

### New Device for Surgeons

An ingenious device that joins blood vessels, reducing the risk to patients and shortening the time they spend in surgery, has been developed by surgeons in the UK. The system was created by clinicians from Papworth Hospital in Cambridgeshire, the country's largest specialist cardiothoracic hospital and the main heart and lung transplant centre.

The sutureless (stitchless) connector, devised to streamline complex vascular surgery, fits neatly inside a blood vessel, enabling grafts to be attached without using sutures for the first time. The device was invented by consultant cardiothoracic surgeons Stephen Large and Samer Nashef who explained that in patients with vascular problems such as aortic aneurysms, part of a vessel may need to be replaced with a synthetic graft.

According to the surgeons, in this system a connector is placed inside the cut end of the patient's blood vessel and secured by using engineered grips. The graft is then passed over the cut end of the vessel and secured by simply tying a thread around the joint. The design of the connector ensures that this cannot slip off and that the connection is robust.

There are many recognised problems with the current system of grafting blood vessels, including bleeding and the time taken to complete the work. "At present, the vessel and the graft are sewn together using sutures, but this is an intricate and time-consuming procedure," said Large. "It can take 15 minutes to complete a single connection and in some patients, five connections need to be made in this way. This leads to lengthy surgery with all the associated risks." He pointed out that suturing the vessel leaves tiny holes around the connection, which can result in bleeding and other complications.

The sutureless connection solves these problems by providing a quick, simple attachment without leaving any holes in the vessel. The connector has a non-slip surface to prevent movement within the blood vessel and features malleable grips that can be adjusted to hold it firmly in place.

Prototype designs have been tested in pig hearts

that are frequently used as a model of the human heart. This testing helped to identify features of an optimum design that is now being developed further. About 215,000 synthetic vascular grafts are sold each year and the market in Europe for aortic repair grafts stands at US\$40 million.

"Our technology will enable healthcare managers to reduce their costs by shortening operation times," explained Large. "In addition, as the risk to the patient is reduced, so the costs of any follow-on care will also likely be diminished." The consultants involved with the project have been working with Health Enterprise East – the National Health Service (NHS) innovation hub for East England – and Papworth Hospital NHS Foundation. □

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### NIO Acquires New Research Vessel

The research vessel *RV Sindhu Sankalp* that has been recently acquired by the National Institute of Oceanography (NIO), Goa, is now undergoing tests and checks for obtaining statutory clearances before beginning its voyages. After obtaining the clearances, the ship will undertake trial research cruises during the next few months, when various newly installed facilities on the ship will be tested, besides collecting data for research. Once NIO is fully satisfied with the handling of the gear and management of the vessel, the latter will be formally dedicated to the nation.

*RV Sindhu Sankalp* is a 56.3 metre vessel with a cruising speed of 11.5 knots. It has a range of 20,000 nautical miles and endurance of 30 days. It can carry 35 persons : 16 scientists, 4 supporting staff and 15 crew members. The vessel has undergone extensive refitting at the Cochin Shipyard Ltd., Kochi, where it has been equipped with modern research equipment for studying physical, chemical, biological, geological, and geophysical oceanography.

The equipment on board *RV Sindhu Sankalp* can record profiles of temperature and salinity in the water column, collect high-resolution data on ocean bottom

topographic features, and profile geophysical structure below the ocean floor. The vessel has equipment to collect water samples at different depths for studies on water column biology and chemistry, and can deploy and retrieve moorings for longterm data recording at sea.

The ship is equipped with three laboratories to conduct on-board analysis and for processing of data. Other equipment on board includes a towing magnetometer, a sparker system, a side-scan sonar system, an automated weather station and seabed samplers.

The new ship has arrived at a time when NIO's research programmes are midway through the 11th Five Year Plan (2007-12) and have been facing shortage of ship-time due to paucity of research vessels in the country. With acquisition of the new vessel, NIO now has two vessels, the second being the 23 meter coastal research vessel, *Sagar Sukti*, which operates mainly in the vicinity of India's coastline. The ship that has now been renamed *RV Sindhu Sankalp*, earlier served as a fishery training vessel *Chishio Maru* for Japan and operated in the Pacific Ocean. NIO acquired this Ship in November 2008 and has now completed its conversion to a multi-disciplinary oceanographic research vessel. □

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### **Monitoring Tsunamis Through Underwater Communication Network**

**A** Novel study reveals that tsunamis send electric signals through the ocean, which could be sensed by the vast network of communication cables on the seabed.

C. Manoj Nair and T. Harinarayana of the National Geophysical Research Institute, Hyderabad; Alexei Kuvshinov of the Swiss Federal Institute of Technology, Zürich; and S. Neetu of the National Institute of Oceanography, Goa used computer models to estimate the size of an electric field created by the force of the 2004 Indian Ocean tsunami as it travelled over major submarine cables.

Salty seawater, a good conductor of electricity, generates an electric field as it moves through Earth's geomagnetic field. "We estimate that the 2004 tsunamic induced voltages of about 500 millivolts (mV) in the cables. This is very small compared to a 9-volt battery, but still large enough to be distinguished from background noise on a magnetically quiet day. By

monitoring voltages across this network of ocean cables, we may be able to enhance the current tsunami warning system", said the researchers.

Tsunamis are created by a large displacement of water resulting from earthquakes, landslides, volcanic eruptions, and even meteors hitting the ocean. Vessels far out at sea may not notice the waves passing underneath at the speed of a jetliner, because the wave heights are very small in the deep ocean. This makes their detection and monitoring a challenge.

The current tsunami warning system relies on a global seismometer network to detect earthquakes that may indicate an impending tsunami. Deep-ocean pressure sensors and coastal tide gauges are the only tools available to detect and measure an actual tsunami. The electric current induced in submarine cables may provide an additional way to confirm and track a tsunami. □

*CSIR News*

### **Risorine – A Novel CSIR Drug Curtails TB Treatment**

**I**n a significant development, Indian Institute of Integrative Medicine (IIIM), Jammu, in public private partnership with Cadila Pharmaceutical Ltd., Ahmedabad, has released a new drug formulation against tuberculosis called '*risorine*' that contains reduced dose (200 mg) of rifampicin + isoniazid (300 mg) + piperine (10 mg) found to be bioequivalent to standard rifampicin regimen. Launched in November 2009, this indigenously developed drug formulation could drastically cut short the duration of TB treatment. Risorine has been approved for marketing by Drug Controller General of India after successful completion of all the phased clinical trials.

The R & D work on developing this formulation was started in the erstwhile Regional Research Laboratory, Jammu now renamed as Indian Institute of Integrative Medicine by Dr. C. K. Atal, former Director, in early 1980s. On scrutinizing a large number of ancient Indian Ayurvedic formulations used in the treatment of a wide range of diseases, it was observed that in a majority of formulations '*Trikatu*' was used as one of the ingredients. *Trikatu* is a combination of three herbal products namely, *Piper nigrum* (black pepper), *Piper longum* (long pepper) and ginger.

Concerted research efforts resulted in the isolation of an active alkaloidal molecule called 'piperine' from piper species, which was shown to increase the bioavailability

of specific drugs. On combining piperine with many common drugs, a reduction of dose of that drug was observed for the same pharmacological effects, without any activity of piperine itself. This is due to enhanced uptake of the drug by body cells, and also because the drug remains available in blood for long durations.

Popularly known as bioenhancers', such compounds simply enhance the bioavailability and bio-efficacy of other drugs with which they are combined, without any pharmacological activity of their own at the same dose level. Scientists at IIM, Jammu, tested the bioenhancing activity of piperine on various drugs, which ultimately resulted in designing the risorine formulation useful for the treatment of tuberculosis. The work, now patented, has been documented in various national and international journals particularly in India, Europe and USA.

The bacterium, *Mycobacterium tuberculosis*, infects one in three people worldwide and kills about 3 million victims every year on a global scale. Nearly 9 million new TB cases add to the TB burden of our planet annually. TB is a major public health problem in our country as India accounts for one-fifth of the global TB incident cases. Besides this huge burden of TB patients, the cases with multi-drug resistant tuberculosis (MDR-TB) are on the rise as many patients discontinue with the TB drugs, primarily rifampicin and isoniazid, due to long treatment and unpleasant side effects of the drugs.

Rifampicin has been a first line antitubercular drug for a long time. It has been used for treating tuberculosis since 1960s and is known for causing many side effects. Also, the levels of rifampicin in blood decrease over a period of time due to the auto-induction of drug metabolizing enzymes by rifampicin.

In fact, cells of the human body contain on their surface membranes certain proteins called 'transporter' proteins that 'pump' specific substances out of cells, for being taken away by the blood. Undoubtedly, these proteins can protect cells from toxic overloads of many substances, but at the same time they can also spoil the efficacy of otherwise beneficial drugs, like rifampicin, by pumping them out of the cells before they can act. One of the most important such 'pump' proteins is *p-glycoprotein*, which is found in the membranes of cells in the intestines, brain, liver, pancreas, kidneys, and other tissues.

At the molecular level, piperine acts by suppressing *p-glycoprotein* and *cytochrome P450* enzymes, which counteract the metabolism of rifampicin via these proteins, thus enhancing the oral bioavailability of rifampicin.

Piperine also decreases the intestinal production of glucuronic acid, thus allowing more substances to enter the body in active form. This wonder compound thus allows many drugs to enter and remain within their target cells for longer durations.

Management of TB with risorine is poised to have remarkable benefits as the use of bioavailability enhancers, in general, not only increase the bioavailability for a drug, but also help reducing the cost of treatment and incidents of drug resistance while minimizing adverse drug reactions. In this new formulation, the rifampicin dose has been reduced from 450 mg to 200 mg along with isoniazid and piperine, with the same pharmacological activity as used earlier. Risorine could even replace the currently used rifampicin for 'Directly Observed Treatment Shortcourse' (DOTS) therapy, run by the Central Government in association with different States.

According to the team of scientists at IIM, risorine is very safe, effective and economical for the management of tuberculosis. In other words, with use of risorine TB patients would get cured in a shorter span of treatment. Interestingly, in a multi-centric clinical trial conducted across India in patients with radiologically confirmed diagnosis of pulmonary tuberculosis, more than 90% of the patients treated with risorine were cured of tuberculosis with lesser side effects. Cadila Pharmaceuticals is all geared to take this new formulation for tackling TB to foreign markets like China, Russia and African countries and expects to multiply its turnover from this segment by over ten times in the coming few years.

A marvel of the plant world and a sure gift to humankind, the black pepper has both culinary and medicinal values. Among its myriad medicinal properties, the one that makes its compound piperine a bioenhancer holds immense promise for making 'dose economy' drugs that particularly suit the health needs of people in the developing countries. □

*P. Cheena Chawla*

## X-ray Imaging Based Mango Sorting System

Mango is one of the most important fruits in India. The internal quality of mango is a concern for consumers and export traders. The Indian mango variety viz. *alphonso* is the most important fruit for export. This variety, however, suffers from physiological disorder of spongy tissue growing in the pulp portion of the mango because of which, its export value and consumer

satisfaction are affected. So far the causative factor of this occurrence has not been identified and there is no proven technology for its control as yet.

Certain varieties of mango viz., *neelam* and *totapuri* have seed weevil or stone-weevil infestation, which can affect the processed pulp. Due to this, the exporters and processors are unable to provide quality mangoes and pulp free from spoilage. As the presence of spoiled pulp inside the mango is not visible to human eye, it is not possible to detect affected mangoes. Till now, certain countries had banned the import of Indian mangoes because of this. In such a scenario, the immediate priority is to detect spongy tissue and seed weevil infected mangoes by instrumental means and grading good quality mangoes for consumption and export.

In view of the above, CEERI's Chennai Centre, at CSIR Madras Complex had taken up a project with funding support from the Department of Science and Technology (DST), New Delhi. Under this programme, a totally non-destructive indigenous technology was developed by employing X-ray imaging technique to sort the mangoes based on internal disorders in real time. This system is poised to be a boon to mango growers, exporters, traders and processing industries. This X-ray scanned mangoes are safe for consumption and there is no health hazard. The developed system was also demonstrated to various user agencies, equipment manufacturers and potential entrepreneurs during a Technology Awareness Workshop held on 4 and 5 June 2009 at Chennai. This technology has now been transferred to M/s Proteck Circuits and Systems Pvt. Ltd. Chennai, for commercialization. □

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### **ISNA Received Meghnad Purashkar – 2009**

Professor Sudhendu Mandal, Honorary Secretary, Indian Science News Association (ISNA) is receiving Meghnad Purashkar – 2009 from Honorable Minister Dr. Surya Kanta Misra, Minister of Health and Family Welfare, Govt. of West Bengal at the Inaugural Ceremony of the 17<sup>th</sup> West Bengal Science and Technology Congress held on 4<sup>th</sup> April, 2010 at West Bengal University of Animal



and Fishery Sciences, Kolkata. The Purashkar was given by Department of Science and Technology, Govt. of West Bengal for the best services rendered by the ISNA towards the popularization of science in West Bengal. □

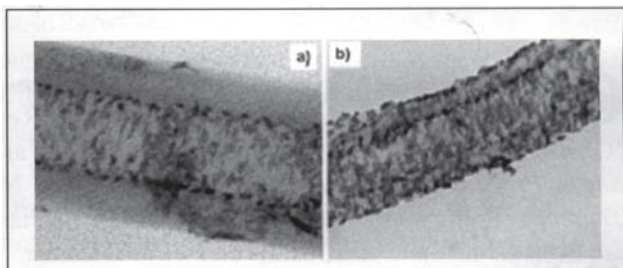
### **A New Strategy for Developing Thin Fuel Cell Electrodes**

Proton Exchange Membrane Fuel Cells (PEMFC) hold great promise for addressing the evergrowing energy demand because of their high efficiency, simplicity in operation and zero emission. Despite their advantages, fuel cells deployment faces stiff economical and technical barriers.

A principal drawback is the slow oxygen reduction reaction leading to inadequate efficiency of energy conversion in PEMFCs. To overcome this limitation and to achieve practical current densities, Pt is the best suited catalyst till date. However, to obtain better performance, a proper dispersion of Pt nanoparticles on a suitable support material is needed.

So far one-dimensional nanostructures of carbon such as nanotubes and nanofibers have triggered wide interest, mainly due to their exciting features such as anisotropy, unique structure and surface properties. However, notwithstanding the much hyped advantages of these materials for fuel cell electrode applications, the inherently low surface area possessed by them restricts the amount of active component (Pt) that can be dispersed on these materials.

A catalyst with higher carbon to Pt ratio can lead to better dispersion, but this will result into a thick layer of catalyst with concomitantly higher mass transfer and electric resistances. From the point of view of designing membrane electrode assemblies (MEAs) – the active power producing center of a PEMFC – apart from controlling the size of Pt and its dispersion, a proper tuning of mass transfer rate is also important.



To overcome these two prevailing constraints on mass transfer and electric resistance there is a need to develop MEAs with thin electrodes. To accomplish this goal, a desired level of Pt loading should be achieved while restricting the carbon content to the minimum possible level.

Dr. Sreekumar and colleagues at the National Chemical Laboratory (NCL), Pune, have developed a novel approach to address these issues. The basic idea is to exploit the inner cavity of nanostructured carbon support materials for metal dispersion, which is more complex as compared to outer wall utilization.

A fascinating aspect of this achievement is that by implementing the metal dispersion on the inner and outer walls of the substrate, the available active species' surface area can be doubled by keeping the same carbon amount.

Moreover, the hollow cavity may provide an intriguing confinement environment which can result in a modified behaviour of the materials confined inside.

The key step in the proper choice of a support material with tubular morphology and open tips where the inner cavity can be utilized as well. The first step towards practical utility is the filling of such cavities with suitable materials which need a better interplay between capillary action and wettability.

This goal is attained by a careful optimization of experimental procedure to achieve balanced surface tension and polarity characteristics of the reaction medium. Thus, by proper control of the experimental parameters, selective decoration of Pt nanoparticles on the inner as well as on the inner and outer walls of carbon nanofibers could be achieved.

Figure (a) and (b) show the HRTEM images of the Pt decorated carbon nanofiber samples consisting of decoration selectively on the inner wall and inner as well as the outer wall, respectively. While The HRTEM images show the selective decoration of Pt nanoparticles, the enhancement in the activity of the present catalyst as compared to the conventional CNT supported catalyst is clear from electrochemical studies. Cyclic voltammetry confirms almost double active area complimented by four times higher rate constant for oxygen reduction as revealed by rotating disk electrode (RDE) studies.

This catalyst has immense scope as an electrode material for PEMFCs because for a fixed catalyst loading, the available surface area will be doubled leading to better dispersion and a concomitantly low electrode thickness owing to the effective utilization of the carbon surface.

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