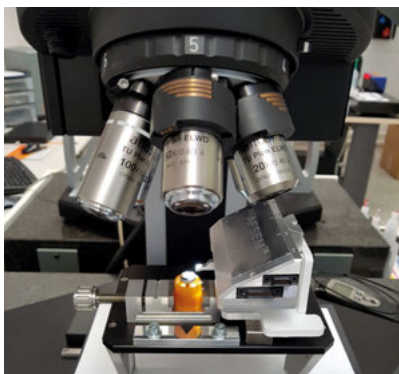
If you cannot find the right cryostat for your particular application, please contact us! Together with Janis, we will build a customized solution.

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		Measurement advantages					Typical measurements				
		Simultaneous source and measurement	Synchronous source and measurement	Low noise in source and measurement	Dual AC/DC source	Lock-In Autoranging	Differential conductivity, low frequencies	Differential conductivity, high frequency	Resistance, low temperature	I-V Characteristics	Thermal conductivity
Thermal transport	1D materials, thermoelastic materials	x	x				x				x
Materials Research	Nano devices, superconducting devices, non-linear devices			x			x	x	x	x	
Material development	Linear systems, sensors			x					x	x	

New Publication by AFSEM user Wood K Plus

The Austrian Kompetenzzentrum Holz GmbH is one of the leading research institutes in the area of wood and wood-related renewable resources in Europe. Its research covers a wide range of fields from the development of high-performance materials made from wood fibers and natural fibers to process technology along the complete value chain — from raw material to “green composites” to finished products. This requires top expertise comprising



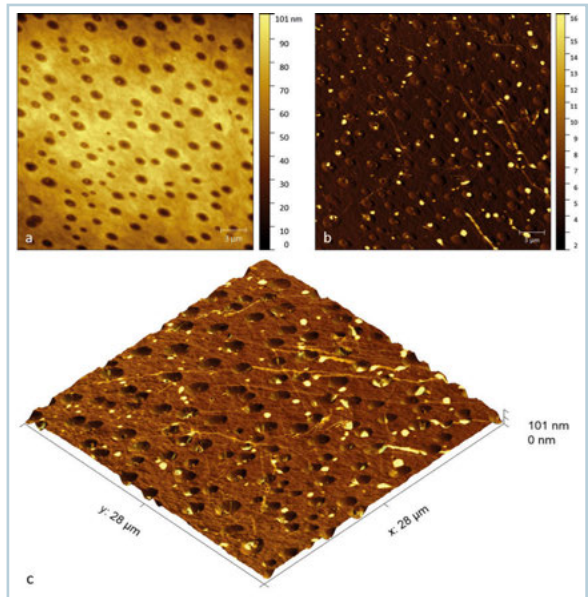
especially the microscopic and macroscopic characterization of wood and fiber structures as well as latest technologies for stability investigations at macro-, micro- and nanoscale.

These scientific challenges were the reason for Wood K plus to add AFSEM, the in-situ correlative AFM by Quantum Design to their research lab.

There AFSEM is combined with a Keyence VHX 5000 optical microscope. The complementary strengths of both instruments support the research team in gaining completely new insights to their current scientific work.

Following the installation, Wood K plus focused on AFSEM characterization of self-healing surfaces based on melamine resins. Thanks to the high resolution of the optical microscope, it was easy to position the cantilever tip precisely at the area of interest. The AFM was the method of choice to show melamine particles embedded in the polymer that is not visible in the topography. The phase signal AFSEM provides was used for detection of material contrast (see figure 1). The light regions can be interpreted as hard material like melamine particles embedded in ‘soft’ polymer.

Most recently, the research team of Wood K Plus used their AFSEM system to observe quality metrics such as surface stain and scuff resistance



at the cross-section of wood-based materials. The obtained AFM data supported them in the further development of sample preparation techniques to better analyze the chemical and physical characteristics.

They published their research results in an article in the Journal of Microscopy, Volume 289, Issue 2, February 2023.

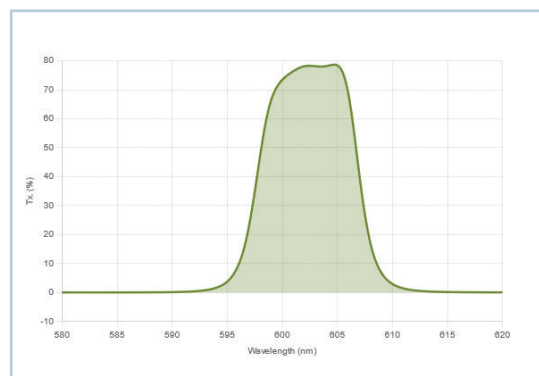
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Web Portal for Inquiries for Andover Bandpass Filters

Andover offers a wide range of standard bandpass filters. To make it easier for you to select the right filter, we have set up a web portal. Here, you can see all filters in a clear layout. To automatically narrow the selection of filters shown, users can choose the specifications they are looking for. In the detailed view, you can see all specifications at a glance, together with the individual filter curves.

Thus, you can find the right filter with just a few clicks. Our automatic inquiry system will immediately forward your selection to the corresponding staff. We will then contact you and give you a quote.

Please contact us
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Andor Launches New Version of its Popular Zyla sCMOS Camera

With ZL41 Wave sCMOS, Andor Technology presents the successor to its popular Zyla sCMOS camera. The latest model of the small sCMOS cameras from Belfast is more robust and powerful than ever before. Particular attention has been paid to a new design of the sensor chamber, which provides for longer service life with minimal service requirements.

With a quantum efficiency of up to 82% and a readout noise of $<1e^-$, up to 100 full frames per second - as before - can be achieved with both sensor variants of the ZL41 Wave.

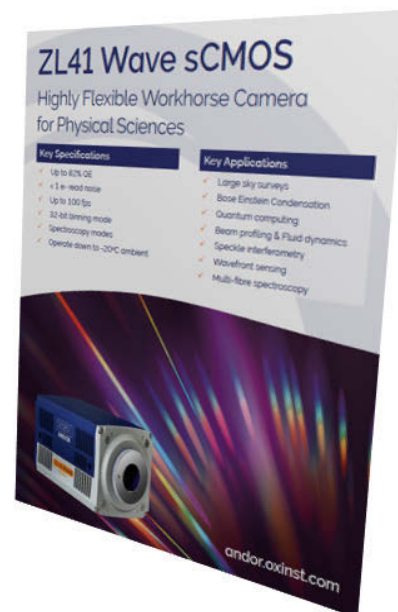


Another innovation is the spectroscopy mode, which is now a standard feature, working with a data

depth of up to 32 bits. Optimised quality control processes lead to improved image quality.

One application example for which the ZL41 Wave is the ideal choice is that of large sky surveys. In this field, large arrays of low-cost, high-performance ZL41 Wave cameras are used to continuously and quantitatively monitor huge sections of the night sky, looking for photometric or astrometric changes or occultations across a range of time-resolutions. Occultation in this context refers to the passing of a seemingly larger celestial body in front of another one. Whether used to detect Near-Earth Objects (NEO), track orbital debris or look for exoplanets, ZL41 Wave 4.2 provides for highest sensitivity and facilitates detection of smaller objects or occultations. Alternatively, the model ZL41 Wave 5.5 features a true global shutter, which may be important when tracking moving objects relative to a reference background of stars.

With SDK wrappers for Python, LabVIEW, MATLAB and other programming languages, as well as

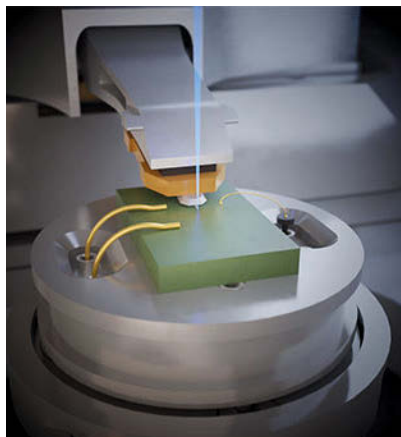


compatibility with ASCOM, EPICS and TANGO-LIMA open-source physics platforms, Andor Technology offers its usual broad software support on Windows and Linux.

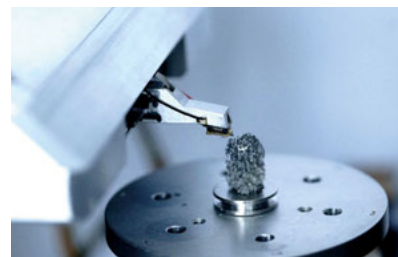
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Do you have difficult AFM and SEM samples?

Our FusionScope provides you with a completely new analysis system in the field of atomic force



microscopy (AFM) and electron microscopy (SEM). With its correlative approach, the FusionScope offers completely new possibilities for both types of microscopy and can, in some circumstances, make the difference for samples that are difficult to measure. Do you have AFM samples that are difficult or impossible to measure with a conventional AFM because of their geometry? Or SEM samples of which you would like to know the local topography or the mechanical, electrical or magnetic properties in detail? Then please contact us. We are al-



ways looking for difficult samples and would be pleased to possibly offer you a solution.

Please contact us
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Thanks to Sample Space, OptiCool Can Be Expanded to Feature a High Magnetic Field Sample Station

When it comes to experiments requiring low temperatures, high magnetic fields and low vibrations, the range of cryostats that can be used is not exactly huge. If, moreover, a large sample area is required, the only available choice is OptiCool.

OptiCool is a powerful optical cryostat that can be directly mounted on an optical table. Instead of the usual superconducting solenoid, it features a 7 Tesla split-coil magnet. This allows optical access both through a top window and several side win-



dows and provides for a generous, free sample space with a diameter of 89 mm.

Common cryogenic sample stations offer a field strength of just up to 3 Tesla and limited optical access. The OptiCool sample space is large enough to accommodate four XYZ positioning systems and a stationary sample holder. Thus, it can easily be expanded to provide an automated sample station with 7 Tesla field strength. The low vibration level of only 10 nm (peak-to-peak) ensures that the measurement tips do not lose contact with the sample. The contact pressure of a commercially available cryogenic positioner is significantly lower than that of a manual arm as used in cryogenic sample stations.

Usually, the measuring tips of a sample station are cooled, but are still warmer than the sample. This causes the sample to be heated by the tips during measurement. In the Opti-



Cool, the positioners and thus the measuring tips have the same temperature as the sample holder.

Usually, the camera of a sample station can only show the position of the measuring tips. In the OptiCool, the working distance to the sample is significantly shorter than in solenoid magnets, so that a lens with a short working distance and high NA can be installed. Thus, combined optical and electrical measurements may be performed in addition to optical excitation. A corresponding setup was recently installed at Fraunhofer IPMS in Dresden.

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Merck company run 2023 – we were there again

This year we participated again as a team in the Merck company run. After 4500 participants were at the start last year due to corona, this year 5798 runners crossed the finish line after a distance of between approx. 3 and 10 km. Due to the higher number of participants and the partly very narrow course around the Böllenfalltor in Darmstadt, the pace was slow at the beginning and the-



re were also some small traffic jams along the course. Of course, this did not stop us from being motivated to keep going. We all made it to the finish line and are proud to have been there again. After the run, we could



strengthen ourselves with food and drink at the Merck Stadium and were able to round off the successful day.

As always, it was fun to accomplish something as a team.

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Team building and more

In May, our company trip took place at the beautiful Seehotel in Niedernberg. The trip offered a packed two-day program that provided a diverse experience for all participants. On the first day after our arrival, we attended seminars on "Efficient Stress Management" and "International Project Work". Both seminars offered the opportunity for optimization and self-reflection, which was very valuable for our professional growth. After the seminars, we were able to end the day with a cozy dinner, where we could relax and share our impressions of the day. The dinner also gave us the opportunity to exchange ideas with colleagues and make new contacts. On the second day, the focus was on team building. Small teams were given the challenge of solving puzzles in a so-called "black box". This not only promoted team spirit, but also the creative problem-

solving ability of each individual. After successfully completing the tasks, we headed to the marketplace in Großostheim, from where we took a hike to the Höflich winery. During the hike, we were entertained by Mr. Hartmut Hasenkopf



with interesting stories about the area. This not only offered us a pleasant change of pace, but also created a relaxed atmosphere in which we could exchange ideas with our colleagues. In addition, we were treated to light snacks and refreshments to keep our energies up. As a crowning finale, we were invited to a final dinner at the Höflich winery. This evening gave us the opportunity to review the experiences and memories of our company trip. It was a great time that we greatly appreciate and are grateful for. The company trip allowed us to develop personally and professionally, strengthen team spirit and build valuable relationships with our colleagues.



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