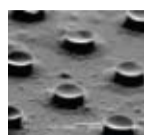


PERSPECTIVES

CORPORATE NEWS



Turning ordinary surfaces into extraordinary, multi-role materials

RESEARCH



New transparent polymer film as good as metalised plastic used in food packaging

AWARDS



Roses in Research

VISITS & EVENTS



Highlight of recent events

UPCOMING EVENTS



Seminars and workshops to look out for!

CORPORATE NEWS

Turning ordinary surfaces into extraordinary, multi-role materials

IMRE's nanoimprint technology (NIT) gives companies the opportunity to adopt a versatile, industry-ready technology that produces unique chemical and additive-free material surfaces through Singapore's first nanotechnology-focused industry consortium, the *Industrial Consortium On Nanoimprint (ICON)*.

Walls that are as colourful as a butterfly's wing, new non-slip materials, adhesives that do not leave sticky residues, waterproof and anti-bacterial surfaces for everyday use. These can all be produced without using chemicals or potentially harmful coatings but merely by engineering the surface or 'skin' of materials using a unique method called nanoimprint technology (NIT).



Butterfly wing nanostructure on synthetic materials produce similar iridescent colours

IMRE scientists have used NIT, which involves making uniform, nanometer-sized structures to create specifically patterned surfaces that produce specific properties. Often mimicking the structure of natural surfaces, examples of such technology include coating-free raw materials that are highly anti-reflective and anti-bacterial.

IMRE together with A*STAR's Institute of High Performance Computing (IHPC), and in partnership with Singapore's leading trade and industry development bodies, Economic Development Board (EDB), International Enterprise

(IE) Singapore and SPRING Singapore, launched the Industrial Consortium On Nanoimprint (ICON) in August 2010 to exploit this versatile technology. The first group of consortium members included Singapore's DSO National Laboratories and Solves Innovative Technology Pte Ltd, Nypro, Inc. (USA), Innoc Co., Ltd. (Japan), NTT-Advanced Technology Corporation (Japan) and Youngchang Chemical Co., Ltd. (South Korea).

"The goal of ICON is to open up NIT's many benefits to industries and to get them to adopt this versatile technique into some of their existing

processes", said Dr Low Hong Yee, Head of IMRE's Patterning and Fabrication Group which is driving the consortium.

"ICON is a proactive way for research institutes like IMRE to give back to our stakeholders – industry and ultimately the community", said Prof Andy Hor, Executive Director of IMRE.

"We were sold on the benefits of nanoimprint technology from the start and having a platform like ICON that helps put that technology into practice was all the convincing we needed to join the consortium", said Mr Tatsuo Shirahama, President of Innoc Co Ltd, Japan, which specialises in the design, development, production and sale of functional nanostructured films for light management and other applications. Innoc is confident that NIT can enhance the anti-reflection properties of the company's current display industry related plastic films by bringing down the optical reflectance to just 0.1%.



ICON Project Agreement Official Signing Ceremony (L-R): Prof Andy Hor (ED IMRE), Dr Kenji Kurihara (NTT-AT), Mr Tatsuo Shirahama (Innox), Mr Tan Kai Hoe (SPRING), Prof Charles Zukoski (Chairman SERC), Prof David Srolovitz (ED IHPC), Mr Bernard Nee (EDB), Mr Reginald Wee (IE), Mr Kennon Pek (Solves), Mr Lee Seung Hun (Young Chang), Mr Eric Paszkowski (Nypro)

The Pioneer Projects

The consortium was officially launched with two pioneer projects:

Highly anti-reflective surfaces

– This project aims to develop structures that have additional surface functional properties, such as self-cleaning, using novel nanoimprint processes developed in IMRE. Potential applications are in the area of photovoltaics, displays, optics and sensors. The project was launched on 3 August with 6 company members.



SEM image of anti-reflection structure

Anti-bacterial surfaces – This project aims to use NIT to create a chemical-free, eco-friendly alternative to existing technologies that prevent bacterial attachment to surfaces. An additional goal is to create a database of different surfaces to study how they affect bacterial attachment as there is currently no available design rule on effective anti-bacterial surface topography. Potential applications are in the packaging, biomedical and health science industries. The project will be launched in November 2010.

A third ICON project on roll-to-roll nanoimprint technology is expected to begin in the second quarter of 2011.

Membership has its privileges

ICON members enjoy a number of advantages:

- Access to the advanced nanoimprint technology and know-how in A*STAR
- Shared R&D resources and costs to develop new products and applications that reduces R&D risks and investments
- Training of manpower in nanoimprint techniques and tools
- Networking with companies that cover the entire spectrum of nanopatterning services

Molecular Materials Meeting (M3) @ Singapore

International Conference on "Big Ideas in Molecular Materials"
to commemorate the International Year of Chemistry (IYC) in 2011

10 - 11 January 2011 (Level 4, Matrix Building at Biopolis, Singapore)

This international meeting commemorates IYC 2011 by providing a forum for researchers in the field of molecular materials to discuss their BIG IDEAS in the intersecting area between materials and chemistry and related developments in other scientific and technological arena.

Come and be part of something BIG!

For more information and to register, please go to <http://www.imre.a-star.edu.sg/m3conference>

CORPORATE NEWS

Focus on the science and fame will follow

Prof Tang Ben Zhong believes that recognition does not need to be pursued but will follow when one focuses solely on doing good research.

“A good scientist doesn’t need to go around chasing titles and awards. Instead, just focus on doing good research and enjoy what you are doing, and you will find that recognition will naturally follow”, said Prof Tang Ben Zhong, advising young researchers on the important aspects in an R&D career.



Prof Tang Ben Zhong from The Hong Kong University of Science & Technology (HKUST)

Prof Tang should know – he has a number of awards to his name; Distinguished Young Scholar Grant (National Science Foundation of China – 2002), State Natural Science Award (2007), Croucher Senior Research Fellowship Award (2007), and has published over 300 journal articles, which have been cited about 9,000 times, making him one of the most cited scientists, chemists and materials scientists at one time or another. All this just by doing what he does best – focusing on his passion for research. He is the current Chair Professor of Chemistry at The Hong Kong University of Science & Technology (HKUST) and is one of a select number of people that have been elected to China’s prestigious Chinese Academy of Sciences which boasts an elite fraternity of some 700 top Chinese scientists.

research colleagues who are content with synthesising new polymers and publishing papers, Prof Tang makes it a point to ensure have a viable application in mind for the new polymer. “From my time in industry, I’ve learned that it is always useful to have an end in mind for the polymer that you are making to ensure your hard work has a life of its own after you’ve created it!”

It is here that he sees some similarities in the R&D work done at IMRE. “IMRE is a unique organisation as it acts like a conduit where the application-based research knowledge has a goal – to eventually be applied in industry”, said Prof Tang, adding that such research knowledge was essential in ensuring the continued advancement of the economy.

Prof Tang’s fascination with chemistry and materials, in particular polymers, began gradually from his college days and turned into a passion for developing new synthesis methods and processes for making new polymers. But unlike some of his

Prof Tang was at IMRE to give a presentation on “Aggregation-Induced Emission: Phenomenon, Mechanism and Applications” in August 2010.

Doing research in materials science to make a difference

Prof Zhao Dongyuan thinks that materials R&D will play a crucial role in tackling today’s issues relating to sustainability, the environment, energy, and health.

“I chose materials science as my vocation because it is an important research field, and one which is able to significantly change people’s lives”, elaborated Prof Zhao Dongyuan when asked about his inspiration for wanting to delve into materials research. “New devices and initiatives in sustainability development, environmental control, energy harnessing and efficiency and health depend a lot on the development of new materials and improvements in material performances”.



Prof Zhao Dongyuan from the Laboratory of Advanced Materials, Fudan University, China

And staying true to his word, Prof Zhao is one of the leading experts in mesoporous materials.

Mesoporous materials are a new kind of porous materials that have pores sizes ranging from 2-50 nm in diameter. The materials are very useful for catalysis, separation, and absorption. Hence, their applications

Publication highlights

Listed below are some highlighted IMRE research publications.

Nickel (Ni) seed layer - A silver lining for surface plasmon resonance (SPR)

Enhanced Surface Plasmon Resonance in a Smooth Silver Film with a Seed Growth Layer; ACS Nano vol 4, 3139, June 2010; Hong Liu, Bing Wang, Eunice S. P. Leong, Ping Yang, Yun Zong, Guangyuan Si, Jinghua Teng, and Stefan A. Maier

Abstract: In this paper, we report a new method of fabricating smooth silver (Ag) films for plasmonic applications, by using a thin nickel (Ni) seed layer assisted deposition. Crucially, we provide a comprehensive investigation of changes in the plasmonic response due to the influence of the seed layer. The additional Ni film has led to a better SPR sensitivity than pure Ag film in terms of figure of merit (FOM), which is a quantitative measure of the overall performance of SPR, by reducing the surface roughness while adding no extra damping to the Ag film. The new Ag/Ni films made by IMRE have also

resulted in a sharper and stronger resonant peak which signals further enhancement of SPR sensitivity. Our results demonstrate that Ni serves as a surface roughness diminishing layer for Ag film growth while enhancing the SPR properties of the structures, which is essential for the low-loss plasmonic devices and metamaterials application.

For more information about the publication, please contact:



Dr Teng Jinghua
jh-teng@imre.a-star.edu.sg

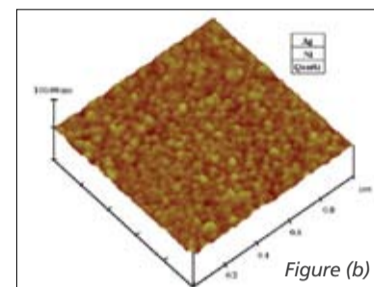
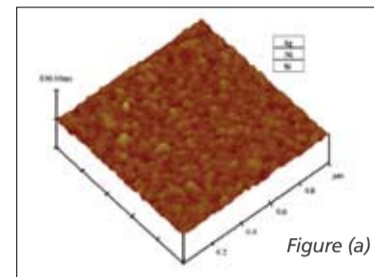


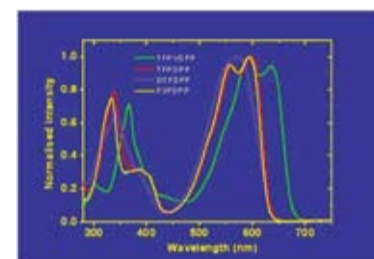
Figure (a) and (b) shows that Ag/Ni films presents an improved root-mean-square (rms) surface roughness varying from 1.3 ~ 1.7 nm in 1 nm² area on both silicon and quartz, comparing with those of pure Ag film, i.e. about 8 nm on Si and 4.5nm on quartz

New acceptor material makes it easier to produce cheaper organic solar cells

Solution processable low bandgap diketopyrrolopyrrole (DPP) based derivatives: novel acceptors for organic solar cells; J. Mater. Chem., 2010, 20, 3626–3636; Prashant Sonar, Ging-Meng Ng, Ting Ting Lin, Ananth Dodabalapur and Zhi-Kuan Chen

Abstract: Novel low bandgap solution processable diketopyrrolopyrrole (DPP)-based derivatives functionalised with electron withdrawing end capping groups (trifluoromethylphenyl and trifluorophenyl) were synthesised, and their photophysical, electrochemical and photovoltaic properties were studied. These compounds showed optical band gaps ranging from 1.81 to 1.94 eV and intense absorption bands that cover a wide range from 300 to 700 nm. Such low bandgap materials with low lying LUMO are in demand

for use as acceptor material in organic photovoltaics (OPV). These findings suggested that DPP-based materials could be promising candidates to replace wide band gap fullerene-based acceptors in OPV devices. Compared to fullerenes, DPP-based materials are also easier to fabricate in bulk and are inexpensive. There has been research done using DPP-based materials (both small molecules and copolymers) as donors but this is the first report of them being used as acceptors in OPVs.



Normalised UV-vis absorption spectra (which cover a wide range from 300 to 700 nm) of DPP-based acceptor materials in chloroform solution.

For more information about the publication, please contact:



Dr Prashant Sonar
sonarp@imre.a-star.edu.sg

in magnetic fluorescent delivery vehicles, drug-delivery systems and even bone-tissue engineering, which are just some of their many uses in the medical and environmental fields. His research group has just completed synthesising many new types of ordered mesoporous materials of varying compositions and structures.

Prof Zhao is currently the Director of the Laboratory of Advanced Materials and a Professor of Chemistry at Fudan University, China. He has published more than 400 papers, reviews, and communications, including papers in Science, Nature and Nature Materials, and has some

38 patents to his name. Prof Zhao’s accolades include the Ho Leung Ho Lee Foundation Award for Scientific and Technological Progress (2009), TWAS Prize in Chemistry (2008), Fellow of the Royal Society of Chemistry (2008), IMMA (International Mesoporous Materials Association) Award (2008), and election to the Chinese Academy of Sciences (2007).

“The R&D in IMRE and in Singapore is of very high quality. IMRE’s research on materials is consistently peer-recognised. In some areas, such as display materials and patterning OLEDs, for example, it

is fast approaching the forefront of worldwide development”, commented Prof Zhao on the level of R&D in Singapore, adding that this was largely due to the excellent research talent pool in Singapore.

“Compared with other countries, Singapore also has a high ratio of young researchers which bodes well for any nation pursuing excellence in research!”

Prof Zhao was at IMRE to give a presentation on “Core-Shell Porous Microspheres: Synthesis and Applications” in August 2010.

RESEARCH

Low-cost hydrothermal method for producing lead-free piezoelectric materials

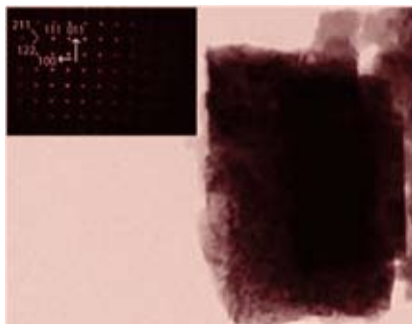
Hydrothermal synthesis of sodium potassium niobate solid solutions at 200°C; Green Chemistry v12, p680, 2010; A. D. Handoko and G. K. L. Goh

Abstract: This is the first demonstration by a low temperature solution method of the synthesis of (Na,K)NbO₃ powders, the precursor for lead-free piezoelectric compositions. This paper demonstrates that compositions around the morphotropic phase boundary (which is a prerequisite for high performance) can indeed be synthesised hydrothermally at 200°C in water. This is the first step to growing lead-free films required for the integration of miniaturised devices. In addition, the hydrothermal method is important as it is low cost and can also be used to produce nanostructures.

For more information about the publication, please contact:



Dr Gregory Goh
g-goh@imre.a-star.edu.sg



TEM revealing single crystalline nature of powder particles

New transparent polymer film as good as metalised plastic used in food packaging

IMRE has developed a flexible, transparent clay-based polymer nanocomposite barrier film that is eco-friendly, cost-effective and protects as well as commonly used metalised plastic food packaging films.

Metalised plastic films are commonly used in food packaging to prevent oxygen permeation so that foodstuff stays fresher for longer periods. This technology is not only expensive but also not environment friendly because of the process used in depositing the metals on the plastic. Conventionally made polymer composites have been explored to replace the metalised films but the oxygen transmission rate, or the rate at which oxygen permeates through the polymer composite films, has proven to be too high for packaging applications.

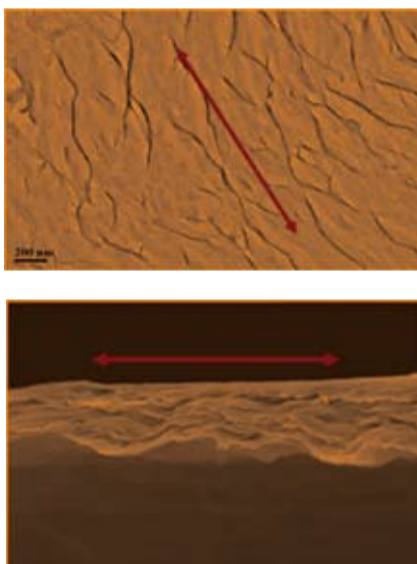
Researchers from IMRE have developed new plastic films that are flexible, protects as well as metalised plastic and more importantly, transparent. The researchers used a combination of polymer materials and high clay content to produce a new film that has excellent oxygen barrier properties. With a thickness of just 5 microns (a micron is a millionth of a meter) the film has an oxygen transmission rate as low as 0.1 cc/m²/day. Despite having a high clay load, the film remains flexible and transparent. The process used to make the film is also simple resulting in a thin three-layer film compared to some currently available laminated multi-layer films that have more than 10 layers of different materials such as nylon and silica.

The composite films can be readily used in packaging applications such as for food, medicines and cosmetics.

For more information about this patent, please contact:



Dr Li Xu
x-li@imre.a-star.edu.sg



Both TEM (top) and SEM (bottom) image of the cross-section of Clay(PVA/PAA) composite layer demonstrates the stacked clay sheets are orientated along the substrate. (The arrow indicates the substrate plane). This significantly improves the barrier property of the composite film.

AWARDS

Roses in research

IMRE's Dr Low Hong Yee was one of three women honoured with the L'Oreal For Women in Science National Fellowships 2010 for her contribution to materials science.

Dr Low Hong Yee L'Oreal For Women in Science National Fellowships 2010



Dr Low Hong Yee is a very busy scientist these days.

She is the Director (Research and Innovation) for IMRE. She leads the Patterning and Fabrication research capability group. She is also the chairperson for the newly launched Industrial Consortium On Nanoimprint (ICON), an industry consortium that puts private companies in direct partnership with research entities like IMRE to jointly develop commercial applications for nanoimprint technologies.

But in all that, she always finds time for her family. "My kids and my family are very important to me and so is finding that balance between them and my research career", said Dr Low who has a 5-year old son and a 2-year old daughter. According to the 2008 National Survey of Research and Development in Singapore, she is one of the few women working in R&D with female scientists forming only about 30% of the total research cohort.

"Women in research are not many but the few who are in research can make an impact. Some of the

most influential scientists have been women like Marie Curie who won a Nobel prize for her work on radiation", added Dr Low who was recognised for her contribution to materials science, particularly her work at IMRE on nanoimprint technology. "This proves that research and much any other career is not gender dependent. Anyone with zeal and passion can make a difference!"

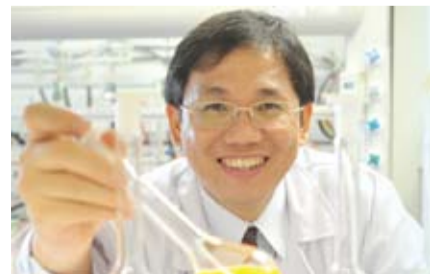
Dr Low's speciality is in nanoimprinting and nanopatterning, a nanotechnology technique that creates unique, complex and uniform patterns at the nanometer-sized scale. The method can be used to make engineered surfaces that mimic natural surfaces so that the properties of those natural surfaces can be re-created synthetically. The eco-friendly, non-chemical method can help produce the iridescent colours of a butterfly's wings or the water-proofing properties of lotus leaves on common plastic films.

The award is jointly organised by L'Oreal Singapore, the Agency for Science, Technology and Research (A*STAR), and the Singapore National Commission for UNESCO.

AWARDS

Awards for IMRE joint and adjunct appointees

IMRE often has joint and adjunct appointment arrangements with other research institutions, and vice-versa, to leverage on the talents of unique individuals in the research community. Two of these talents were recently recognised for their outstanding research.



Asst Prof Wu Jishan Young Scientist Award (YSA) 2010

Asst Prof Wu, who shares a joint appointment with NUS' Department of Chemistry and IMRE, was one of the winners of the 2010 Young Scientist Award.

He was presented the award during the annual President's Science and Technology Awards ceremony for his research on organic optoelectronic materials and supramolecular

chemistry. Asst Prof Wu has been a joint appointee with IMRE since August 2010.

Congratulations Asst Prof Wu!



Prof Seeram Ramakrishna Foreign Fellow of the Indian National Academy of Engineering (INAE)

Prof Ramakrishna is the Vice-President (Research Strategy) and a Professor of Mechanical Engineering at the National University of Singapore. He was elected to the INAE which confers Fellowships on Indian and foreign nationals who are in a position of high responsibility and have demonstrated their

eminence by virtue of outstanding accomplishments in new and developing engineering fields. Prof Ramakrishna has been an adjunct appointee with IMRE since February 2010.

Congratulations Prof Ramakrishna!

AWARDS

The cream of the crop

Dr Tanu Suryadi Kustandi from IMRE was one of two winners of the Philip Yeo Prize for Outstanding Achievement in Research 2010.



Out of a total of 34 entries from across A*STAR, Dr Kustandi was one of only two winners of the Philip Yeo Prize 2010. But these were no ordinary entries. The 2010 prize was open to the cream of A*STAR's scholar cohort – NSS (National Science Scholarships), AGS (A*STAR Graduate Scholarships) and AIF (A*STAR International Fellowship) scholars who are currently pursuing their PhDs, deployed in A*STAR research institutes, or undertaking post-doctorate attachments.

"It is truly an honour for me to have been selected for this award", said Dr Kustandi who is a Research Engineer in IMRE working on nanopatterning and nanofabrication R&D.

The Philip Yeo Prize for Outstanding Achievement in Research was launched in 2007 with the aim to recognise outstanding scholars who make significant contributions to research.

Safety comes first!

IMRE's Mr Ong Kian Soo was selected as one of the awardees of the inaugural A*STAR Safety Advocate Award 2010!



At the 2nd A*STAR Safety Day on 20 September 2010 to promote and cultivate a safer working environment for all A*STAR entities, a special safety advocate award was included to recognise staff who have contributed towards solving safety and health issues in the respective research institutes over the past year.

Mr Ong Kian Soo was selected as a safety advocate for his good safety track record and his active involvement in safety-related training including Occupational First Aid Training, Chemical Spillage Control and In-house Fire Fighting Training. As one of IMRE's laboratory coordinators, he is also responsible for risk management in his daily workplace, giving additional laboratory safety briefings to all new students and staff before approving their access to the lab, and conducting random safety spot-checks. He is also always keen to show and share his experiences on safe practices with fellow IMRE staff.

VISITS & EVENTS

IMRE @ World Cities Summit

28 Jun – 1 Jul 10

IMRE's R&D on carbon-fibre reinforced polymers (CFRP) and solid-state lighting were on display at the A*STAR booth. The CFRP panels can be used to forge high performance coating materials, mould components for packaging and to craft thermally and mechanically stable materials for building parts. The solid-state research highlighted IMRE's phosphor-free indium gallium nitride quantum dots white LED with tunable wavelength functionality for application in advanced lighting systems that can alternate light atmosphere settings from a single source.

IMRE Workshop on Transmission Electron Microscopy (TEM) & Microanalysis

01 Jul 10

The workshop featured invited speakers from China, Denmark, Japan and Singapore addressing the full spectrum of microanalysis techniques in the application of TEM. This included the study of TEM tomography, holography for the study of magnetic materials, application of high-resolution imaging and analysis, high-resolution EELS, sample preparation and industrial sample analysis. The popularity of the workshop was evident in the overwhelming attendance of some 230 participants.



IMRE researchers at X-periment 2010

X-periment Exhibition 2010

30 Jul – 1 Aug 10

The annual exhibition, organised by A*STAR and Science Center Singapore, was held in Marina Square Atrium. This year, IMRE showcased interesting demonstrations, including the behaviour of ferrofluids, shear-thickening fluid materials for use in body armour and carbon-fibre reinforced polymers (CFRP).

VISITS & EVENTS

IMRE's 4th Industrial Symposium on Nanoimprint Lithography

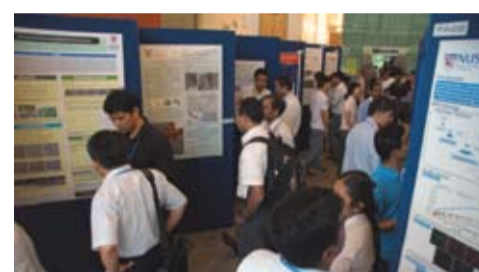
03 Aug 10

The symposium was held in conjunction with the launch of the Industrial Consortium on Nanoimprint (ICON). More than 100 industry guests attended the event which featured invited speakers from industry and academia as well as exhibits by industrial partners showcasing the latest innovations related to nanoimprinting.



Industry participants at the 4th Industrial Symposium on Nanoimprint Lithography

MRS-S Trilateral Conference on Advances in Nanoscience – Energy, Water & Healthcare



The poster session of the MRS-S trilateral conference

11-13 Aug 10

Jointly organised by Materials Research Society (MRS) – Singapore, NUS Nanoscience and Nanotechnology Initiative (NUSNNI) and IMRE, scientists from India, China and Singapore participated in the 3-day conference to collaborate on research in the energy, water and healthcare domains.

IMRE Workshop on Surface and Interface Analysis of Nanomaterials and Industry Applications



Participants at the workshop on surface and interface analysis

19 Aug 10

The aim of the workshop was to provide a forum of technical exchange for researchers from universities, institutes under A*Star and industry, on surface and interface analysis. The 120 participants were also briefed on new and potential surface analysis techniques to be developed for future material characterisation needs.

UPCOMING EVENTS

Diary of upcoming events @ IMRE

09 – 10 December 2010

Workshop on Organic and Polymer Electronics

15 December 2010

Singapore Scanning Probe Microscopy (SingSPM) 2010 Workshop

10 – 11 January 2011

Molecular Materials Meeting (M3) @ Singapore Biopolis, Singapore

To find out more about IMRE's seminars and events, please visit www.imre.a-star.edu.sg/eventsall.php

Past issues of our newsletters are available on our website at

www.imre.a-star.edu.sg

For general enquiries please write in to enquiry@imre.a-star.edu.sg