Next Issue's Focus:
Assembly and Automation

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PDR reworks with focused IR; Nano Dimension improves additive electronics manufacturing; HZO ruggedizes edge computing; Desco and StaticStop improve factory ESD control; BTI highlights managed security systems; Kett boosts QC for polymer manufacturing. Special features begin on...

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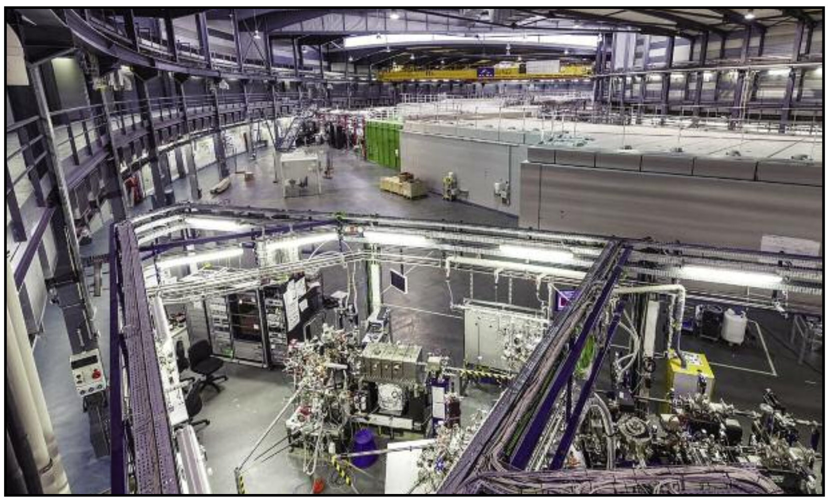
Wi-Fi Tech Meets Fiber Optic Performance for Industry 4.0

BARCELONA, SPAIN — Despite significant advances in wireless technology, the manufacturing industry continues to turn to wired forms of communication, such as Ethernet or fiber optics for its most critical tasks. However, a new study has opened the door to the use of wireless technologies with power and reliability comparable to that of fiber optics and could replace cabled connections.

A group of researchers from Universitat Oberta de Catalunya (UOC), in Barcelona, Spain, have achieved what is reportedly the first parameterization of a millimeter-band signal propagation model. The technology is capable of transmitting a huge amount of data per second in an industrial environment.

"This study is aimed at making communication less expensive and more flexible, by incorporating mobile devices into the manufacturing process," says Cristina Cano, head of the research team. "This could be very useful in moving toward Industry 4.0, since it allows, for example, connecting freely movable robotic arms to the production process or establishing communications for data reporting and controlling or stopping the different components of the process in an emergency. It could also allow the worker to be a part of the process."



The ALBA synchrotron, an electron accelerator located in Barcelona.

The ALBA Synchrotron

Before implementing millimeter bands in industrial settings, they first need to be understood in similar types of environments. There are currently several propagation models of this

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Stretching Diamonds for Microelectronics

HONG KONG — Diamond is the hardest material in nature, but in addition to its toughness it also has great potential as an electronic material. A research team from Hong Kong, the U.S. and China have demonstrated uniform tensile elastic straining of microfabricated diamond arrays through a nanomechanical approach.

Their findings show the potential of strained diamonds as prime candidates for advanced functional devices in microelectronics, photonics and quantum information technologies.

An Electron's Best Friend

Well known for its hardness, industrial applications for diamonds usually involve cutting, drilling or grinding. But, diamond is also considered a high-performance electronic and photonic material, due to its high thermal conductivity, exceptional electric charge carrier mobility, high breakdown strength, and ultra-wide bandgap.

Bandgap is a key property of semiconductors and wide bandgap allows operation of high-power or high-frequency devices. "Diamond can be considered the 'Mount Everest' of electronic materials, possessing all these excellent properties," says Dr. Lu Yang, assistant professor in the department of mechanical engineering at CityU, Hong Kong. "Our findings demonstrate the possibility of developing electronic devices through 'deep elastic strain engineering' of microfabricated diamond structures."

However, the large bandgap and tight crystal structure

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Efficient μ-processors with Superconductors

YOKOHAMA, JAPAN — The demand for greater computational power is constantly increasing, and the energy needed for this power is growing immensely. In fact, so much energy is used by today's data centers that some are built near rivers to cool the machinery with flowing water.

Researchers from Yokohama National University in Japan have developed a prototype microprocessor using superconductors that are about 80 times more efficient than state-of-the-art semiconductor devices.

Slashing Energy Costs

The digital communications infrastructure that supports our current information age currently

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Real-Time NIR Spectroscopy in Polymer Quality Control

By Del Williams

When manufacturing plastics, rubbers, elastomers, and adhesives, it is critical to monitor polymerization processes for quality and cost at every production stage from material receipt through final inspection.

Whether polymerization is bulk, solution, suspension, or emulsion, gathering essential data can help to prevent costly quality issues. Otherwise, internal production failures can require rework or scrap, and external failures can lead to warranty claims, recalls and even potential liability.

While traditional testing is critical in determining polymerization factors from simple moisture content to complete chemical analysis, it is time-consuming, labor-intensive and incurs substantial ongoing costs, in terms of the purchase and disposal of reagents and chemicals.

NIR Spectroscopy

Conventionally, testing requires sample preparation and can take 5 to 15 minutes for moisture testing and 24 to 48 hours for more complex chemical testing.

Now, a new approach using NIR spectroscopy can provide immediate, real-time, lab-quality readings by using a noncontact method. This method can provide moisture, composition and full spectrum readings for a fraction of the running costs of traditional processes.

Instant polymer testing drives quality control and offers the opportunity of immediate adjustments if the process drifts.

"Real-time NIR measurement enables continuous monitoring and optimization of polymerization processes," says John Bogart, managing director of Kett US, a manufacturer of moisture meters, composition analyzers and full spectrum testing equipment. "It provides more timely quality assurance data than a team of QA people, using traditional testing methods, and 100 percent of product can be inspected."

Instant testing offers superior quality control and immediate adjustment if a process starts to drift out of its target range. Results can improve batch consistency and yield, while helping to eliminate batch failure and reduce material waste.

NIR spectroscopy bounces beams of light off a material and measures how much light is absorbed across certain wavelengths of the electromagnetic spectrum (700 to 2,500 nm). This produces a sort of "optical fingerprint," with the device calculating the desired measurements after the meter has initially been calibrated to a lab or production standard.

Filter-Based NIR Systems

NIR devices fall into two general categories: filter-based and full-spectrum. Filter-based products block visible light and only allow certain wavelengths to enter the device. These are simpler than full-spectrum devices and work within a limited range of wavelengths.

"Filter-based products are less expensive, easier to calibrate and to maintain," says Bogart. "The devices are also more robust and typically more stable for opera-

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Real-Time NIR Spectroscopy in Polymer Quality Control

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tors to use. The drawback is that the instruments are more limited in what they can test."

Traditionally, a slower method of measuring moisture is a loss on drying test, which measures the total material weight change before and after drying. However, these tests typically require a sample to be prepared and brought back to the lab. The test takes at least 15 minutes and up to several hours to perform. It also requires the samples to be altered or destroyed.

NIR moisture meters are the simplest and most economical type of filter-based device. These are often used to inspect incoming raw materials. However, the meters can be used anywhere in the production process where achieving a specific moisture content is important. With these devices, reflected light is filtered to a narrow portion of the NIR spectrum, usually at only one or two wavelengths.

Bulk polymerization does not usually require much more than a moisture meter, since the reaction proceeds without a solvent or diluent. But, moisture meters can also be used with more complex forms of polymer, where the manufacturer may want to measure moisture anyway.

Among filter-based devices, NIR composition analyzers are a step up in measuring capability and can simultaneously measure a few different chemical components in the polymer while being limited to about six or seven wavelengths of light. In addition to moisture, the devices may also be used to measure residual oils or solvents, which can cause contamination.

A third traditional use of this type of device is to measure coating thickness or film thickness. Both desktop and real-time online process measurements can be provided in many cases. Generally, the price point of the NIR composition analyzer is substantially lower than alternative technologies.

Full-Spectrum NIR Systems

Full-spectrum NIR devices can measure more than 500 wavelengths to determine if materials meet a wide range of criteria. Once the device is specifically calibrated for a particular application, the widest number of targeted factors can be measured in real time.

In addition to moisture, polymer manufacturers may measure density, viscosity, melt flow rate (MFR), and functional groups. Such testing is common during emulsion polymerization, which is used to create latexes and synthetic polymer colloids for paint, coatings, rubber, binders, and adhesives.

The testing is also helpful for carrying out suspension polymerization processes, which are often used to produce polymer beads. These processes generally involve an initiator and comonomers, with the final polymers suspended in an aqueous phase that contains additives and residual monomer.

Traditional direct measurements of these parameters can take up to 48 hours for results. The tests are complicated. Various substances must be broken down into their underlying compositions. The tests require meticulous set up and execution to avoid errors.

By contrast, full-spectrum NIR testing is

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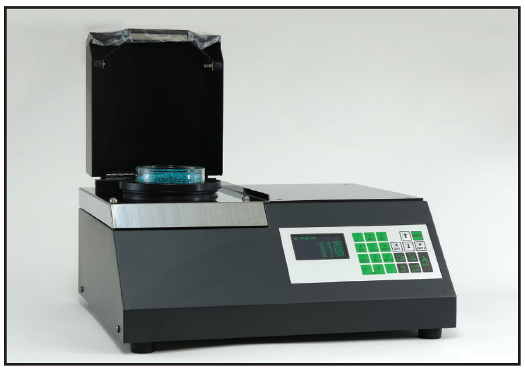

Kett KB270F desktop NIR moisture analyzer.

StaticStop and Desco Develop ESD Vinyl Flooring

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StaticStop's patented "hidden zipper-lock," invented by Ricciardelli. The 18.5 x 18.5 in. (470 x 470 mm) interlocking tile system is an ESD flooring product that is suitable for use over high-moisture, irregular and problematic subfloors.

The tiles interlock to provide tile-to-tile electrical conductivity, offer quick installation to eliminate downtime and can be cleaned and shined easily to a gloss, while maintaining their electrical properties — without using an ESD floor finish.

The FreeStyle 8400 does not require any adhesive and can be laid over existing floors, including concrete, wood, rubber, vinyl, composite tiles, and other standard floors. The flooring tile is designed to provide the most reliable static control flooring and meet the requirements of ANSI/ESD S20.20.

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Real-Time NIR Spectroscopy in Polymer Quality Control

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instant and can produce results in real time, without relying on laborious and difficult techniques. Such real-time monitoring of the polymerization process can give the manufacturer the ability to make immediate adjustments to optimize it.

While polymer manufacturers are more familiar with traditional methods, for those concerned not only with quality but also with profitability, selecting the NIR approach that works best for the application, whether it be a moisture meter, composition analyzer or full-spectrum tester, can have a major impact on the bottom line.

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