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Features

R&D 100 Awards Microscopy

Ramping Up Failure Analysis

In no small way, the role of microscopy within the semiconductor and nanotechnology industries has evolved to become a critical component for conducting failure analysis and validating physical dimensions. The Multiscan AFP (Atomic Force Probe), engineered by a research team at Multiprobe Inc., Santa Barbara, Calif., is a response to this trend. Designed within the framework of the 90- and 65-nm development nodes, this system features multiple atomic force microscopy tips in close proximity, enabling simultaneous high-resolution, nanoprobng of four sub-100-nm contacts.



Current and voltage (IV) curves from ultra-small transistors can now be readily taken without the risk of damage, thereby simplifying transistor failure

analysis. These properties are further bolstered by a factor of four reduction in system cost. Additional features such as the use of synchronized scan wave forms to drive multiple tips forward and a proprietary software to control all of the AFPs in concert, will appeal to researchers in a variety of fields.

The primary application for this system is in the electrical testing of semiconductors, but also reaches into static random access memory cell work, novel conductive polymer

Bait & Map



Within the highly competitive world of drug discovery, speed and efficiency have become more important than ever. Yet, significant challenges remain in optimizing the drug discovery process, with pharmaceutical labs looking toward new instrumentation and hardware in order to gain a competitive edge. This is the framework behind the development of the **PicoTREC: Topography and RECOgnition System**, created by researchers at Molecular Imaging Corp., Tempe, Ariz. Without the use of fluorescent markers, this system offers users the ability to simultaneously detect and map recognition or molecular binding events with single molecule sensitivity, while generating topographic images all in real-time.

The detection scheme is carried out by the inclusion of a specific ligand molecule attached to an atomic force microscope (AFM) cantilever, which recognizes target molecules or features in a sample. Working side-by-side with the PicoPlus AFM, PicoTREC then processes the cantilever deflection signal to identify changes characteristic of a successful antibody-binding event. The microscope continues to operate at full scanning speed, maintaining resolution. Finally, the PicoTREC output signal is fed to a second image to plot the

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device development, and testing of
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>>More info: www.multiprobe.com

Nanotech Takes a Step Forward

The complexity of dealing with nanoscale structures has placed a unique demand on instrument providers to develop cost-effective machinery to perform on this scale and beyond. As important are the benchmarks by which this instrumentation is measured against.



A group of engineers at the NASA Glenn Research Center, Cleveland, Ohio, have addressed this need in the area of scanning probe microscopy (SPM). The **Nanometer Step Height Standard** (Nanometer SHS) is a calibration standard with atomically flat steps of 0.5 and 1 nm heights, for use in SPM applications on nano and sub-nm scale features. Previously available calibration standards had minimum steps of 8 nm; an order of magnitude larger than the features now requiring analysis.

The structures are fabricated from single crystal silicon carbide (SiC) and represent the only known structures with subnanometer scale features that are quantifiable to a fixed physical property—the crystal structure of SiC. Since the step height on the Nanometer SHS is fixed, every Nanometer SHS standard has identically sized steps. This repeatability alleviates the need for sample standards to be sent for NIST certification, cutting down costs and boosting user appeal.

>>More info: www.grc.nasa.gov

location of the binding events simultaneously with the acquisition of high-resolution topographical images. The insight and speed gained by this approach will also prove useful in a variety of other applications, namely in semiconductors (mask-making) and wafer fabrication, data storage including DVDs, CDs, and hard drives, and polymer research.

>>More info: www.molec.com

Maximizing Mine Safety

U.S. coal companies produce over 1 billion tons of coal per year, with about half that amount originating from underground mines. But the human and production costs due to a loss of mine integrity is the pervading factor behind the **RIM-IV** (radio imaging method) **Imaging System**, engineered by researchers at Stolar Research Corp., Raton, N.M. Harnessing the frequencies of radio waves, the RIM-IV facilitates the identification and location of anomalies within coal seams, ore bodies, or down boreholes at depths down to 365 m.

Similar to the principles found in seismic systems, the RIM-IV's use of magnetic dipole antennas (transmission and receiver) give users the ability to survey changes in attenuation rates and phase shifts, enabling mine owners and managers to make better informed decisions on overall mine integrity and ensure continuous coal production without costly shutdown scenarios. Three dimensional imaging capability (3-D RIM) with enhanced resolution and improved transmission and range to survey larger blocks of coal (especially important for super panels in longwall mining) are also noted features which have contributed to its adoption in the U.S. and Australia.

>>More info: www.stolarhorizon.com

Plug-and-Play Microscopy



The value of scientific information gathered by microscopes has undoubtedly transformed the worlds of medicine and technology. This gain in knowledge and subsequent complexity level has been the fuel behind a series of advancements in microscope design with resolution, speed, and magnification all being areas of focused development. Now researchers at Nikon Instruments, Melville, N.Y., have taken the conventional light microscope further by creating a self-contained, bright-field digital microscope, dubbed the **COOLSCOPE**. The device gives untrained and expert users the ability to simply insert a specimen slide (26 x 76 mm) into the system, whereby aperture, focus, brightness, and staging positions are automatically adjusted. There are no eyepieces, knobs, or stages to reckon with. Images can be magnified up to 40x and are simultaneously displayed on a monitor and handled by an easy-to-use graphical user interface.

Each COOLSCOPE can be networked through a TCI/IP connection with the added benefit of each unit being equipped with its own IP address. This level of flexibility creates options for shared and remote viewing routines particularly those used in telemedicine and instructional applications.

>>More info: www.nikon.com

Substrate Swap

Variety has come to the field of cellular biology and medicine via the creation of the **PlasDIC System for Relief**



Contrast Microscopy. Developed through a partnership between Carl Zeiss Micro-Imaging, Inc., Thornwood, N.Y., and the Carl Zeiss Light Microscopy Group, Goettingen, Germany, this new tool is designed for the routine application of the differential interference contrast (DIC) technique for thick biological specimens, such as living cells.

Unlike current transmitted light interference contrast methods, the PlasDIC does not require a compensation prism at the condenser side. The object is illuminated with natural, non-polarized light. It is only upon directly passing in front of the DIC prism that the light becomes linearly polarized. A downstream analyzer lets light oscillating in the same plane through, creating interference. A one-slit diaphragm in the condenser is adequate for setting the 1/4 condition.

But the system truly distinguishes itself by being the first DIC system to successfully address the industry's need to image biological samples in the plastic, as opposed to glass, vessels they are typically grown on. This added feature will help reduce long-term costs in sample handling and increase ease-of-use.

>>More info: www.zeiss.com

Safer and Better Mammography

Mammography is one of the most difficult imaging tasks in the field of radiology since the difference in x-ray attenuation is slight between normal healthy tissue and abnormal breast tissue. Researchers Robert Dickerson, William Moore, and David Streklenski at Eastman Kodak Co., Rochester, N.Y., have developed a new x-ray film, **KODAK MIN-R EV Screen Film System**, that increases the film performance while cutting the radiation dose to the patient in half and improving its processability. A lower dose also eliminates the need for retakes due to patient motion.



The EV system (for extended visualization) features an asymmetric coating structure that provides improved

processing features, potentially reducing processing time by up to a third, as well as increasing productivity. A new sensitizing dye has been used to reduce dye stain and enhance the film's contrast. Due to its visually adaptive contrast, not only is contrast increased, but its latitude is enhanced by two times allowing for a greater exposure consistency. An improved upper scale contrast allows "fatty" breasts to not look low in contrast when exposed to higher densities. And a higher mid-scale contrast improves the conspicuousness of the anatomy, especially in breast calcifications and spiculations.

Additional improvements in the system's intensifying screen features finer grain phosphors that are used to maximize sharpness and provide an even higher system speed.

>>More info: www.kodak.com/go/mammo

Pump Up the Volume

It has been nearly 50 years since Prof. Erwin Müller from Pennsylvania State Univ. was first able to "see" an atom using his then appropriately termed flight ion spectrometer. Years later, Müller would once again revolutionize the field by being the first to include a mass spectrometer to a field ion instrument, giving birth to the first atom field ion or atom probe microscope. Today, these devices compete with a host of other microscopy techniques, i.e. scanning-electron, transmission electron, and scanning probe microscopy, for the distinction of being the instrument of choice for semiconductor, metallurgy, and nanotechnology applications.

To that end, researchers Thomas Kelly, Tye Gribb, and Jesse Olson of Imago Scientific Instruments Corp., Madison, Wis., have reworked the framework behind conventional atom probe microscopy with the development of their **LEAP three-dimensional atom probe microscope**. The LEAP, or Local Electrode Atom Probe, system delineates itself from other approaches by the inclusion of a cone-shaped, local electrode in place of the planar, remote electrodes used in other 3-D atom probe platforms. This design allows for a 100x increase in sample analysis rates. Moreover, users can expect a 40x increase in field of view and an analysis volume nearly three orders of magnitude greater than standard atom probes.

>>More info: www.imago.com

Semiconductor Damage Control

The drive toward smaller critical dimensions (100 nm) continues to foster the need for new process solutions in the semiconductor arena. Within that framework, engineers at

The Naked Truth

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>>More info: www.grc.nasa.gov

Soluris, Inc., Concord, Mass., have created the **Yosemite Ultra Low Voltage Critical Dimension Scanning Electron Microscope (CD-SEM)**. This system addresses the challenges associated with measuring semiconductor resists without causing photoresist slimming. Industry studies have shown that uncertainties on the order of 5 to 10 nm occur due to line slimming when probing with higher energy electron beams (400 eV and above). A patented electro-optical column design enables the Yosemite to resolve these features with a landing energy at and below 200 eV minimizing the damage/slimming effects incurred by samples during analysis.

The principal applications of this platform are in imaging and CD metrology of advanced semiconductor features whose geometry is smaller than 100 nm, yet it can also be used for feature inspection, defect review, SEM-overlay, and pattern-verification monitoring. The electron collection sub-system was designed to achieve more than 95% geometric collection efficiency by actively collecting the signal electrons. Yosemite's other motion-controlled subsystems include a vibration isolation table, a piezo-ceramic motor driven stage, and a laser diode feedback working distance monitor.

>>More info: www.soluris.com

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