Technology Scan

ASIA-PACIFIC

AUSTRALIA

Salt tolerant wheat

In a major breakthrough for wheat farmers in salt-affected areas, CSIRO researchers have developed a salt tolerant durum wheat that yields 25 per cent more grain than the parent variety in saline soils. Recent field trials in northern New South Wales proved that durum wheat varieties containing new salt tolerant genes outperformed the other varieties in saline soils.

The breakthrough will enable wheat farmers to achieve higher yields of durum wheat in saline soils. Although durum wheat is less salt tolerant than bread wheat it attracts a premium price because of its superior pasta making qualities. "By planting the new salt tolerant durum wheat in different levels of salinity and comparing their yield with other durum wheat, we've demonstrated an impressive 25 per cent yield advantage under saline soil conditions," says CSIRO scientist, Dr Richard James.

The CSIRO Plant Industry research team responsible for the breakthrough recently isolated two salt tolerance genes (Nax1 and Nax2) derived from the old wheat relative *Triticum monococcum.* "Both genes work by excluding sodium, which is potentially toxic, from the leaves by limiting its passage from the roots to the shoots," says the leader of the project, Dr Rana Munns.

Through traditional, non-GM breeding methods aided by molecular markers the team was able to introduce the salt exclusion genes into durum wheat lines. Salinity, a major environmental issue affecting much of Australia's prime wheat-growing areas, often prevents farmers from growing durum wheat.

This research is a collaborative project between the CSIRO, the NSW Department of Primary Industries, the University of Adelaide and the Australian Centre for Plant Functional Genomics. It is supported by the Grains Research and Development Corporation (GRDC).

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CHINA

Finest carbon nanotube synthesized

Not long ago, scientists from Zhejiang University and University of California have successfully synthesized the smallest carbon nanotube, or C90, in the world. The finding was published in the first issue of German Applied Chemistry in the year. Chinese and American scientists have long worked together to synthesize novel and metal Fullerene. In recent years, they have achieved a range of findings on large carbon and metal Fullerene, and synthesized three large metal Fullerene: Gd2C2@C92, Ca@C94, and Sm2@C104, which eventually allowed them to work out a C90 with a unique nanotube structure. The synthesized C90 is 0.7 nanometer across, with a length at 1.1 nanometers, the world's finest and shortest closed carbon nanotube that can stay stable in the air, enjoying a high D5h symmetry. Researchers are currently working on the physical and chemical properties of C90, exploring its possible applications in the area of organic solar energy and nanoelectronic components.

http://www.most.gov.cn

Distributed GPU system

China's first distributed GPU computing system was put into official operation on April 24, 2010 at the premises of the Chinese Academy of Sciences (CAS). With the support of the Chinese Ministry of Finance, CAS has built the super GPU computing system with dual precision peak operations exceeding a petaflop per second, and a single precision peak operation exceeding 3 petaflops per second. In collaboration with Legend and Dawning, CAS has installed 10 computing systems able to work on a hundred-trillion peak operations per second at its subordinated institutes, which in turn builds up a distributed super GPU computing system able to run 6 petaflop operations per second.

At present, a number of research institutes under CAS, including Institute of Process Engineering, Institute of High Energy Physics, and National Astronomic Observatories, have used the computing system to work on high-energy physics modeling and associated experimental data analysis, astrophysics and space science studies, petroleum prospecting data analysis and oil reserve mining process modeling, and industrial and medical image processing. The super computing system has also provided services to a range of projects run by the national programs, National Natural Science Foundation, and large enterprises.

http://www.most.gov.cn

Carbon-fiber localization

A project to develop polymerization techniques for producing high performance PAN-based carbon fiber, undertaken by Ha'erbin Tianshun Chemicals, has recently passed the experts' approval. The project has achieved innovative developments in a number of areas. Researchers enhanced polymer spinability, and developed the techniques able to produce high performance PAN-based carbon fibers using the 3-element low temperature polymerization technique. They worked out the patented 3-element hardening and shaping techniques to enhance the properties of raw

fibers. The enhanced fibers enjoy a reduced pre-oxidation temperature and a steady carbonization process, which in turn cuts down fiber defects in the carbonization process. The reduced temperature has hit the bottom of the temperatures applied for polymerization in the industry. The innovation made the techniques applied meet the criteria of energy efficiency and emission reduction. Researchers also developed a raw fiber oil agent that has been test proved by Beijing Chemistry University desirable for pre-oxidation, without sticking and coking, with a dust rate less than 0.45%. Meanwhile, a vertical gradient washing facility, derived from the same effort, is a unique system in the country, enjoying the merits of energy efficiency and environmental protection.

The project has established a pilot production line with an annual capacity of 20 tons of high performance PAN-based carbon fiber, and has completed the test run of the production line, with high performance raw carbon-fibers produced up to the required standard.

http://www.most.gov.cn

INDIA

Artificial blood vessels developed from jatropha

After bio-diesel, this humble tropical weed could now help Indian researchers to indigenously develop blood vessels. A biodegradable polymer recently developed from Jatropha has attracted researchers from the Indian Institute of Technology-Madras (IIT-Madras) to work towards a project in this direction. IITians are not alone. A Thiruvananthapuram-based medical institute, Sree Chitra Tirunal Institute for Medical Sciences & Technology (SCTIMST), and a Belgium-based multi-national company have also evinced interest in the polymer developed by a Gujarat-based national research institute.

The Central Salt Marine Chemicals and Research Institute (CSMCRI) located in Bhavnagar district of the state has hit upon a process by which biodegradable polymers can be developed at almost zero-cost using one of the byproducts of Jatropha — a drought-resistant perennial plant that grows even in sandy and saline conditions.

"The technique to create bio-degradable plastic from the recently discovered polymers may not remain limited to making bio-degradable polythene bags. The IIT-Madras has now evinced interest in collaborating with us in developing artificial blood vessels," said Pushpito K Ghosh, director of the institute.

The institute has so far been offering its expertise to a number of Indian and foreign automotive manufactures like DaimlerChrysler, General Motors and Mahindra & Mahindra to develop efficient vehicles that run on bio-diesel sourced from Jatropha.

It has also been doing pioneering work in developing bio-diesel from Jatropha. The scientists, however, continued to experiment with one of the by-products crude glycerol and discovered this biodegradable polymer which is believed to have multiple uses in the field of medicine including the development of artificial blood vessels.

Such artificial blood vessels generally comprise of a woven, braided or knitted fabric structure. They are tubes made from synthetic (chemically produced) materials to restore blood circulation. "The polymer could be used in spinning thin hollow fibres which could act as a substitute for blood vessels," Mr Ghosh said. The polymer was a "relatively inert material" and is biodegradable when left in soil. "The long term degradation of this material is a matter of careful study," he added.

A leading cardiac surgeon in Ahmedabad, Dr Apoorva Kanhere says that any material that is being developed as an artificial blood vessel need to be inert and supple. "It should not be thrombogenic (meaning it should not aid the clotting of blood) and it should also be able to withstand the blood pressure," he said.

Synthetic grafts in humans are often required in various vascular by-pass surgeries. Such surgery is done to open blocked arteries in one part of the body by using a vessel from elsewhere in the body. However, up to 40% of patients (especially those who are diabetic) don't have a vessel suitable for the procedure. In such cases, surgeons use synthetic grafts or artificial blood vessels.

While IITians are looking to develop artificial blood vessels, a Kerala-based institute is also looking at possibilities to develop nano particulate systems which could be used in developing medical instruments for targeted delivery of drugs.

The success of the polymer has also attracted the country's Department of Science and Technology which has floated a proposal to fund 70% of the project cost, provided the institute has an industry partner who can fund the remaining 30% of the cost.

http://economictimes.indiatimes.com

First carbon fibre plant

Former President Dr APJ Abdul Kalam inaugurated the country's first carbon fibre manufacturing facility. The Rs 250-crore set up will produce lightweight material for use in defence, aerospace and infrastructure — under technology transfer from the National Aerospace Laboratory (NAL) of Council of Scientific and Industrial Research's (CSIR), which had developed the ultra-light material for the Light Combat Aircraft.

Kalpesh Patel, CMD, Kemrock Industries and Exports Limited, said that

their 400 tonne per annum output will primarily service the domestic aerospace needs — Indian Space Research Organisation and Hindustan Aeronautics Limited. "Carbon fibre is a unique material as it is stronger than steel, lighter than aluminum, and is corrosion resistant. Such qualities make it the best bet for manufacture of satellites, missiles, aircraft and rockets," he said.

http://www.indianexpress.com

ISRAEL

New fibre-optics technology to speed up internet

It may look like a piece of gel but it's a new nano-based telecom technology "enabler" that can make computers and the internet hundreds of times faster. The technology, that may be in use only five or 10 years in the future, is being designed by Koby Scheuer of Tel Aviv University's (TAU) School of Electrical Engineering.

Mr. Scheuer has developed a new plastic-based technology for the nano-photonics market, which manufactures optical devices and components. His plastic-based "filter" is made from nanometre (a billionth of a metre) sized grooves embedded into the plastic. When used in fibre optics cable switches, this new device will make our communication devices smaller, more flexible and more powerful, he says.

"Once Americans have a fibre optics cable coming into every home, all communication will go through it - telephone, cable TV, the Internet," adds Mr. Scheuer. "But to avoid bottlenecks of information, we need to separate the information coming through into different channels. Our polymeric devices can do that in the optical domain - at a speed, quality and cost that the semi-conductor industry can't even imagine," Mr. Scheuer says.

In the next decade, fibre optic cables that now run from city to city will feed directly into every individual home. When that technology comes to light, the new plastic-based switches could revolutionise the way we communicate.

"Right now, we could transmit all of the written text of the world though a single fibre in a fibre optics cable in just a few seconds," says Mr. Scheuer. "But in order to handle these massive amounts of communication data, we need filters to make sense of the incoming information. Ours uses a plastic-based switch, replacing hard-to-fabricate and expensive semi-conductors."

Semi-conductors, grown on crystals in sterile labs and processed in special ovens, take days and sometimes months to manufacture. They are delicate and inflexible as well, Mr. Scheuer explains. "Our plastic polymer switches come in an easy-to-work-with liquid solution. Using a method called 'tamping,' almost any lab can make optical devices out of the silicon rubber mould we've developed."

His biggest hurdle, says Mr. Scheuer, is in convincing the communications industry that polymers are stable materials. "There is a lot of prejudice in this industry against plastics. But this approach could take us to a new level of communication," the researcher says, according to a TAU release.

He also notes that the process is not much different from the way that mass numbers of DVDs are produced in a factory - except Mr. Scheuer works on a nano, not a "giant" micro, scale. His device can also be used in the gyros of planes, ships and rockets; inserted into cell phones; and made a part of flexible virtual reality gloves so doctors could "operate" on computer networks over large distances.

http://beta.thehindu.com

The end of an inter-duct tube, which protects fibre-optic cables. (Photo: AP)

JAPAN

Flexible CIGS solar cell submodule

Shigeru Niki (Leader; concurrently, Deputy Director of Research Center

for Photovoltaics), Shogo Ishizuka (Research Scientist) et al., of the Thin Film Compound Semiconductor Team, Research Center for Photovoltaics, the National Institute of Advanced Industrial Science and Technology (AIST) have demonstrated the world's highest photovoltaic energy conversion efficiency among monolithically integrated flexible solar cell submodules (independently certified efficiency) of 15.9% (aperture area: 75.7 cm2) using a CIGS thin film (a solar cell material made of Copper, Indium, Gallium and Selenium).

Lightweight and flexible solar cells are attracting attention as a key technology for wider use of photovoltaic power generation; we can expect wider applications because they can be installed even at locations where current solar cell panel modules cannot be installed. However, it was extremely difficult to obtain photovoltaic energy conversion efficiency higher than 10% in a flexible solar cell module of an integrated structure. We have worked on the technical challenges of alkali addition control and integration processes, and succeeded in drastically enhancing the photovoltaic energy conversion efficiency of an integrated-type flexible CIGS solar cell using a submodule-size substrate of the practical use level.

http://www.aist.go.jp

Continuous synthesis equipment for metal nanoparticles

Masateru Nishioka (Research Scientist), Catalysis Team (Leader: Masayuki Shirai), the Research Center for Compact Chemical Process of the National Institute of Advanced Industrial Science and Technology (AIST) and K. K. Shinko Kagaku Kogyosho (President: Hiroshi Kunigami) have jointly developed continuous production equipment for metal nanoparticles and have succeeded in the practical use of a process where metal nanoparticles are synthesized continuously with uniform quality. The continuous production equipment for metal nanoparticles is developed utilizing a technology for microwave flow reactors jointly developed by AIST and IDX Co., Ltd. (President: Shuitsu Fujii).

Although it has been known that metal nanoparticles with a uniform size can be synthesized in a short time by applying microwave irradiation to reactant solution, the continuous synthesis suitable for industrial production has been difficult. AIST had developed a technology for applying a concentrated and uniform microwave to a tubular reactor by using a semiconductor microwave source. In this joint research, the irradiation technology was optimized for a metal nanoparticle synthesis and the safe equipment for the continuous synthesis of metal nanoparticles with stable quality was put into practical use.

Because the conventional production of various kinds of metal nanoparticles has been carried out in batch operation, there are problems such as considerable time and effort required for maintenance including the change of reaction solution and washing in each batch, stability of quality, and the environmental load by waste water treatment. The equipment developed here overcame these problems and allowed the continuous synthesis and stable quality of synthesized metal nanoparticles.

http://www.aist.go.jp

Superconductivity in iron-based superconductors

A research team at RIKEN, Japan's flagship research organisation has experimentally determined the mechanism underlying the formation of electron pairs in iron-based high-temperature superconductors. The landmark finding, reported in the April 23rd issue of *Science,* establishes a key role for magnetism in superconductivity.

In classical theory, superconductivity occurs when two electrons are bound together to form a pair, known as a Cooper pair, by lattice vibrations. This pairing mechanism, however, has never been confirmed for high-temperature superconductors, whose transition temperatures, well above the theoretical limit of about 40K, pose an enigma for condensed matter physics.

The iron-based superconductors investigated by the research team, first discovered in 2008 by Japanese researchers, offer the greatest chance of solving this enigma. With a maximum transition temperature of 55K, these superconductors are governed by an electron pairing mechanism that is different from earlier superconductors mediated by lattice vibrations, one based on two types of electrons with different momenta.

To analyze this complex pairing mechanism, the researchers applied scanning tunnelling microscopy to electron pairing in Fe(Se, Te), the iron-based superconductor with the simplest crystal structure. Imaging electronic standing waves produced by scattering interference under a powerful 10-Tesla magnetic field, they found that Cooper pairs adopted a characteristic "s±-wave" structure that is unique to a material with two types of electrons.

The discovery of s±-wave structure breaks new ground by supporting a mechanism for electron pairing based not on lattice vibrations, as in other forms of superconductivity, but on magnetism. In providing a powerful constraint on theoretical models, the finding thus marks a major advance towards unraveling the

mystery of high-temperature superconductivity.

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REPUBLIC OF KOREA

New nano material developed

The Republic of Korean researchers have developed an advanced high-density nano material that eventually could be transformed into a next-generation memory device, a state-run research foundation said yesterday. The National Research Foundation of Korea said a team led by Kim Jin-kon, a professor of chemical engineering at Pohang University of Science and Technology, created a 20 nanometer-level ferroelectric material. A nanometer is equal to one-billionth of a meter (3.3 feet).

It said the nano material has all the good characteristics of ferroelectrics, yet it is much smaller than similar devices built in the past. The smallest ferroelectric material is 60 nanometers in size. Ferroelectric material has generated considerable interest because of its ability to maintain its "polarization" without an electrical field. This quality allows it to be used in sensors, and it can be employed as a non-volatile memory device.

Non-volatile devices are expected to replace the ubiquitous dynamic random access memory chips (DRAM) used by all computers today. DRAMs are volatile memory devices that lose data when they have no power source.

"Such a material, if it can be made into chips, could cut back on energy use and significantly reduce the booting time of computers," the foundation said. The research foundation claimed this could allow it to be utilized in futuristic computers. The discovery has been published in the latest Internet edition of the *Nano Letters* journal.

http://joongangdaily.joins.com

EUROPE

IRELAND

Novel oat processing technologies

Oat is a highly nutritious cereal, which can be tolerated by large number of celiac patients. A range of commercial oat flours as well as specific oat flours produced from single varieties have been evaluated for their suitability for bread-baking. Enzyme technology, bioprocessing as well as high-pressure processing technology have been successfully applied to improve the quality, safety and nutritional attributes of oat based foods.

The interest in oats for human nutrition is growing due to its exceptional nutritional quality. In fact, the health effects of oats rely mainly on the total dietary fibre and β-glucan content, which reduce postprandial blood glucose and insulin responses and lower blood lipids, especially serum total and LDL-cholesterol. Besides β-glucan, oats also contain high amounts of other valuable nutrients such as proteins, unsaturated fatty acids, vitamins, minerals and antioxidants. Moreover, recent studies have shown that oats can be tolerated by most people suffering from celiac disease.

Bread, mostly made from wheat, is an essential constituent of the human diet and the nearly ubiquitous consumption places it in a position of global importance. Thus, the development of 100% oat bread could enhance the range of products suitable for people affected by celiac disease and satisfy the consumer demand for diverse and healthy foods. Yet, oat proteins do not possess the unique visco-elastic properties characteristic for wheat gluten, thus oat doughs resemble cake batters rather than bread doughs. Furthermore, most studies investigating the effect of oats on bread quality were previously conducted on composite breads, containing significant amounts of wheat which masked bread making properties of oats.

Consequently, the objective was to establish the properties of oats required for the production of high quality oat bread by exploiting a combination of baking, rheological and analytical chemistry techniques. The bread making properties of commercial oat flours as well as oat varieties were investigated on simple flour/water mixtures without addition of wheat or structure forming agents in order to avoid synergistic effects with functional ingredients. Moreover, sourdough fermentation and Hydrostatic Pressure (HP) processing were investigated for their potential to improve oat bread quality.

The results showed significant differences in the bread making performance of commercial oat flours. Overall, it was established that in order to achieve high quality oat bread wholegrain oat flours should present low batter viscosity, low flour water hydration capacity, starch content of above 65%, protein content of about 12%, low starch damage and coarse particle size. In addition, it was assessed whether certain oat varieties yield better quality bread than others by investigating their bread making properties under optimised

conditions, which allowed the evaluation of oat constituents affecting oat bread quality.

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THE NETHERLANDS

Soot-free diesel derived from industrial waste

Diesel has two drawbacks: it leads to fine particles (soot) and is made of a raw material becoming exhausted: oil. TU/e researcher Michael Boot developed a new diesel type (Cyclox), which emits far less soot. The raw material for this comes from industrial waste. Doubly 'green' then, this new biodiesel. In addition, this raw material may serve to make nylon. On April 20 Boot will defend his dissertation at Eindhoven University of Technology.

The doctoral research conducted by ir. Michael Boot was intended to make a soot-free diesel variant. He has succeeded in doing so by mixing the substance cyclohexanone with ordinary diesel. This causes the fuel, which is named Cyclox, to ignite later than usual, which allows oxygen and fuel to mix better. As a result, fewer soot particles are produced. "We have measured zero emission of soot at an air-fuel ratio of 50 to 50", Boot explains. During tests conducted in an idling passenger car, with a ratio of 10/90 (cyclohexanone/ordinary diesel), there is a fifty percent reduction in soot emission. That is an important datum, as soot emission poses a problem in inner cities in particular, where cars often move slowly or idle. The university has applied for an international patent on Cyclox.

Moreover, Boot's research bore out that cyclohexanone can be made from lignin. This substance is released in great quantities as a waste product in the paper industry, among others. For this reason the Eindhoven researcher wants to try and develop an industrial process for making cyclohexanone from waste lignin on a large scale and at low cost. Together with three Departments and several companies he has submitted a project proposal for this with Agentschap NL. The purpose is eventually to make not only Cyclox with this, but also 'green' nylon. Indeed, cyclohexanone is also the main raw material of nylon.

It sounds like just the thing we want: fuel and nylon from waste. Will all our cars be running on this 'waste fuel' before long? It will not come to that. In the Netherlands for one, the amount of waste lignin is enough to reach five percent admixture to all diesel taken in. In the Scandinavian countries, where the paper industry is bigger, this percentage is higher. Boot: "Cyclox is not the final solution, but it can make a substantial contribution to solving the energy issue."

Boot found yet another way to make diesels cleaner. He came up with a new kind of diesel injector tip, the PFAMEN (Porous Fuel Air Mixing Enhancing Nozzle). Normally an injector tip has a limited number of holes. Boot had a surprising idea: what if we use a filter as the tip? Thereby the diesel is atomized much more, so its combustion is better – as well as cleaner. Boot developed this idea into a prototype, which has already carried out half a million injections successfully. The PFAMEN has another big advantage: it works at a lower than the usual pressure. This reduces the fuel consumption. And the fuel circuit, which is the most expensive part of the engine, can be made much more cheaply.

http://www.azocleantech.com

NORTH AMERICA

CANADA

New biomaterial that mimics muscle elasticity

University of British Columbia researchers have cast artificial proteins into a new solid biomaterial that very closely mimics the elasticity of muscle. The approach, detailed in the current issue of the journal *Nature,* opens new avenues to creating solid biomaterials from smaller engineered proteins, and has potential applications in material sciences and tissue engineering.

"There are obvious long-term implications for tissue engineers," says Hongbin Li, associate professor in the Department of Chemistry. "But at a fundamental level, we've learned that the mechanical properties we engineer into the individual proteins that make up this biomaterial can be translated into useful mechanical properties at the larger scale."

Li, Canada Research Chair in Molecular Nanoscience and Protein Engineering, and UBC colleague John Gosline, professor in the Dept. of Zoology, engineered the artificial proteins to mimic the molecular structure of titin.

Titin – also known as connectin – is a giant protein that plays a vital role in the passive elasticity of muscle. The engineered version-which resembles a chain of beads-is roughly 100 times smaller that titin. The resulting rubber-like biomaterial showed high resilience at low strain and was tough at high strain -- features that make up the elastic properties of muscles.

"A hallmark of titin-like proteins is that they unfold under a stretching force to dissipate energy and prevent damage to tissues by over-stretching," says Gosline. "We've been able to replicate one of the more unique characteristics exhibited by muscle tissues, but not all of them."

The mechanical properties of these biomaterials can be fine-tuned, providing the opportunity to develop biomaterials that exhibit a wide range of useful properties -- including mimicking different types of muscles. The material is also fully hydrated and biodegradable. UBC researchers Shanshan Lv, Daniel Dudek, Yi Cao and MM Balamurali also contributed to the study. This research is supported by the Canadian Institutes of Health Research, the Canada Research Chairs program, the Canada Foundation for Innovation, the Michael Smith Foundation for Health Research, and the Natural Sciences and Engineering Research Council of Canada.

http://www.sciencedaily.com

DNA nanotubes

McGill researchers create DNA nanotubes able to carry and selectively release materials. A team of McGill Chemistry Department researchers led by Dr. Hanadi Sleiman has achieved a major breakthrough in the development of nanotubes – tiny "magic bullets" that could one day deliver drugs to specific diseased cells. Sleiman explains that the research involves taking DNA out of its biological context. So rather than being used as the genetic code for life, it becomes a kind of building block for tiny nanometre-scale objects.

Using this method, the team created the first examples of DNA nanotubes that encapsulate and load cargo, and then release it rapidly and completely when a specific external DNA strand is added. One of these DNA structures is only a few nanometres wide but can be extremely long, about 20,000 nanometres. (A nanometre is one-10,000th the diameter of a human hair.)

Until now, DNA nanotubes could only be constructed by rolling a two-dimensional sheet of DNA into a cylinder. Sleiman's method allows nanotubes of any shape to be formed and they can either be closed to hold materials or porous to release them. Materials such as drugs could then be released when a particular molecule is present.

One of the possible future applications for this discovery is cancer treatment. However, Sleiman cautions, "we are still far from being able to treat diseases using this technology; this is only a step in that direction. Researchers need to learn how to take these DNA nanostructures, such as the nanotubes here, and bring them back to biology to solve problems in nanomedicine, from drug delivery, to tissue engineering to sensors," she said.

The team's discovery was published on March 14, 2010 in *Nature Chemistry.* The research was made possible with funding from the National Science and Engineering Research Council and the Canadian Institute for Advanced Research.

http://www.innovations-report.com

USA

Technology to print solar cells on paper

Scientists at the Massachusetts Institute of Technology have developed a new technology that allows solar cells to be coated on paper. The printed solar cells are still in the research phase and might be years away from being commercialized. The technique involves the coating of organic semiconductor material on paper using a process similar to an inkjet printer.

The solar cells that are developed using carbon-based dyes are about 1.5 percent to 2 percent efficient in converting light into electricity, but the cost of manufacturing the cells is less. MIT is focusing much of its effort on quantum dots, which can prove beneficial in energy conversion.

http://www.ecofriend.org

Carbon composite holds promise for bionics

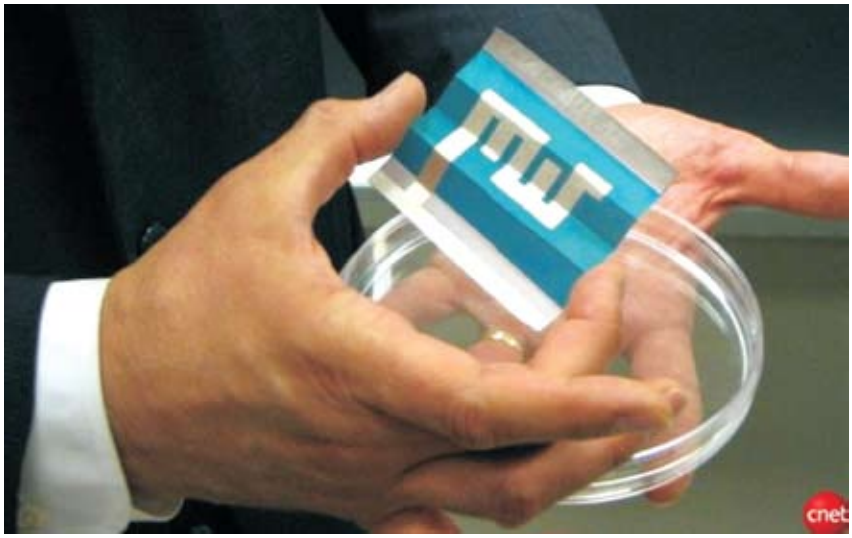
Mimicking the human nervous system for bionic applications could become a reality with the help of a method developed at Oak Ridge National Laboratory to process carbon nanotubes. While these nanostructures have electrical and other properties that make them attractive to use as artificial neural bundles in prosthetic devices, the challenge has been to make bundles with enough fibers to match that of a real neuron bundle.

With current technology, the weight alone of wires required to match the density of receptors at even the fingertips would make it impossible to accommodate. Now, by adapting conventional glass fiber drawing technology to process carbon nanotubes into multichannel assemblies, researchers believe they are on a path that could lead to a breakthrough.

"Our goal is to use our discovery to mimic nature's design using artificial sensors to effectively restore a person's ability to sense objects and temperatures," said Ilia Ivanov, a researcher in the Center for Nanophase Materials Sciences Division. Ivanov and colleagues at ORNL recently published a paper in *Nanotechnology* that outlines the method of processing loose carbon nanotubes into a bundle with nearly 20,000 individual channels.

Ultimately, the goal is to duplicate the function of a living system by combining the existing technology of glass fiber drawing with the multi-functionality of sub-micron (0.4 micron) scale carbon nanotubes, according to Ivanov, who described the process.

Ivanov and John Simpson of the Measurement Science and Systems Engi-



Low-cost solar cells being developed at MIT

neering Division are doing something similar except they use thousands of glass tubes filled with carbon nanotube powder. After several draw cycles, they demonstrated that they could make fibers just four times thicker than a human hair containing 19,600 submicron channels with each channel filled with conducting carbon. Each carbon nanotube-containing channel is electrically insulated from its neighbors by glass so it can be used as an individual communication channel. With this achievement, the researchers are moving closer to realizing one of their goals.

"The human hand has a density of receptors at the fingertips of about 2,500 per square centimeter and about 17,000 tactile receptors in the hand," Ivanov said. "So in terms of density of channels, we are already in the range needed for 17,000 receptors in the hand." This multichannel composite has many other potential uses, including in aeronautics and space applications, where low weight of conducting wires is important. The next steps are to make these channels highly conductive and then show sensor communication through individual channels.

http://www.innovations-report.com

Tiny glass beads can deliver drugs

A Duke University engineer is working on a way to change medicines and convey them without clogging syringes. Anyone who has made rock candy in a kitchen chemistry experiment is familiar with the transformative process of evaporation. Now a Duke engineer is using a similar approach to make something more sophisticated: protein-based, intravenously delivered pharmaceutical drugs in tiny glass bead form.

By putting proteins dissolved in water into a larger solution of the organic solvent octanol, David Needham, an engineer and chemist at the Duke University Pratt School of Engineering, discovered he could remove the water, leaving behind a spherical, protein glass bead. The process is called glassification.

"With this method, we can control the size of the protein particles, as well as the rate of dispersion for more efficient drug delivery," Needham said. "We've also determined that glassification helps proteins hold on to their work abilities better than other protein preservation methods."

Michael Bishop, director of medicinal chemistry for GlaxoSmithKline Research & Development, said the pharmaceutical company is in preliminary discussions with Needham to see if glassification can make drug delivery and production more efficient and less expensive.

Protein-based drugs include insulin or the cancer drug Herceptin. Currently, the ingredients must be freeze-dried into a powder. The protein powder must be hydrated to work as an injectable drug, but it often clogs the delivery syringes. Using glass beads is more efficient because they create a thinner substance that won't block syringes, Needham said.

John Carpenter, a professor of pharmaceutical biotechnology at the University of Colorado Denver, said the cost of shifting to Needham's technology may be prohibitive, at least until the process proves viable in large-scale testing. "It sounds good on paper, but for traditional vaccines, drugs, and therapeutic proteins, I don't see (Needham's) discovery replacing the current system," Carpenter said. Still, he said, the development holds promise. "I'm excited that his engineering can be applied to other approaches that have failed because they haven't been able to control particle size, like those that blast drugs through the skin," Carpenter said.

http://www.charlotteobserver.com

Special theme of Asia-Pacific Tech Monitor, Jul-Aug 2010

SME Entrepreneurship: Creating sustainable and high performance SMEs