Review of Scientific Instruments

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AFFILIATIONS

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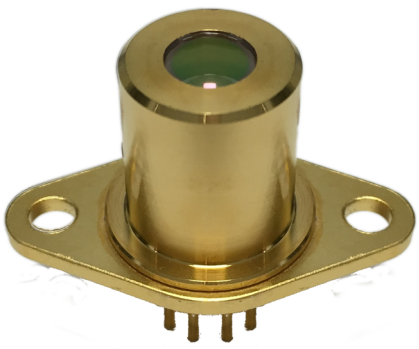
In order to supplement manufacturers' information, this department will welcome the submission by our readers of brief communications reporting measurements on the physical properties of materials which supersede earlier data or suggest new research applications.

NEW INSTRUMENTS AND COMPONENTS

Short wave infrared (IR) laser diodes

Short wave IR (SWIR) laser diodes from Alpes Lasers are continuous-wave, multiple-longitudinal-mode Fabry–Perot devices that emit light over a bandwidth of approximately 20 nm with output power up to 50 mW. They are either offered as chip-on-carrier or encapsulated in a low-power TO-66 package with collimated or divergent free-space beam output. Alpes SWIR laser diodes are based on indium phosphide technology. The emission can be tailored in the 1.45–2.2 μm range. Available wavelengths include the absorption bands of N_2O, H_2O, CH_4, and HCl. Other wavelengths can be developed on request. The diodes feature low dissipation, high beam quality, and a small footprint. Applications include beacons, IR illumination, and sensing gases such as water vapor. *Alpes Lasers SA, Avenue des Pâquiers 1, CH-2072 St-Blaise, Switzerland. (+41 32 729 95 10)* http://www.alpeslasers.ch



Scanning probe microscopes

Bruker's Dimension XR family of scanning probe microscopes (SPMs) incorporates major advances in atomic force microscope (AFM) technology for nanoscale quantification in air, fluid, electrical, and chemically reactive environments. The microscopes are built on the company's Icon and FastScan AFM platforms and are available in three configurations optimized for nanomechanics, nanoelectrical, and nanoelectrochemical applications. The Dimension XR nanomechanics configuration combines the new AFM-nanodynamic mechanical analysis (nDMA) mode, which correlates polymer nanomechanics to bulk DMA; PeakForce quantitative nanomechanical property mapping; and FASTForce volume and volume contact resonance modes. It rapidly and quantitatively characterizes materials for their nanomechanical properties. The nanoelectrical configuration includes Bruker's proprietary DataCube mode and its PeakForce tunneling AFM and Kelvin probe force microscopy modes. The company claims it offers the most complete array of electrical AFM techniques available on a single system. The NanoEC configuration for energy research uses Bruker's nanoelectrode probes with EC-AFM and PeakForce scanning EC microscopy modes to perform *in situ* topography scans in the electrochemical environment. It provides a turnkey solution for real-time quantitative analysis of nanoscale local reactivity. *Bruker Nano Surfaces, 3400 East Britannia Drive, Suite 150, Tucson, Arizona 85706. (520-741-1044)* https://www.bruker.com

High-compression turbopumps

Pfeiffer Vacuum has launched its very-high-compression HiPace 700 H turbopumps, which generate high and ultrahigh vacuum for research, analysis,

and industrial applications. Their compression ratio for light gases such as hydrogen is $\geq 2 \times 10^7$. Due to the high compression ratio, a low residual gas spectrum—desirable for certain mass spectrometry applications—is created in the chamber. Advanced rotor design enables an exceptionally high critical backing pressure capability of 22 hPa, which allows the pumps to reach ultrahigh vacuum even when operating with high backing pressures that occur in combination with diaphragm pumps. The HiPace H's intermittent-mode function turns on a connected backing pump if the backing pressure is insufficient. This reduces the system's energy consumption by up to 90%, without loss of performance. The turbopumps are equipped with a robust hybrid bearing that combines a ceramic ball bearing on the fore-vacuum side with a permanent-magnet radial bearing. The bearing concept contributes to the pumps' long service life with a service interval of more than four years. *Pfeiffer Vacuum, Inc., 24 Trafalgar Square, Nashua, New Hampshire 03063-1988. (800-248-8254 or 603-578-6500)* http://www.pfeiffer-vacuum.com

Cryogenic temperature controller

The model 26C cryogenic temperature controller from Cryogenic Control Systems combines the wide-temperature-measurement range of model 24C with the high-output-power control loops of the original model 26C. With an appropriate sensor, model 26C operates from 100 mK to over 1500 K. Four inputs and four independent control loops provide a total output power of 150 W. Each of the four multipurpose input channels is enhanced with the negative-temperature-coefficient resistance sensors commonly used at ultralow temperature. The controller also supports general-purpose devices such as diodes and platinum resistance-temperature detectors. Thermocouple inputs can be installed in the field. The model 26C features two large 10-A dry-contact relays, and fail-safe cryostat protection prevents damage to equipment. Data logging is performed by continuous recording to an internal 1000-entry buffer. Data are time-stamped, and nonvolatile memory is used to ensure that data will survive a power failure. Applications include use in helium-3 refrigerators, probe stations, superconducting magnets, oven-based systems, and large cryocoolers. According to the company, proprietary cryocooler thermal signature removal offers the best control stability available for cryocooler-based systems. *Cryogenic Control Systems, Inc., 17279 La Brisa, Rancho Santa Fe, California 92067. (858-756-3900)* https://www.cryocon.com

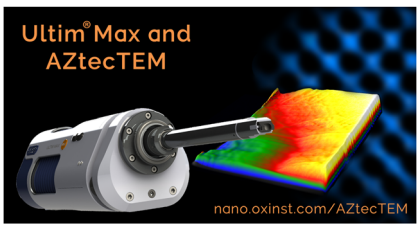
Rugged accelerometer

Ametek Programmable Power has brought to market its latest VTI Instruments integrated electronics piezoelectric (IEPE) accelerometer/voltage product. The 24-channel model RX0424 provides high accuracy for programmable data acquisition rates of up to 204.8 kSa/s. Multiple input ranges combine with independent 24-bit analog-to-digital converters for repeatable, high-resolution measurements to ensure users capture all vibration events, large or small. The device is suitable for measuring acceleration forces, such as sensing static and/or dynamic movements. It delivers repeatable laboratory-grade measurements, with fully integrated IEPE current excitation and tachometer input channels to enhance its utility and functionality. Users can program the IEPE current excitation sources to generate either 4.5 mA or 10 mA drive current and can tailor the sources to specific application demands. Built-in self-test diagnostics improve user test confidence by offering closed-loop, end-to-end self-calibration and access to the device's memory and internal temperature information. The RX0424 can be used in virtually any environment. It is rated to IP66 for protection against dust, spills, humidity, and water jets. The compact, lightweight design leverages thermal conduction cooling techniques to dissipate heat without using a fan, enabling extended operating temperatures of −20 °C to +60 °C. Users can easily distribute multiple instruments around the test article to reduce analog cabling and noise errors. Shorter, more manageable transducer cable runs reduce setup and maintenance time. The RX0424 achieves data correlation by using industry-standard IEEE-1588 synchronization and timestamp methodology. Ametek's EXLab software streamlines configuration, data visualization, and analysis. Its open-source, industry-standard drivers and programming interfaces allow for a flexible selection of the application programming environment best suited to a given application. *Ametek Programmable Power, Inc., 9250 Brown Deer Road, San Diego, California 92121. (800-733-5427 or 858-450-0085)* https://www.powerandtest.com

NEW DETECTORS, MEASUREMENTS, AND MATERIALS

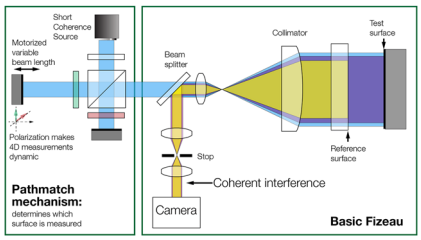
Microscope for elemental analysis

Oxford Instruments developed its AZtecTEM with Ultim Max technology to offer new capability and increased productivity for elemental analysis in areas such as biology, advanced materials, and *in situ* chemistry. It achieves high performance through the use of energy-dispersive x-ray spectroscopy (EDS) on the transmission electron microscope (TEM). According to the company, the Ultim Max detectors deliver a threefold increase in sensitivity compared with previous-generation silicon drift detectors and a fourfold increase in speed. With that high sensitivity and speed, AZtecLive EDS analysis software can be used in a TEM. AZtecLive combines live x-ray maps, electron images, and x-ray spectra and allows real-time feedback of chemistry changes in specimens exposed to heat, liquids, gases, and electrical fields. It quantifies elemental composition by mass thickness and delivers accurate quantification across the entire range of specimens analyzed in a TEM. Users can measure the thickness of specimens using EDS alone. *Oxford Instruments Nanoanalysis, Halifax Road, High Wycombe HP12 3SE, United Kingdom. (+44 (0)1494 442255)* https://nano.oxinst.com



Fizeau interferometer for optical metrology

The AccuFiz Fizeau interferometer from 4D Technology, a Nanometrics business unit, offers the flexibility of a Fizeau interferometer; the ability to measure optics in vibrating, turbulent, or uncoupled environments; and on-axis alignment. According to the company, the interferometer can increase accuracy in a dynamic, single-frame phase-shifted acquisition. Data acquisition can be performed in as little as 33 μs using 4D Technology's dynamic metrology technique. The technique eliminates the need for vibration isolation or coupling, so the interferometer can measure in turbulence and in controlled environments such as cryogenic and vacuum chambers used for testing space-based optics. Dynamic metrology also allows for a lightweight mainframe, which reduces the costs and logistics of mounting on gantry towers and gimbal alignment systems. The innovation of the AccuFiz on-axis dynamic Fizeau interferometer is that, besides its other advantages, the system now offers on-axis paths. It therefore reduces the risk of retrace errors that can be present in off-axis Fizeau systems. In addition, since it has a short-coherence source, the interferometer can measure plane-parallel optical systems. The new AccuFiz is suitable for measuring flat optics, thin or wedge-free flat optics, and spherical optics, providing users with flexibility of application. *4D Technology Corporation, 3280 East Hemisphere Loop, Suite 146, Tucson, Arizona 85706-5039. (855-712-7737)* https://www.4dtechnology.com



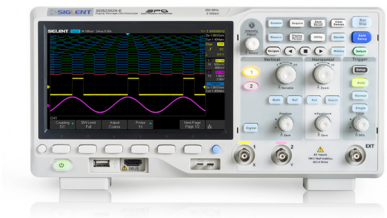
Near-IR source characterization

Radiant Vision Systems has released an intensity lens for measuring the near-IR light-emitting diode and laser sources used in nonvisible three-dimensional (3D) sensing applications such as facial recognition and eye tracking. According to the company, the new lens is the first commercially available Fourier optic for near-IR measurement. Compared with traditional light-measurement methods such as goniometric systems, it has the potential to reduce the time and complexity and improve the accuracy of comprehensive near-IR source characterization. The system is mounted to a Radiant ProMetric Y16 imaging radiometer. It uses Fourier conoscopic optics to map each emission angle from a near-IR light source onto the imaging system's charge-coupled device to capture a 2D polar plot of the angular distribution. This is used to evaluate the complete scope of near-IR emissions for inconsistencies in radiant intensity, power, and radiant flux across 3D space. The system measures wavelengths from 930 nm to 950 nm and captures accurate radiometric values to ±70° with approximately 0.05°-pixel resolution at every point measured. *Radiant Vision Systems LLC, 18640 Northeast 67th Court, Redmond, Washington 98052. (425-844-0152)* https://www.radiantvisionsystems.com

Super phosphor oscilloscopes

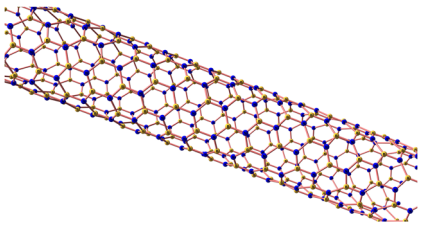
SDS2000X-E series oscilloscopes from Siglent Technologies use the latest generation of "super phosphor" technology. According to the company, the series exhibits excellent signal fidelity and produces lower background noise than similar products. The SDS2000X-E series digital-storage oscilloscopes are available in bandwidths of 200 MHz and 350 MHz. They have a maximum sample rate of 2 GSa/s, with a maximum record length of 28 Mpts. As mixed-signal oscilloscopes—digital channels are optional—they can simultaneously display 2 analog and 16 digital channels. A new math coprocessor enables fast Fourier transform (FFT) analysis of incoming signals. It uses up to 10^6 samples/waveform, providing high-frequency resolution with a fast refresh rate. The FFT function supports various window functions so that it can adapt to different spectrum measurement needs. The SDS2000X-E can search events specified by the user in a frame and can navigate by time (delay position) and historical

frames. Users can play back the historical waveform to observe an abnormal event and quickly locate problem sources through the cursor or measurement parameters. The sequential mode divides the waveform storage space into multiple segments, each of which stores one trigger frame. The SDS2000X-E can control the universal serial bus arbitrary waveform generator (AWG) module (SAG1021) or a separate Siglent AWG device (SDG series) to perform amplitude-frequency characteristic and phase-frequency characteristic scanning, display the results in Bode plot or list formats, and export the scanned data. *Siglent Technologies America, Inc., 6557 Cochran Road, Solon, Ohio 44139. (877-515-5551 or 440-398-5800)* https://www.siglentamerica.com



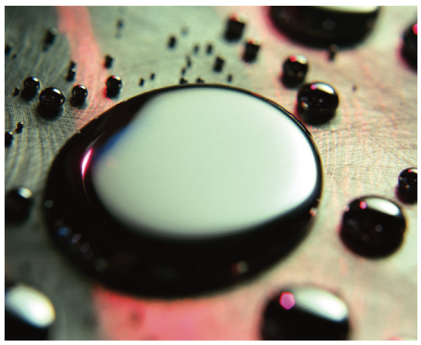
Boron nitride nanotubes

Goodfellow now offers boron nitride nanotubes (BNNTs). Although they resemble carbon nanotubes (CNTs) in their light weight, mechanical strength, and stability, BNNTs differ in some ways. While CNTs can be metallic or semiconducting, a BNNT is an electrical insulator with a bandgap of ~5.5 eV. BNNTs exhibit superior thermal and chemical stability compared to CNTs and have 200 000× higher thermal neutron absorption capacity. According to the company, those differences offer advantages in various applications. For example, BNNTs can be used to create high-temperature structural materials for nuclear and space applications and to address the heat-dissipation issue resulting from the miniaturization of electronic components. They have potential biomedical use as a drug delivery agent and target. According to the company, as a desalination membrane in the energy field, they provide faster and more efficient desalination than is currently available. Goodfellow supplies two grades of BNNTs in powder form: a product with purity of 70% or higher for applied research and one with purity of 90 wt. % or higher for conducting characteristic research through high-purity products. The company also offers other forms of boron nitride, including hexagonal, single-crystal (2D), pyrolytic, hot-pressed, and hot-isostatic-pressed. *Goodfellow Corporation, 125 Hookstown Grade Road, Coraopolis, Pennsylvania 15108-9302. (800-821-2870)* https://www.goodfellowusa.com



Hybrid thermal interface material

Indium Corp has released m2TIM, a novel solid–liquid hybrid thermal interface material that provides reliable thermal conductivity for heat dissipation. A solid metal solder preform absorbs and contains the liquid metal alloys, eliminating the risk of pump-out of the alloy while improving thermal conductivity. The m2TIM is available in various alloys, including indium gallium and indium gallium tin. It exhibits a high wetting ability to metallic and nonmetallic surfaces and extremely low interfacial resistance. *Indium Corporation, 34 Robinson Road, Clinton, New York 13323. (315-853-4900)* https://www.indium.com



Flat-top beam-shaping optics

II-VI Incorporated has introduced flat-top beam-shaping optics for micromaterials processing at visible laser wavelengths. The optics improve laser-based micromaterials processing by converting circular laser beams with Gaussian intensity profiles to circular or rectangular beams with uniform or "flat-top" intensity profiles only a few millimeters in size. Such laser beams enable process areas to be delineated precisely and processed evenly. According to the company, existing beam-shaping solutions for visible lasers based on fused silica are limited to circular geometries. II-VI's diamond-turned calcium fluoride freeform optics enable radially asymmetric flat-top laser intensity profiles, such as rectangular beams, with high uniformity. *II-VI Incorporated, 375 Saxonburg Boulevard, Saxonburg, Pennsylvania 16056-9499. (724-352-4455)* https://www.ii-vi.com

BIOINSTRUMENTATION AND BIOTECHNOLOGIES

Light-sheet microscope

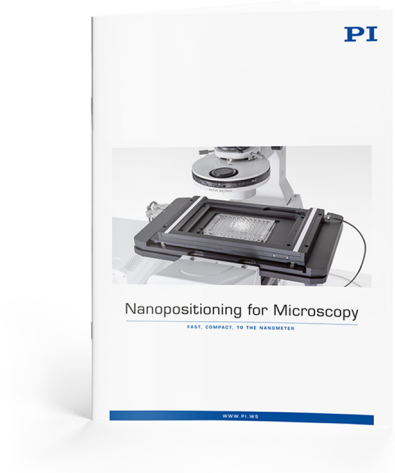
Olympus has announced a partnership with PhaseView, a 3D microscopy and scientific imaging company based in Paris, France. As a result of the partnership, Olympus has added the Alpha^3 LSM to its Life Sciences line of optics products to offer a cost-effective light microscopy solution for research. The Alpha^3 LSM system combines Olympus' BX43 upright frame and optics with PhaseView's advanced multiview selective plane illumination

technology. It provides high temporal and spatial resolution of both fixed and live biological samples for 3D imaging. The optional Smart 3D scanning technology allows for fast *z*-stacking and perturbation-free acquisition at 75 images/s. Unlike traditional confocal technologies, which experience a drop in brightness with increasing depth, light-sheet offers a greater depth of field over the entire field of view. Owing in part to its dual illumination units, the Alpha^3 can provide greater subcellular resolution without compromising the speed or excitation efficiency. In addition to increased speed, light-sheet microscopy allows for reduced phototoxicity. According to Olympus, the system's multiview selective plane illumination combined with real-time laser focus sweeping technology permits ultrathin optical sectioning for illumination homogeneity, increased axial resolution, and enhanced signal-to-noise response compared to traditional confocal techniques. The Alpha^3 system can be used in applications from *in vivo* observation to large, cleared samples, thanks to its advanced features. These include various sample holders to accommodate a broad range of sample sizes, live observation using optical eyepieces and an environmentally controlled yet easily accessible sample chamber, macro-to-micro viewing for imaging whole organs as well as very small organisms at a subcellular resolution, and corrosion-resistant mounting accessories for aqueous and organic solvents. The system can be easily upgraded with options such as fast scanning (Smart 3D scanning), XY tiling, and temperature controls. The QtSPIM software provides a clear, intuitive interface for fast collection of X, Y, Z, θ, T, and λ images. The modularity of the Alpha^3 system's components, including a full selection of 2X–60X detection objectives, extends the benefits of light-sheet technology to a wide range of academic research fields. *Olympus Scientific Solutions Americas, 48 Woerd Avenue, Waltham, Massachusetts 02453. (781-419-3900)* https://www.olympus-lifescience.com/en/

NEW LITERATURE AND SOFTWARE

Nanopositioning products catalog

Physik Instrumente has published *Nanopositioning for Microscopy,* a brochure that explains nanopositioning mechanisms for high-resolution microscopy applications. Positioning optics or samples with resolution in the subnanometer range is feasible and critical for improving the resolution, focusing speed, and stability of images taken with techniques such as fluorescence, widefield, laser scanning, atomic force, transmission electron, super-resolution, optical stereo, and correlative microscopy. Informative flow charts and application tables simplify the process of selecting the best drive technology for each application. Available in print and as an interactive PDF with links to additional information on the company's website, the brochure addresses the needs of scientists and engineers by providing a comprehensive overview of nanopositioning sample stages, nonmagnetic linear motor stages, fast piezo nanofocus drives, objective and lens scanners, and multiaxis motion systems with up to six degrees of freedom. *Physik Instrumente LP, 16 Albert Street, Auburn, Massachusetts 01501. (508-832-3456)* https://www.pi-usa.us



Illumination and optical design software

Lambda Research has unveiled the 19.2 release of its TracePro 2019 software for illumination and nonimaging optical design and analysis. The new version has enhancements in the Texture Optimizer II, 3D Interactive Optimizer, and analysis and lighting toolkits. It also fixes several problems reported by TracePro users. *Lambda Research Corporation, 25 Porter Road, Littleton, Massachusetts 01460. (978-486-0766)* https://www.lambdares.com