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Nanotechnology Update

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Commissioned by

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CONTINUING COVERAGE OF *NANOTECHNOLOGY AND THE BUILT ENVIRONMENT*

This report provides ongoing coverage to the comprehensive industry review, *Nanotechnology and the Built Environment: The Transition to Green Infrastructure,* published in November 2011 and available at www.crystalra.com or from Livingston Securities, LLC by calling (212) 520-8481. This update contains a number of key developments since the release of the last update on **November 6, 2012**.

Watch for the upcoming annual edition of *Nanotechnology and the Built Environment*, due out this coming December.

This update contains key corporate developments on…

Bruker Corporation (BRKR-NASDAQ) ▪ Cabot Corporation (CBT-NYSE) ▪ Calgon Carbon Corporation (CCC-NYSE) ▪ Clean Harbors, Inc. (CLH-NYSE) ▪ Codexis, Inc. (CDXS-NASDAQ) ▪ FEI Company (FEIC-NASDAQ) ▪ Fluor Corporation (FLR-NYSE) ▪ Harris & Harris Group (TINY-NASDAQ) ▪ Headwaters Incorporated (HW-NYSE) ▪ Honeywell International Inc. (HON-NYSE) ▪ Industrial Nanotech, Inc. (INTK-OTC) ▪ KiOR, Inc. (KIOR-NASDAQ) ▪ PPG Industries, Inc. (PPG-NYSE) ▪ Universal Display Corporation (PANL-NASDAQ)

…as well as key industry news outlining new research and product/technology developments.

INNOVATIVE COMPANIES IN THE NANOTECHNOLOGY ARENA MAY BE THE KEY FOR NEW GROWTH AND VALUE IN ESTABLISHED BUILDING SECTORS, AS INVESTMENT IN NANOSCIENCE IS LEADING TO MORE ECOFRIENDLY, ENERGY-EFFICIENT, HIGHER-QUALITY INFRASTRUCTURE.

Please see page 2 and back cover for disclosures.

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Recent Corporate News

Bruker Corporation (BRKR-NASDAQ)

Bruker Corporation Wins Over $3 Million in Orders for Consumer Display Solution

Bruker, a provider of high-performance scientific instruments and solutions for molecular and materials research, as well as for industrial and applied analysis, announced that it has received over $3 million in orders from a consumer displays provider for its self-calibrating ContourGT-X 3D optical microscopes. The ContourGT 3D optical microscope family features patented, higher brightness dual-LED illumination that, when combined with the systems' vertical resolution, improves sensitivity and stability, enabling precision non-contact 3D surface metrology in difficult applications and environments that are challenging for competing systems. The ContourGT microscopes additionally feature new Vision64™ operating and analysis software and the industry's most intuitive, modular user interface to deliver user-level customization capabilities for a wide range of surface metrology applications.

http://www.bruker.com/news-records/single-view/article/bruker-wins-over-3-million-in-orders-for-consumer-display-solution.html

Cabot Corporation (CBT-NYSE)

Cabot Aerogel and Advanced Glazings Ltd. Introduce Affordable Insulated Glass Daylighting Solutions

Cabot Corporation and Advanced Glazings Ltd. announce the launch of SOLERA® + Lumira® aerogel R5 daylighting glazing units. The new product joins the suite of SOLERA + Lumira aerogel products. These insulated glass daylighting systems deliver natural light distribution and diffusion as well as superior thermal performance. The SOLERA + Lumira aerogel R5 system is a 1-inch thick panel in which the insulated glass units are filled with Lumira aerogel. The use of Lumira aerogel diffuses sunlight, removing any interior hot spots, shadows, or glare. Compared with gas filled triple-glazed windows, the R5 systems deliver the same level of thermal protection at a similar price. As well, the full spectrum diffused light from the R5 system provides benefits in light distribution, glare control, and permanent performance. The 1-inch thickness of the new R5 unit also makes it easy to install into any standard framing system. Solera + Lumira aerogel systems enable architects and building owners to affordably and easily meet the challenging requirements of thermal efficiency without compromising optimal daylighting. Unlike other products in the industry that have elements that break down, the new R5 product provides a long lasting insulation and daylighting performance solution. By reducing heat gain and loss, Solera + Lumira aerogel can improve the overall energy efficiency of a building, with less stress on heating and cooling systems. The use of artificial light during the day can also be dramatically reduced, resulting in further energy cost savings.

http://www.businesswire.com/news/home/20121112005459/en/Cabot-Aerogel-Advanced-Glazings-Ltd.-Introduce-Affordable

Calgon Carbon Corporation (CCC-NYSE)

U.S. Department of Commerce Issues Final Tariffs on Activated Carbon Imports from China

Calgon Carbon Corporation announced that the Department of Commerce (DOC) issued new tariffs on steam activated carbon from China ranging from $0.00 to $0.96 per lb. These rates were based upon a review of prices of Chinese activated carbon imported into the U.S. from April 1, 2010 to March 31, 2011. These announced tariffs may be modified to correct any errors made by the Commerce Department. The average duty is $0.47 per lb., which replaces the average tariff rate of $0.127 that had been in effect. Calgon Carbon's tariff with respect to

products it imports into the U.S. from China continues to be $0.00. The company has stated that it is optimistic these revised tariffs will continue to encourage fair competition and fair prices that reflect demand and manufacturing costs for activated carbon products.

http://www.calgoncarbon.com/news/index.cfm?mode=detail&id=E08BFD18-B282-D9F6-323984B3E2976567

Clean Harbors, Inc. (CLH-NYSE)

Clean Harbors Reports Third-Quarter 2012 Financial Results

Clean Harbors, a provider of environmental, energy and industrial services throughout North America, announced financial results for the third quarter ended September 30, 2012. Revenues for the third quarter were $533.8 million compared with $556.1 million in the same period in 2011, noting that revenue in the third quarter of 2011 included approximately $42 million in emergency response revenue related to the Yellowstone River oil spill. Third quarter 2012 net income was $12.4 million, or $0.23 per diluted share, compared with $37.1 million, or $0.70 per diluted share, in the third quarter of 2011. The third quarter of 2012 included a $26.4 million pre-tax charge related to the Company's recent senior debt refinancing. Adjusted net income, excluding the charge, was $28.8 million, or $0.54 per diluted share. The Company serves more than 60,000 customers, including a majority of the Fortune 500 companies, thousands of smaller private entities, and numerous federal, state, provincial, and local governmental agencies.

http://ir.cleanharbors.com/phoenix.zhtml?c=96527&p=irol-newsArticle&ID=1755371&highlight=

Codexis, Inc. (CDXS-NASDAQ)

Codexis Reports Third Quarter 2012 Results

Codexis, Inc., a developer of world-leading enzymes and processes for the production of pharmaceuticals, biofuels, and bio-based chemicals, with product lines that include CodeXyme™ cellulase enzymes and CodeXol™ detergent alcohol, announced third quarter financial results for the quarter ended September 30, 2012. Revenues for the third quarter 2012 were $26.3 million, a 21% decrease from $33.3 million in the third quarter of 2011. Product revenue in the third quarter of 2012 was $7.1 million, a 41% decrease from $12.2 million in the prior year quarter and a 5% sequential increase from $6.8 million in the second quarter of 2012. Product gross margin in the third quarter was 10%, compared to 18% in the prior year quarter due to a higher percentage of generic products sales and lower on patent sales in the third quarter of 2012. Collaborative research and development revenue of $18.6 million decreased 3% from $19.2 million in the third quarter of 2011. Cash, cash equivalents, and marketable securities at September 30, 2012 were $53.9 million. For the full year 2012, Codexis expects a decline in total revenues relative to its full year 2011 total revenues of $124 million and adjusted EBITDA to be negative. The Company anticipates its year-end cash, cash equivalents, and marketable securities to be $45 million.

http://phx.corporate-ir.net/phoenix.zhtml?c=208899&p=irol-newsArticle&cat=news&id=1755750

FEI Company (FEIC-NASDAQ)

Three Part Advisors, LLC Announces the Southwest IDEAS Investor Conference to be Held November 14 and 15, 2012 in Dallas: FEI Company to Participate

Three Part Advisors, LLC announced details for The Southwest IDEAS Investor Conference held November 14 and 15, 2012 at The Sheraton Dallas near the Galleria, Dallas, Texas. The mission of the IDEAS Investor Conferences was to provide independent venues for quality public companies to present their investment merits to an influential audience of investment professionals and analysts from across the country. Unlike traditional bank-sponsored events, IDEAS Investor Conferences are sponsored directly by and for the benefit of the members of the regional

investment communities. The presenting companies come from a diverse group of industries, market capitalization, and investment styles. Approximately 50 companies were expected to present at this year's event, including FEI Company.

FEI Announces New DualBeam for Failure Analysis

FEI announced its new Helios NanoLab™ 450 F1 DualBeam™ system, designed to provide semiconductor manufacturers with faster, better images of their most advanced device architectures. A new STEM (scanning transmission electron microscope) detector delivers improved contrast between materials, and the new flip stage and rotating nanomanipulator support advanced preparation techniques for complex device architectures, such as finFETs and three-dimensional (3D) memory structures. In the long run, faster, better answers cut development costs, accelerate process ramps, and get new products to market sooner. The new STEM detector lets the operator know precisely when the sample is thin enough, and in certain situations, the images can eliminate the need for standalone TEM analysis altogether. Dual beam instruments combine an SEM (scanning electron microscope) for imaging and a FIB (focused ion beam) for milling and deposition. Dual beams also provide STEM imaging capability by adding a detector for collecting transmitted electrons below the sample. An increasingly important application of dual beam instruments is the preparation of the ultra-thin samples required for TEM analysis. This need for high-resolution TEM analysis has grown dramatically in recent years as many device's structures have shrunk beyond the resolving power of SEM.

http://investor.fei.com/releasedetail.cfm?ReleaseID=720592

Fluor Corporation (FLR-NYSE)

Fluor to Provide Environmental Services Upgrades for PNM San Juan Generating Station in New Mexico

Fluor Corporation announced that it was awarded an early-phase engineering, procurement, and construction (EPC) contract by PNM to provide environmental services upgrades for four power units at the San Juan Generating Station in New Mexico. Fluor expects to begin the second phase in January 2013 with full notice-to-proceed projected for mid-2013. Fluor will provide full EPC services to design, build, install, and commission new selective catalytic reduction (SCR) equipment for each of the San Juan Generating Station's four units. When the environmental upgrades are completed, the equipment utilized will provide one of the highest NOx removal efficiencies in the country and will comply with the Environmental Protection Agency federal plan to address regional haze at San Juan Generating Station. The San Juan Generating Station is located in Waterflow, N.M., and is expected to have more than 500 craft laborers at construction peak in mid-2015. All units are expected to be online by mid-2017.

http://investor.fluor.com/phoenix.zhtml?c=124955&p=newsarticle&id=1756243

Harris & Harris Group, Inc. (TINY-NASDAQ)

Harris & Harris Group Notes Solazyme's Announcements of One Expanded and One New Partnership Agreement

Harris & Harris Group, Inc. (an investor in publicly traded Solazyme, Inc. [SZYM-NASDAQ]) noted Solazyme, Inc.'s announcement that it had entered into a Joint Venture Expansion Framework Agreement with Bunge Global Innovation LLC, a wholly-owned subsidiary of Bunge Limited. The agreement sets forth the intent of the partners to expand joint venture-owned oil production capacity at Solazyme Bunge Renewable Oils from the current 100,000 metric tons under construction in Brazil to 300,000 metric tons by 2016 at select Bunge owned and operated processing facilities worldwide. The companies intend to expand the portfolio of oils to be produced out of their joint venture facility in Brazil.

http://solazyme.com/media/2012-11-14-0

Headwaters Incorporated (HW-NYSE)

Headwaters Incorporated Announces Results for Fourth Quarter and Fiscal Year 2012

Headwaters announced results for its fourth quarter and fiscal year ended September 30, 2012. Fourth quarter 2012 revenues increased by 7% to $190.1 million from $178.3 million for the fourth quarter of 2011. Gross profit increased by 16% to $56.7 million in the fourth quarter of 2012, compared to $49.0 million in the fourth quarter of 2011. Total revenue for the 2012 fiscal year was $632.8 million, up 8% from $588.0 million for 2011. Gross profit increased 20%, from $145.9 million in 2011 to $175.1 million in 2012. The company had approximately $53.8 million of cash on hand at September 30, 2012 and total liquidity of $104.9 million, which includes the impact of Headwaters providing $18.9 million for letters of credit for various purposes.

http://www.headwaters.com/data/upfiles/pressreleases/11.6.12%204th%20Quarter%202012.pdf

Honeywell International Inc. (HON-NYSE)

Honeywell's UOP Wins Third License For Breakthrough Methanol-To-Olefins Technology to Convert Coal into High-Value Petrochemicals

UOP LLC, a Honeywell (HON) company, announced the third technology license for its breakthrough methanol-to-olefins (MTO) technology, which converts methanol from coal into key plastics building blocks. China's Shandong Yangmei Hengtong Chemicals Co. Ltd. will use Honeywell UOP's MTO process, which combines Honeywell's UOP/Hydro MTO process and the Total Petrochemicals/UOP Olefin Cracking process to convert methanol from gasified coal into ethylene and propylene—building block materials used in the production of films, packaging, plastics, and other petrochemicals. The MTO process, jointly developed by Honeywell's UOP and INEOS (formerly Hydro), converts methanol derived from crude oil and non-crude oil sources such as coal or natural gas to ethylene and propylene. The process, based on proprietary UOP catalysts, is proven to provide high yields with minimal byproducts. MTO also offers flexibility in the quantity of propylene and ethylene produced so producers can adjust plant designs to most effectively address market demands.

http://honeywell.com/News/Pages/Honeywell%E2%80%99s-UOP-Wins-Third-License-For-Breakthrough-Methanol-To-Olefins-Technology.aspx

Industrial Nanotech, Inc. (INTK-OTC)

Industrial Nanotech, Inc. Issues Business Update

Industrial Nanotech, Inc. announced a business update to its shareholders and supporters of recent activity and progress, having worked diligently to establish substantial relationships and progress in market sectors that provide the opportunity for significant growth in 2013 and beyond. (1) *Roof coating insulation market.* The company is seeing a large increase in sales volume to consumers and corporations using its Nansulate® Crystal clear insulating and mold/algae/bacteria resistant roof coating for building energy efficiency. (2) *Oil and gas market.* After two successful projects with Galp Energia in Portugal and heavy marketing to this sector, the company has two large oil and gas companies in Asia currently conducting field studies with Nansulate® coatings for insulation and corrosion prevention in severe service environments, with both expected to be completed by spring of next year. (3) *Industrial Nanotech market.* The company continues to strengthen its national and international distributorship network with new relationships announced earlier this year in several countries, including Columbia and Venezuela with DuPont Power Coatings Andina. They have also brought on distributors this year in India, Malaysia, Norway, Spain, and Oman, and have plans to finalize relationships for several other countries in the first half of 2013. (4) *Residential housing structures.* The Company is working through its agents with two government funded energy saving organizations on field trials studying how Nansulate® HomeProtect can best affordably reduce energy costs in several types of residential housing structures. (5) Industrial Nanotech

continues research and development activities in nanotechnology-based solutions for energy savings and surface protection.

http://www.industrial-nanotech.com/INTK_press_release_11052012.htm

KiOR, Inc. (KIOR-NASDAQ)

KiOR Reports Third Quarter 2012 Results

KiOR, Inc. announced its financial results for the third quarter ended September 30, 2012. Third quarter 2012 net loss was $27.0 million, or $0.26 per share, compared to a net loss of $23.0 million, or $0.22 per share, for the second quarter of 2012. Net loss for the third quarter of 2011 totaled $14.8 million, or $0.15 per share. KiOR did not recognize revenue during the third quarter of 2012; its activities remained focused on commissioning and start-up of its first commercial facility in Columbus, research and development (R&D) designed to improve production yields, and obtaining necessary financing for its expansion plans. KiOR had cash and cash equivalents of $74.3 million at September 30, 2012, a $57.3 million decrease from the December 31, 2011 balance, primarily driven by capital expenditures, operating uses of cash, and paying off previous business loans, partially offset by funding from the $75.0 million 4-year-term loan announced earlier this year. Net long-term debt stood at $112.5 million as of quarter-end.

http://investor.kior.com/releasedetail.cfm?ReleaseID=719652

PPG Industries, Inc. (PPG-NYSE)

PPG CFO Navikas to present at 2012 Citi Basic Materials Symposium in New York

PPG Industries' senior vice president, finance and chief financial officer David B. Navikas will participate in the 2012 Citi Basic Materials Symposium in New York City on Tuesday, November 27, at 9:30 a.m. ET. Mr. Navikas will discuss PPG's business and financial performance.

http://www.ppg.com/en/newsroom/news/Pages/20121113A.aspx

PPG to Debut ULTRAPAX Coatings Package at FABTECH

PPG Industries' industrial coatings business announced the introduction of ULTRAPAX™ packaged pretreatment and powder coatings solutions and exhibited its full range of liquid, powder, pretreatment, and electrocoat products at FABTECH booth C2739, November 12-14 at the Las Vegas Convention Center. In addition, James Gezo, PPG technical service consultant, industrial coatings, presented "Introduction to Electrocoating," a technical seminar that is part of the continuing education program at FABTECH. The new Ultrapax packaged technology program will provide PPG's customers with a full range of pretreatment products to be coupled with PPG powder coatings as part of a cost-effective, comprehensive, single-source coatings solution. PPG pretreatment products encompass traditional spray and immersion zinc- and iron-phosphate systems, multi-metal cleaners, low-temperature cleaners, low-temperature phosphates and high-technology zirconium-based products.

http://www.ppg.com/en/newsroom/news/Pages/20121109A.aspx

Universal Display Corporation (PANL-NASDAQ)

Universal Display Corporation Announces Third Quarter 2012 Financial Results

Universal Display announced its results for the third quarter of 2012. Revenues for the third quarter of 2012 were $12.5 million versus revenues of $21.8 million in the same quarter of 2011. Material sales were $11.0 million in the third quarter of 2012 versus $15.4 million in the third quarter of 2011 due to lower volumes of green emitter and host materials. The anticipated ramp up of phosphorescent green materials did not occur this quarter. Research and development expense was $8.2 million for the three months ended September 30, 2012, compared to $6.1 million for the three months ended September 30, 2011. The increase is primarily attributable to a $1.0 million increase in costs incurred under the company's agreement with PPG Industries for development and scale up of new materials, and a $500,000 increase in outsourced sponsored research and development contract costs as Universal Display continues to invest in the future. Cash and cash equivalents and short-term investments are $238.8 million as of September 30, 2012.

http://www.universaldisplay.com/downloads/Press%20Releases/2012/11.07.12%20UDC%20Announces%20Q3%202012%20Financial%20Results.pdf

Veeco Instruments Inc. (VECO)

Brolis Semiconductors Ltd. Receives Shipment of Veeco MBE Production System

Brolis Semiconductors Ltd. and Veeco Instruments Inc. announced that Brolis has received shipment of a Veeco GEN200® Edge™ Molecular Beam Epitaxy (MBE) production system for installation at their new epitaxial wafer production facility in Vilnius, Lithuania. Veeco's process equipment solutions enable the manufacture of LEDs, power electronics, hard drives, MEMS, and wireless chips. Are well, it is the market leader in MOCVD, MBE, Ion Beam, and other advanced thin film process technologies.

http://phx.corporate-ir.net/phoenix.zhtml?c=111487&p=irol-newsArticle&ID=1756123

Key Industry Developments

Buildings Can Be Smarter, But Are We Up To The Challenge?

Crumbling bridges and roads are not the only infrastructure needing upgrading. Buildings where we work, play, or live also in dire need of as well. The United States National Science and Technology Council estimates that commercial and residential buildings consume one-third of the world's energy. In North America, such energy use translates to 72% of the electricity generation, 12% of the water use, and 60% of non-industrial waste. If worldwide energy use trends continue, buildings will become the largest consumer of global energy by 2025—larger than the transportation and industrial sectors combined. Opportunities to improve our country's buildings' infrastructure was a major topic of discussion in March at the second meeting of the Innovations for Environmental Sustainability Council, formed by IBM Corp., with the World Environment Center and other companies, including Boeing, CH2M Hill, Coca-Cola, Dow Chemical, F. Hoffman-La Roche, General Motors, Ingersoll Rand, Johnson & Johnson, and Walt Disney. Buildings emit more harmful carbon dioxide emissions into the environment than cars. Energy costs alone represent about 30% of an office building's total operating costs. As well, up to 50% of energy and water used in buildings is wasted—issues which are accelerated by worldwide urbanization. While 85% of companies say they are focused upon sustainability, only 30% are collecting data with enough frequency to make changes. Building sustainability is a growing priority as companies, property owners, builders, utility companies, and local governments work to meet the demands of a sustainable future. By adding a layer of intelligence, elements of a building (temperature, electricity consumption, ventilation, water consumption, waste management, telecommunications, and physical security) can be integrated for better management and control. With the increase of sensors and control systems employed use over the last decade, many buildings now can sense, measure, and see the exact condition of practically everything in them. This can drive efficiency, save money, and advance sustainability. The so-called "green" building movement uses environmentally preferable materials and construction techniques to be environmentally friendly, but that's only part of the equation. Institutions can construct or retrofit buildings that capitalize on new, analytical insights derived from the wealth of data generated by the infrastructure itself, and they can consequently operate and maintain buildings more efficiently as well. Making buildings and infrastructure systems more efficient and sustainable is crucial. Luckily the key enabler for real change exists—the technology is here and available, and people want it.

http://www.smartplanet.com/blog/ideas-insights/buildings-can-be-smarter-but-are-we-up-to-the-challenge/204?tag=mantle_skin;content

Controlling Heat Flow Through a Nanostructure

Thermoelectric devices, which can harness temperature differences to produce electricity, might be made more efficient due to new research on heat propagation through structures called superlattices. The new findings show that heat can travel like waves, rather than particles, through these nanostructures (materials made up of layers only a few billionths of a meter in thickness). Heat—the vibration of atoms and molecules in a material—usually travels in a "random walk," which is difficult to control. The new observations show a very different pattern, called coherent flow. This is more like ripples that move across a pond in an orderly way and opens the possibility of new materials in which the flow of heat could be precisely tailored. Reported in the journal *Science,* the study involves a nanostructured material called a superlattice. A stack of alternating thin layers of gallium arsenide and aluminum arsenide, each is deposited in turn through a process called metal-organic chemical vapor deposition. Chemicals containing these elements are vaporized in a vacuum, and then deposited on a surface, their thicknesses precisely controlled through the duration of the deposition process. The resulting layers are just 12 nanometers thick—about the thickness of a DNA molecule—and the entire structures ranged in thickness from 24 to 216 nanometers.

http://phys.org/news/2012-11-nanostructure.html

Gold Nanorods That Detect Proteins Could Simplify Kidney Disease Detection

Detecting acute kidney injury could become as simple as dipping a paper test strip printed with gold nanorods into a urine sample. Doctors at Washington University School of Medicine, have developed a biomedical sensor employing gold nanorods, designed to detect the elevation of the protein neutrophil gelatinase-associated lipocalin (NGAL)—a promising biomarker for acute kidney injury—in urine. Biomarkers are typically small molecules or proteins in the body whose concentration changes in response to disease or therapy. With a process called biomolecular imprinting, they can create the plasmonic biosensor. This process involves attaching the target proteins to the surface of the nanorods, then adding small molecules around the proteins to form a polymer layer around the outside of the nanorods. The target proteins are removed to leave cavities on the surface of the nanorods, which are the artificial antibodies. When exposed to a substance such as urine, which contains the target protein, those proteins settle into the cavities, like a puzzle piece into a jigsaw puzzle. Acute kidney injury develops rapidly over a few hours or a few days when the kidneys become unable to filter waste products from the blood. It is common in people who are hospitalized, particularly in those critically ill people or who have had heart surgery.

http://onlinelibrary.wiley.com/doi/10.1002/adfm.201202370/abstract

Nanocanary: A Modern-Day, High-Tech Equivalent Of The Canary In A Coal Mine

Nanotechnology is making a great impact on businesses by offering new and improved products, materials, and processes for diverse applications. Researchers are also assessing the health and environmental risks linked to this new technology resulting from exposure to, or contamination from, nanoparticles during production, storage, and transportation. To detect the toxicity of engineered nanomaterials, such as carbon nanotubes, on living cells a "nanocanary," has been developed—the modern-day, high-tech equivalent of the canary in a coal mine that warned miners of dangerous buildups of toxic gases in the mine shaft. The nanocanary is an ultrasensitive biosensor designed to continuously monitor tiny physiological changes in the live cells contained within it. This biosensor has a range of applications—from testing for toxicity in nanomanufacturing to drug development and customized cancer therapeutics. The sensor can also be used to test the response of normal and cancerous cells to drug therapies. This technology may help guide oncologists in selecting the most appropriate drug for a cancer patients in the future.

http://www.mos.org/events_activities/podcasts&d=5683

Scientists 'Clone' Carbon Nanotubes to Unlock Their Potential For Use In Electronics

Integrated circuit computer chips have been made from silicon since the beginning of computing in the 1960s. A team of University of Southern California (USC) researchers has found that carbon nanotubes may emerge as a contender to silicon. Carbon nanotubes have the potential to be far smaller, faster, and consume less power than silicon transistors. A significant reason carbon nanotubes are not being used now is that they are difficult to manufacture in a predictable way as scientists have had a difficult time controlling the manufacture of nanotubes to the correct diameter, type, and ultimately chirality—factors that control nanotubes' electrical and mechanical properties. A team from the National Institute of Standards and Technology in Maryland solved the problem by inventing a system that consistently produces carbon nanotubes of a predictable diameter and chirality. The next steps in the research will be to carefully study the mechanism of the nanotube growth in this system, to scale up the cloning process to get large quantities of chirality-controlled nanotubes, and to use those nanotubes for electronic applications.

http://phys.org/news/2012-11-scientists-clone-carbon-nanotubes-potential.html

Stacked Nanoparticle Layers Shine New Light on Optical Thin Films

Solar cell manufacturers have developed various types of antireflection coatings to reduce the unwanted reflective losses. The purpose of these optical thin-films is to minimize the differences in the refractive indices between the ambient medium and the solar cells. For both solar cells and LEDs, coating with nanoparticles can enhance the performance without harming the electrical properties of the devices. The main motivation has been to develop an economical easy method to construct optical thin films. Traditionally, multi-layer optical thin-films with graded refractive indices were fabricated by PVD (physical vapor deposition) or CVD (chemical vapor deposition). Using vacuum systems, however, is not only time consuming but also costly. In order to save money and processing time, scientists are spin-coating dielectric nanoparticle stacks with suitable refractive index to fabricate graded refractive indices multi-layers. This rapid, low-cost, solution-based method allows the construction of graded-refractive-index nanoparticle stacks that function as broadband, omnidirectional antireflection coatings, minimizing the reflectance of the silicon-air interface and increasing the efficiency of silicon solar cells. Because the fabrication approach involves rapid and simple spin-coating and does not require any etching, the electrical properties of the devices will remain unaffected. It is possible that this nanoparticle-based technique has great potential for application to other optoelectronic devices, including thin-film solar cells, organic solar cells, transparent conductors, and OLEDs.

http://www.nanowerk.com/spotlight/spotid=27180.php

Our Three-Dimensional Future: How 3D Printing Will Shape the Global Economy

A hot topic as of late, it appears there have been an abundance of things being reproduced by 3D printers—3D printed guns, drones, and the army of items sold among a small marketplace for 3D printed goods. There are, in fact, many innovative uses for these trendy machines. However, it may be some time before individuals are able to print for example, a 3D house (though it appears that this topic is gaining greater discussion). Some individuals question as to whether these machines will change the way we manufacture goods, and subsequently change the global economy, or in fact, is this already occurring. The answer: yes and no. The term "3D printing" entails two very different worlds—hobbyist 3D printing, where individuals with relatively inexpensive machines print plastic objects (see ***3-D Photo Booth Makes a Miniature You, page 11***) in the comfort of their homes; and in more elaborate developments, industrial 3D printing, which is usually referred to by another name: additive manufacturing. Each is very different and will have differing impacts on the economy. However, both are positioned to change the way businesses think about producing goods.

Home 3D printing is relatively costly hobby, with a machine running about $4,000, which typically only prints objects from plastic. These objects are currently along the line of bracelets, puzzle games, figurines, etc. It is, however, believed that people will be able to 3D print replacement parts, or even entire products, at home at some point in the future. What could eventually emerge is a situation like this: take your faulty toaster to Home Depot or Sears, and a store employee could isolate the problem and print a solution on the spot. The development path of 3D printing could resemble that of photo printing. And the economic impact of these kinds of 3D printed products—one-off components or replacement parts—could be major as it could eliminate the need for huge warehouses of parts and cut the need for shipping different components from place to place as ordered. 3D printing could reduce or eliminate some of the steps between product creators and consumers. Thus, the middle man—who buys, sells, and ships—existance is threatened. To compare, three-dimensional printing also stands to make industrial design more efficient; and with new capabilities comes new processes. For big industry, a better bottom line makes additive manufacturing worth it. It allows for efficiencies in the process, speed, and cost of manufacturing. For now, the costs to research and begin implementing such a process are significant. Five years from now, however, designing in 3D will mean that each part will be designed to perform several functions, rather than just one.

http://www.smartplanet.com/blog/report/our-three-dimensional-future-how-3d-printing-will-shape-the-global-economy/559?tag=main;carousel

3-D Photo Booth Makes a Miniature You

Omote 3D Shashin Kan is a pop-up portrait studio that uses a handheld scanner to create a three-dimensional (3D) model of a person's entire body. A 3D printer then makes a small, intricately detailed plastic figurine. The final, full-color models look exactly like the larger person, including the wrinkles on the clothes and part in the hair. The project is part of a photography exhibition at the Eye of Gyre gallery in Tokyo's Harajuku neighborhood, and will only be open from November 24 to January 14. A person can get a small version of themselves in three different sizes: 3.9-inches (10cm), 5.9-inches (15cm), or 7.8-inches (20cm) tall. A pocket-sized person does not come cheap. Prices range from $264 (21,000 yen) to $528 (42,000 yen). The price tag is more reasonable when you think of them as miniature sculptures. It takes 15 minutes for the artists to scan a person's entire body, thus a person should chose a comfortable pose that they can hold. As well, an individual should not wear fluffy fabrics like fur, small detailed patterns like polka dots, shiny materials such as patent leather, and any accessory too detailed for the 3D printer to replicate (i.e., earrings, glasses, or bags). The models take about a month to complete. The 3-D photo-booth project is the brainchild of PARTY, a young ad, branding and entertainment company based in New York and Tokyo.

http://whatsnext.blogs.cnn.com/2012/11/15/3-d-photo-booth-makes-a-miniature-you/?hpt=hp_c3

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