FormFactor Launches New High-Power Semiconductor Wafer Probing System for Automotive, Renewable Energy, and Industrial Applications

FormFactor, Livermore, California, launched the TESLA300 high-power semiconductor probing system. Designed specifically for IGBT and power MOSFET device measurements, the TESLA300 provides accurate data at up to 10,000 V and up to 600 A current on 300 mm wafers. Integrating new anti-arcing and wafer automation capabilities, the TESLA300 enables high-throughput, unattended testing over a wide thermal range to speed development and lower production cost of power devices.

Some key TESLA300 features include:

- Accurate, high-yield, drain-to-source resistance (Rds) vertical device measurements over temperature, automated and assured through FormFactor’s unique Contact Intelligence technology and powerful Velox 3 engineering software.
- Industry-leading measurement performance, with patented MicroChamber shielded test environment, and TESLA FemtoGuard thermal chuck with AttoGuard and MicroVac technologies for low contact resistance and high temperature uniformity.
- Flexible wafer handling, up to 300 mm in wafer size, with semi- or fully-automated configuration.
- Full thermal testing from −60 to +300 °C (−75 to +570 °F).
- Integrated, TÜV-certified safety system for high-voltage measurements.

Jens Klattenhoff, FormFactor’s vice president and general manager of the systems business unit, says “The increased demand for power semiconductors from the automotive market is fueling IDMs/foundries to move more production to 300 mm wafers while maintaining strict zero-defect quality standards. With innovative technologies designed specifically to automate and optimize on-wafer high-voltage and high-current measurements, our new TESLA300 helps our customers accelerate time to market for new power devices on 300 mm wafers.”

For more information: www.formfactor.com.
Graphene-Coated Gold Electrodes for Anticorrosion in Wearables

Gold has been widely adopted in biosensors for its biocompatibility and in flexible electronics for its ductility. Despite the common perception that gold is chemically inert for use as electrochemical electrodes, it is still prone to surface oxidation or corrosion.

Ultra-thin graphene coatings have already been demonstrated as corrosion-resistant surface coatings for metals. In addition, adding a few graphene layers onto conventional gold-film surface plasmon resonance (SPR) biosensor will boost up its sensitivity dramatically. The improved sensitivity comes from the graphene layers’ increased adsorption of biomolecules.

Avoiding complicated preprocessing steps of CVD graphene growth and the required high temperatures of plasma-enhanced CVD (PECVD), researchers have now demonstrated the feasibility of direct growth of graphene on gold thin films by PECVD at low temperature.

By accelerated soak testing in oxygenated saline solution, the team was able to demonstrate excellent anti-corrosion performance of their graphene-on-gold coating.

The authors conclude by noting that their work of low-temperature direct growth of graphene on gold by PECVD appears promising for anti-corrosion in smart wearable, implantable, and flexible hybrid electronics, where sweat and body fluids could have corrosive effects on common electrode materials.

For more information: www.nanowerk.com/nanotechnology_articles.

Ipsen Expands Services with Vacuum Chamber Wall Thickness Testing

Ipsen, Cherry Valley, Illinois, has expanded its field service capabilities to include ultrasonic wall thickness testing for vacuum furnaces. The test helps customers verify the integrity of their chamber and determine its remaining lifespan.

“Having a better understanding of the furnace’s condition will result in more accurate maintenance planning,” said Ipsen’s chief service officer John Dykstra. “Customers can have peace of mind knowing their furnace is safe for operation, while also preparing for future repairs or replacement.”

Vacuum chamber wall thickness testing is a service provided by Ipsen’s field service engineers using an ultrasonic inspection instrument. This nondestructive method requires only the removal of a small amount of paint at each desired test point. Ipsen’s service team works with the engineering department to determine the appropriate thickness for each chamber wall, and whether it passes or fails to meet the ASME Pressure Vessel Code. When the test concludes, customers receive a detailed report charting the thickness of the chamber wall across a wide range of areas, as well as maintenance and repair recommendations.

For more information: www.ipsenusa.com/news.
Magnetism Helps Electrons Vanish in High-Temperature Superconductors

Superconductors—metals in which electricity flows without resistance—hold promise as the defining material of the near future, according to physicist Brad Ramshaw, and are already used in medical imaging machines, drug discovery research and quantum computers being built by Google and IBM.

The Fermi surface on the left shows the arrangement of electrons in a copper-oxide high temperature superconductor before the “critical point.” After the critical point, the Fermi surface on the right shows that most electrons vanish. Research by the Brad Ramshaw’s lab connects this disappearance with magnetism. Credit: Nature Physics (2022). https://doi.org/10.1038/s41567-022-01514-1

However, the super-low temperatures conventional superconductors need to function—a few degrees above absolute zero—make them too expensive for wide use.

In their quest to find more useful superconductors, Ramshaw and colleagues have discovered that magnetism is key to understanding the behavior of electrons in “high-temperature” superconductors.

“All metals have electrons, and when a metal becomes a superconductor, the electrons pair up with each other,” he said. “We measure something called the ‘Fermi surface,’ which you can think of as a map showing where all the electrons are in a metal.”

They found that the Fermi surface changes completely as researchers dial past the critical point.

“There have always been hints that magnetism and superconductivity are related in high-temperature superconductors, and our work shows that this magnetism seems to appear right at the critical point and gobble up most of the electrons,” Ramshaw said. “This critical point also marks the electron concentration where the superconductivity happens at the highest temperatures, and higher-temperature superconductors are the goal here.”

Knowing that the critical point is associated with magnetism offers insight into why these particular superconductors have such high transition temperatures, Ramshaw said, and maybe even where to look to find new ones with even higher transition temperatures.

For more information: https://phys.org/news/2022-03-magnetism-electrons-high-temp-superconductors.

Neutrons Help Researchers Observe Real-Time Stress Reduction in 3D-Printed Parts

The heat, pressure, and force that materials experience during manufacturing processes, such as forming, casting, and molding, can cause internal inconsistencies in manufactured metal parts. These inconsistencies include distortions and uneven microstructures, or “strain,” which can lead to the parts cracking and failing.

GE is using neutron experiments to develop improved computer models to help predict if and where 3D-printed parts might crack. Credit: Oak Ridge National Laboratory
Reducing internal strain in manufactured parts is why post-build heat treatments, such as annealing, are common. Annealing involves heating manufactured parts to high temperatures to decrease, or relieve, internal stress.

GE Global Research and University of California at Berkeley scientists are working on improving production models that help better design and heat treat parts. The study involved parts manufactured using laser-based additive manufacturing (AM), which employs a laser to melt and deposit a structural material. The melted material—typically starting as a powdered metal or plastic—quickly cools and hardens before another layer is deposited on top of it.

“When using laser AM, the top layer that is being melted is very hot, while the lower layers have cooled. This temperature variation can create internal stresses that can lead to cracking,” said Ade Makinde, a principal engineer at GE Global Research. “Neutrons helped us look through the furnace walls in real time during the annealing process. We observed where the stress was reduced in the material during heating and at what temperature.”

The data obtained is helping GE improve its computer modeling of production processes to reduce or eliminate mechanical failures in printed components. For example, the model can show how changing the shape of a part can make it stronger by minimizing internal stress occurring during production. It can also indicate if changing the width of the laser beam or the speed at which the laser travels can improve production quality.

For more information: https://phys.org/news/2022-03-neutrons-real-time-stress-reduction-3d.

New CCD Cameras Extend Teledyne’s Spectroscopy Portfolio into System Integrator and OEM Markets

Teledyne Princeton Instruments, a Teledyne Technologies company, Trenton, N.J., released LANSIS—a new spectroscopy detector designed specifically for original equipment manufacturers (OEM) and system integrators.

LANSIS cameras is the latest in charge-couple device (CCD) array detector technology specifically tailored to OEMs. Michael Case, product manager at Teledyne Princeton Instruments notes, “LANSIS camera development was driven by OEM requirements, and is designed to offer the highest reliability, performance, sensitivity, for easy integration into OEM platforms; and with competitive OEM pricing.”

LANSIS spectroscopy cameras for OEM applications

LANSIS is targeted to instruments with techniques including Raman, optical emissions spectroscopy (OES), fluorescence, and photoluminescence (PL). This camera is ideal for a broad range of clinical and analytical equipment including in-vivo imaging, life science research, cancer detection, pharmaceuticals, drug discovery, material science, failure analysis for microelectronics, and more.

Some features specific to LANSIS include:

- Highest Reliability: Worry-free, permanent vacuum seal technology
- Highest Performance: Back-illuminated CCD with optional exclusive eXcelon technology
- Highest Sensitivity: Highest average quantum efficiency (QE) from UV to NIR
- Easy System Integration: A variety of mounting configurations makes integration of cameras fast and easy. The software development toolkit makes software integration a breeze.

The LANSIS family of high-performance detectors includes a variety of CCD sensor sizes and technologies for spectroscopy and scientific imaging, including back-illuminated, deep-depletion, EMCCD, and square-format sensors. Other sensor formats are available to accommodate the requirements of specific system integrators and OEMs. Our OEM account managers are committed to helping customers work smarter with easy access to documentation, streamlined parts ordering and integration software.

For more information: www.princetoninstruments.com.

New Method for Stabilizing the Interfaces in Solid-State Lithium-Ion Batteries

In the endless quest to pack more energy into batteries without increasing their weight or volume, one especially promising technology is the solid-state battery. In these batteries, the usual liquid electrolyte that carries charges back and forth between the
electrodes is replaced with a solid electrolyte layer. Such batteries could potentially not only deliver twice as much energy for their size, they also could virtually eliminate the fire hazard associated with today's lithium-ion batteries.

These discs were used for testing the researchers’ processing method for solid-electrolyte batteries. On the left, a sample of the solid electrolyte itself, a material known as LLPO. At center, the same material coated with the cathode material used in their tests. At right, the LLPO material with a coating of gold, used to facilitate measuring its electrical properties. Credit: Pjots Zguns

But one thing has held back solid-state batteries: Instabilities at the boundary between the solid electrolyte layer and the two electrodes on either side can dramatically shorten the lifetime of such batteries. Some studies have used special coatings to improve the bonding between the layers, but this adds the expense of extra coating steps in the fabrication process. Now, a team of researchers at MIT and Brookhaven National Laboratory have come up with a way of achieving results that equal or surpass the durability of the coated surfaces, but with no need for any coatings.

The new method simply requires eliminating any carbon dioxide present during a critical manufacturing step, called sintering, where the battery materials are heated to create bonding between the cathode and electrolyte layers, which are made of ceramic compounds. Carrying out the sintering step in pure oxygen creates bonds that match the performance of the best coated surfaces, without that extra cost of the coating, the researchers say.

Large companies such as Toyota are already at work commercializing early versions of solid-state lithium-ion batteries, and these new findings could quickly help such companies improve the economics and durability of the technology.

For more information: https://techxplore.com/news/2022-03-method-stabilizing-interfaces-solid-state-lithium-ion.

Selecting the Right Structural Materials for Fusion Reactors

Do two promising structural materials corrode at very high temperatures when in contact with “liquid metal fuel breeders” in fusion reactors? This high-temperature compatibility of reactor structural materials with the liquid breeder—a lining around the reactor core that absorbs and traps the high energy neutrons produced in the plasma inside the reactor—is key to the success of a fusion reactor design.

Investigating high-temperature corrosion resistance of structural materials in liquid LiPb fusion blanket. Credit: Masatoshi Kondo
Fusion reactors could be a powerful means of generating clean electricity, and currently, several potential designs are being explored. In a fusion reactor, the fusion of two nuclei releases massive amounts of energy. This energy is trapped as heat in a “breeding blanket” (BB), typically a liquid lithium alloy, surrounding the reactor core. This heat is then used to run a turbine and generate electricity. The BB also has an essential function of fusion fuel breeding, creating a closed fuel cycle for the endless operation of the reactors without fuel depletion.

One type of BB currently being explored is the liquid metal BB. A promising candidate for such BBs is liquid lithium lead (LiPb) alloy. As candidates for structural materials compatible with liquid LiPb at very high temperatures, a certain silicon carbide (SiC) material, CVD-SiC, and an iron–chromium–aluminum (FeCrAl) alloy pre-oxidized in air are being explored.

Cross-sections of the retrieved samples showed that CVD-SiC reacted with impurities in the LiPb alloy to form a layer of complex oxides, which then provided it with corrosion resistance. The untreated FeCrAl alloy formed a layer of the oxide $\gamma$-LiAlO$_2$ upon reaction with LiPb, which then acted as an anti-corrosion barrier. In the case of the pre-treated FeCrAl, the $\alpha$-Al$_2$O$_3$ surface layer provided corrosion resistance at 873 K but transformed into $\gamma$-LiAlO$_2$ at 1173 K, and it was $\gamma$-LiAlO$_2$ that then provided corrosion resistance.

For more information: https://phys.org/news/2022-03-materials-fusion-reactors.

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