Institute of Materials Research and Engineering
A*STAR

PERSPECTIVES

Research, Development and Commercialisation

MITA (P) 289/03/2005 • ISSN 0219-1830 • Vol. 7/ Issue 2 • 2nd Quarter 2005

CONTENTS

Past issues of our newsletters are available on our website at www.imre.a-star.edu.sg

Singular ID

- IMRE's First Start-up Company Signs Licence Agreement for its Anti-counterfeit Technology

Panelists taking questions from media during the press conference (L-R): Dr Cathy Park (BVC), Dr Adrian Burden (Singular ID), Dr Lim Khiang Wee (IMRE), Dr Peter Moran (Singular ID) and Ms Emily Tan (Exploit Technologies).

Two researchers from the Institute of Materials Research and Engineering (IMRE) turned natural "defects" common in materials into a business viable solution which could save millions of revenue lost to counterfeit branded luxury and pharmaceutical products.

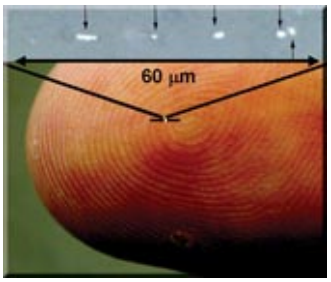
Dr Peter Moran and Dr Adrian Burden, the two inventors have founded a company, *Singular ID Pte Ltd* to develop the unique magnetic identification tags or "magnetic fingerprints" that use a blend of micro and nanotechnology. Like a human fingerprint, each tag has a unique identity that cannot be replicated. It also is inexpensive to manufacture.

At a press conference cum signing ceremony which was held on 11 May 2005, *Singular ID Pte Ltd* signed an exclusive licence agreement with Exploit Technologies Pte Ltd (ETPL) - the commercialisation arm of the Agency for Science, Technology and Research (A*STAR). Concurrently, *Singular ID* had also signed an agreement with BioVenture Centre Pte Ltd (BVC), a subsidiary of Becton, Dickinson and Company, to incubate and co-invest seed capital in the technology.

The unique nano-magnetic "fingerprint" tags are irreproducible, inexpensive to manufacture and can be used in a wide range of products including pharmaceutical packaging, luxury goods such as watches and handbags, and automotive and aviation spare parts.

The tags can also be made extremely small (the width of a human hair), so that they are nearly invisible. They are also thermally and chemically stable and are not adversely affected by external magnetic fields.

"We are very excited that this nanotechnology breakthrough at IMRE is being commercialised. This is a validation of IMRE's world-



The tags can be smaller than the width of a strand of hair.

class research that addresses practical applications. Our research scientists are constantly pushing the frontiers of science and the ultimate gratification is the contribution of these research efforts to the Singapore economy and community at large", explains Dr Lim Khiang Wee, the Executive Director of IMRE.

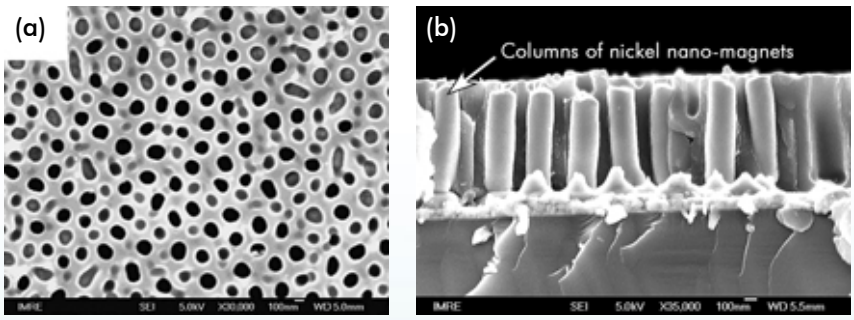
Dr Moran, Chief Technology Officer of *Singular ID* explained the genesis of the technology, "The idea came from the discovery that some magnetic composites contain an inherent disorder that is difficult to reproduce and control. This results in a unique but detectable pattern, much like a fingerprint. Moreover, as these features become extremely small, the "fingerprint" becomes prohibitively difficult if not impossible to duplicate."

One market where counterfeits are a serious and growing issue is that of pharmaceutical and medical products. Dr Cathy Park, Managing Director of BVC outlines, "Being able to authenticate the source of medicines and medical supplies is an important part of tackling counterfeit products. *Singular ID* offers a technology to make genuine products instantly identifiable. BVC will provide business advisory services to *Singular ID* for pharmaceutical and medical applications."

The World Health Organisation estimates that up to 10% of medicines worldwide are fake, a problem that costs the pharmaceutical industry in excess of S$75 billion per annum and causes huge concerns for consumer safety [Business Week, 7th Feb 2005, pp46-53].

The inventors are already in discussion with a number of companies to apply the technology in other areas.

For more information about *Singular ID*, please visit www.imre.a-star.edu.sg/singular-id



What Singular ID looks like under high magnification (a) top view and (b) side view.

Show-and-Tell by Singapore OLED Network

IMRE-led OLED Network showcases R&D capabilities of next generation displays technology.


ON-Singapore members discussing OLED-related technology.

Companies involved in research and manufacturing of organic light emitting diode (OLED) displays, showcased their capabilities and provided the latest OLED technology updates during the second OLED Network of Singapore Reception on 17 March 2005. The exhibitors included *Innoled Pte Ltd* and *Ness Display Co., Ltd*, both of whom are spearheading the manufacturing of OLEDs in Singapore with a combined investment of about S$145 million.

The annual Reception hosted by IMRE provides a platform for members of the OLED Network of Singapore or "ON-Singapore" for short, and key industry leaders to interact with one another to explore partnerships towards developing the OLED industry here.

Launched in 2004, ON-Singapore is an initiative that seeks to draw together industries and research organisations that are interested in developing, supporting and nurturing the research, development and manufacturing of OLED technology locally. The Network counts both international and local corporations in its ranks.

"We have been involved in the R&D of OLED technology for a long time. Given this, we took up the challenge to galvanize relevant industry players, and together with EDB, initiated this Network. It was even more timely given the announcement that Innoled and Ness would start OLED manufacturing here in Singapore," explained Dr Lim Khiang Wee, Executive Director of IMRE.

Mr Peter Karlsson, Managing Director of Innoled Pte Ltd, who was at the ON-Singapore Reception commented, "The setting up of the OLED Network is fortuitous as it allows us to tap on a convenient and close central resource of OLED and related technology."


An exhibition on OLED and related technology was organised by the Network.

Students @ IMRE Win Research Accolades

Junior college and tertiary students who were on attachment programmes @ IMRE had recently won local research awards for their work done on nanocomposite polymers, organic light emitting diodes and miniature microneedles.

Singapore Science and Engineering Fair (SSEF) 2005

Two students from National Junior College won Silver and Bronze medals respectively at the Singapore Science and Engineering Fair 2005 for their research work on *"Photophysical Studies on Conjugated Polymers"* and *"Study of Gas Permeation Properties of Barrier Substrates and OLED Package Structures"*.

Silver Medal winner, 18-year old **Yeo Kai Yun** was elated that her project on the next generation of super-thin and energy-saving light displays won the hearts of the judges. She added that one judge was very impressed with her project and urged her to publish the report to add to her portfolio. Attributing her success to her mentor at IMRE, Kai Yun said, "My research attachment to IMRE was a rewarding and enriching experience. I would not have achieved this result without Dr Vijila's guidance."

"This success will now hopefully spawn future research into this method for enhancing light-emitting polymer brightness", said Dr Chellappan Vijila, an IMRE Research Associate and the supervisor for Kai Yun.

Kai Yun's biggest challenge was to understand the physics behind the experiment. She had to put in a lot of effort in reading journals and information from the internet as the theoretical concepts were beyond what she had studied so far. Operating machines like the spectrophotometer, spectrofluorometer and plotting absorption and photoluminescence spectra needed extra work as well.

Kai Yun studied the photophysical properties of conjugated polymer-metal complex mixtures to increase the photoluminescence (PL) quantum yields for use in polymer light emitting diode (PLED) applications for brighter and more efficient PLED displays. The breakthrough came when she obtained data for optimal PL quantum efficiency by combining two different metal complexes with one conjugated polymer.

Ms Yeo Kai Yun from NJC thanked her researcher at IMRE, Dr Vijila for her guidance.

Bronze Award winner, 18-year old, **Sooi Li Chiang** worked on a project to increase the lifespan of organic light emitting diodes (OLEDs), which would help enhance its commercial viability. His research project involved the measurement of water vapour transmission rates, which was further developed for measurement of oxygen transmission rates through plastic substrates and epoxy seal lines. OLEDs are super thin, lightweight, low energy consumption display devices of the future.

The SSEF is an annual national competition organised by the Ministry of Education (MOE), The Agency for Science, Technology and Research (A*STAR) and the Singapore Science Centre. SSEF is open to all secondary and junior college students between 15 and 21 years of age. Research projects are submitted through the Science Research Programme, Technology & Engineering Research Programme or Science Mentorship programmes.

Polytechnic Student Research Programme (PSRP)

Two teams of Ngee Ann Polytechnic students were among the six recipients of the Best Project Awards for

Ong Cheng Yeow (left) and Wong Chun Yong (right) with their OLED device.

their research done at IMRE on microneedles and OLEDS.

The two teams submitted their research projects on "*Microfabrication of Micro Needles and Medical Devices*" and "*Transparent Electrode for Display Applications*" which were done at IMRE respectively.

Said **Wong Chun Yong** from the "*Transparent Electrode for Display Applications*" research team, "We had little knowledge about OLEDs before the project so the task was daunting but with hard work we slowly came to understand OLEDs, in particular the fabrication methods. It was this effort that helped us improve on the conventional fabrication processes."

"Working with the IMRE supervisors was a good experience for the both of us. Dr Zhu Furong, Mr Ong Kian Soon and the other researchers were very helpful and patient, and assisted us in every way possible, even to the point of staying late to help with our project," added Chun Yong when asked about the guidance they received from IMRE.

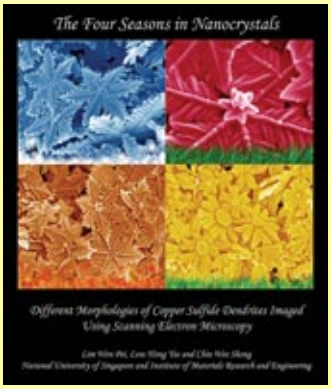
Spokesperson for the "*Microfabrication of Microneedles and Medical Devices*" team, **Noor Haslinda Binte Abdullah** explained that the team's task was to fabricate high quality microneedles, which involved a number of processes. But with the help of the IMRE researchers, the 4-person team produced excellent devices and clinched the award. Said Haslinda, "Our team had a great time working with our IMRE supervisors as they are very dedicated and willing to guide us throughout the whole project. The up-to-date facilities at IMRE also made learning much more interesting." She added that some of the team members had plans to take up research as a career because of this experience.

The Microneedles team with their winning devices.

The six winning projects were chosen from a field of 40 projects conducted by students from Ngee Ann Polytechnic and Singapore Polytechnic who were attached to research institutes and universities.

The Polytechnic Student Research Programme is part of a student attachment programme supported by A*STAR. It is aimed at nurturing local polytechnic students in R&D through an immersion in the scientific and engineering research environment.

The Art of Science – "The Four Seasons of Nanocrystals"



The Four Seasons of Nanocrystals by Ms Lim Wen Pei, an IMRE postgraduate attachment.

Ms Lim Wen Pei, a postgraduate chemistry student of the National University of Singapore won second prize in the 'Science as Art' competition at the 2005 Materials Research Society (MRS) Spring Meeting held in San Francisco, USA from 28 March – 1 April. Wen Pei who began her attachment in IMRE in July 2002, was under the co-supervision of Dr Low Hong Yee, from IMRE's Molecular and Performance Materials cluster.

Her artistic poster entitled, "*The Four Seasons in Nanocrystals*" was based on her research into the architectural control of metal sulfide nanocrystals, which is important in the preparation of nanostructured materials and the study of crystal growth.

BELIEVE IN YOUR IDEAS

Up Close and Personal with Nanotechnology Expert at IMRE

*Dr Christian Joachim joins IMRE under the A*STAR Visiting Investigator Programme (VIP).*

Dr Christian Joachim is a renowned scientist in the field of nanotechnology. His work had won him numerous accolades - he received the 1988 French Chemical Physics Prize for his work on electron transfer theory, the 1991 IBM France Prize for his work on tunnelling through a molecule and the 1997 Feynman Prize for his work on molecular manipulation, to name a few.

Dr Joachim is Director of Research and Head of the Molecular Nanoscience and Picotechnology Group at the Centre for Materials Elaboration and Structural Studies (CEMES), which is part of the French National Centre for Scientific Research (CNRS).

At IMRE, Dr Joachim will set up a programme on "*Atom Technology for Bottom-up Atomic and Molecular Devices*", which will use the "bottom-up" approach to assemble atomic and molecular devices. The project will also explore new instrumentation and nano electro mechanical systems (NEMS). Dr Joachim will work closely with researchers from IMRE and the Institute of High Performance Computing (IHPC) as well as the National University of Singapore.

Perspectives caught up with him when he was in IMRE:

What is the impact of the project that you are doing under the VIP scheme? What sort of benefits can we look forward to?

At the laboratory scale, we need to invent a new technology to study the exchange of data with and from a single molecule. This will not be achieved using the standard fabrication technologies extracted from fundamental research of the last century. Mastering a single molecule on a surface, in a liquid or in space is not only to understand the quantum resources available in the molecule but also to apply these to fields like molecular computing, molecular robotics or molecular medicine. Singapore scientists have fantastic potential in this area. I am looking forward to the challenge of nurturing this potential to help create a true surface atom technology in Singapore.

Why did you take up research as a career? What was your inspiration?

Research is not a career to me but a hobby. It is something that I enjoy and am passionate about. Each morning I tell myself, "If one day, I have no more zeal or that I feel no more inspiration, then it's time to do something else, but thankfully that day has not come". Having a family that supports my passion and 'hobby' helps inspire me. The mixing of science fiction and electrical engineering also serves as my inspiration.

Dr Christian Joachim recently introduced the concept of mono-molecular electronics, of tunnel wired molecular nano-robots with the design of the first molecular wheelbarrow, and is now developing atomic scale technology.

As a distinguished and experienced researcher, what do you think are some of the qualities that make a good scientist?

Continually question the problem that you are trying to solve. Looking at the history of a scientific problem and studying the source that triggered the scientific path you are working on is also helpful as it gives you a better understanding of your research. And if you feel that you are opening up a new scientific path yourself, share it and allow this new path to mature. When it does, it may create a new branch, maybe in a direction you do not expect, leading to new discoveries.

How did you get "hooked" on nanotechnology and science?

It was during my Masters, after attending a course on polymers. I do not remember why I was attending the course on polymers in view of my current interest at that time for theoretical physics rather than for materials science. I was drawing a picture of a long molecule on a board when I suddenly thought how

interesting it would be if an electrical circuit was the size of a molecule. From that I started experimenting and decided to measure the electrical resistance of a tiny piece of carrot. It was fun to see the reactions of people around me when I was preparing the sample. I also researched the literature and found the *A. Aviram* (*Arieh Aviram* is co-inventor, with Mark Ratner and Phil Seiden, of the concept of the molecular diode in the mid 1970s and proposed the first molecular switches in the mid 1980s) paper published in 1974 on the single molecule rectifier and was disappointed that I would not be the first one to publish. But it was a theoretical paper and the tools to access a single molecule electrically were still unknown. As it turned out, we later started to address this point with Aviram in 1986 using the new scanning tunnelling microscope.

What do you do in your spare time?

I like skiing and I dabble in bodysurfing. When I am back in the countryside I indulge in a little gardening. I also spend a lot of time with my family.

Do you have any words of advice for budding scientists?

Believe in your ideas, propose new avenues and push them yourself. But never forget that exploration and research requires a lot of tenacity and long nights, especially if you want new experiments to start working the way you envisage or for solving new equations.

A*STAR's Visiting Investigator Programme (VIP)

The programme taps on the expertise and experience of internationally renowned scientists of high calibre with excellent academic and research credentials.

The VIPs to date include:

- **Ananth Dodabalapur** *
  University of Texas, Austin, USA
  - *Plastic Electronics*
- **Christian Joachim** *
  Centre for Materials Elaboration and Structural Studies (CEMES), France
  - *Atomic and Molecular Devices*
- **David J. Srolovitz** *
  Princeton University, USA
  - *Computational Materials Science*
- **K.C. Nicolaou**
  The Scripps Research Institute, USA
  - *Total Synthesis*
- **Nico De Rooij**
  University of Neuchatel, Switzerland
  - *MEMS, NEMS*

**Hosted by IMRE*

Visits and Events

(January - May 2005)

Future scientists visiting IMRE's Characterisation Laboratory.

A*STAR Graduate Academy (AGA) Tour to IMRE

6 January 2005

Some 30 students visited IMRE in conjuction with A*STAR's efforts to promote the National Science Scholarship. The visit was aimed at giving the students an insight into science and engineering related research.

IMRE PG Students Poster Competition

18 January 2005

IMRE organised a poster competition for its staff and postgraduate students with the objective to encourage an exchange of ideas and increase the level of interaction. The panel of judges for the competition comprised Prof Wolfgang Knoll, Dr Chandrasekhar Natarajan and Dr

Researchers and postgraduate students discussing one of the posters submitted for the competition.

Wong Chia Woan from IMRE, and Dr Tim White (NTU) as well as A/P Feng Yuen Ping (NUS).

Meet-The-Scientist Session

29 January 2005

Dr Troadec and Mr Lau explaining the finer points of their research to the public.

Dr Cedric Troadec and Mr Aaron Lau from IMRE's Micro and Nano-Systems cluster gave a talk entitled "BEEM Me Up SAM!" to students and members of the public at the Singapore Science Centre as part of the on-going series of Meet-The-Scientist talks jointly organised by A*STAR and Singapore Science Centre. The talk centred on the Scanning Tunnelling Microscope (STM) and how it is used for viewing objects as small as atoms. A layperson's introduction to Self Assembled Monolayers (SAM) and Ballistic Electron Emission Microscopy (BEEM) was also presented.

ON-Singapore - Creating opportunities for active involvement in the nurturing and development of OLEDs locally.

OLED Network of Singapore (ON-Singapore) Reception

17 March 2005

IMRE hosted the second ON-Singapore reception, an informal gathering that creates opportunities for members of the displays related group to interact with each other. This year's event featured an exhibition of OLED and OLED-related technology by ON-Singapore members (see page 2, "*Show-and-Tell by Singapore OLED Network*" for more details).

ASEANPLAS Plastic Technology Showcase

26-29 April 2005

The Plastic Moulding Task Force, which includes IMRE, SIMTech and IHPC, showcased their research advancements and capabilities during the ASEANPLAS 2005, an international trade fair for plastics and rubber. The task force was set up to assist plastic processing companies to upgrade their technologies. IMRE highlighted its work on nanocomposite materials.

Visit by Prof Anthony J. Leggett, Nobel Laureate in Physics (2003)

28 April 2005

Prof Leggett being briefed on some of IMRE's research activities.

Prof Anthony J. Leggett, Nobel Laureate in Physics (2003) visited IMRE to learn more about the research conducted here and was briefed on IMRE's facilities and characterisation capabilities. Prof Leggett, the John D. and Catherine T. MacArthur Professor and Center for Advanced Study Professor of Physics, from the University of Illinois, USA was in Singapore to attend the 2005 NSTS-SSEF Awards Ceremony.

SEMICON 2005

4-6 May 2005

IMRE together with IHPC, IME and SIMTech participated in SEMICON 2005, an exhibition of the latest technology in semiconductor manufacturing. IMRE featured its research including III-V materials based MEMS for optical communications, nanoimprinting, white LEDs, environment friendly growth of compound semiconductor crystals and development of new materials for future nanoscale MOSFET devices.

Chemical Analysis Workshop

26 May 2005

Participants of the Chemical Analysis Workshop.

IMRE's characterisation team conducted a Chemical Analysis Workshop as part of its effort to promote its characterisation facilities and capabilities. The workshop provided an overview of expertise in thermal and structural analysis of materials and the resources available for use by industrial partners. The topic of micro-Raman spectroscopy was presented as well. An introduction to the new SERC NanoFabrication and Characterisation (SNFC) Facility was given. Some 69 participants from industry, academia and research institutes attended the workshop.

Patents Filed

Biodegradable poly(ester alkyleneimine)s and their applications

The invention provides biodegradable poly(ester alkyleneimines) having ester linkages inserted between two alkyleneimine units. The polymers have low cytotoxicity and are biocompatible since they are biodegradable due to the ester backbone linkage. The polymers may be useful as a vector for the delivering bioactive agent such as DNA.
Inventors: Liu Ye, He Chaobin, Wu Decheng
Date filed: 29 Apr 05
Country filed: US provisional

Systems and methods for pumping continuous liquid columns using hydrophobicity control features in a microchannel

The invention relates to a micro/nanofluidic pump having inbuilt metering capability, based on controlled hydrophobicity. The pump does not have any moving mechanical parts or mechanical actuators, and therefore can be miniaturized to be truly nano/micropump. The invention will have applications in microfluidic systems, environment monitoring systems, micro diagnostic fluidic systems, drug delivery systems etc.
Inventors: Saman Dharmatilleke, Liu Hong
Date filed: 25 Apr 05
Country filed: PCT

A biomimetic approach to low cost fabrication of complex nanostructures of metal oxides by natural oxidation at low temperature

The invention involved a novel low cost approach for the direct fabrication of complex nanostructures of metal oxides by natural oxidation at low temperature.The oxidation process could be well controlled and the products could be expected to be of high purity. The invention would have applications in solar cells, optoelectronic devices and sensors.
Inventors: Han Mingyong, Zhang Zhongping
Date filed: 13 Apr 05 (US, Singapore)
Country filed: US provisional

A sensor for measuring gas permeability of a test material

The invention relates to the measurement of gas transport properties through polymer or barrier oxide coated polymer films or sheets. In particular it makes use of a highly sensitive technique for measuring calcium degradation. This method also provides excellent spatial and time resolution in the measurement. The invention is potentially useful in enabling the study of permeation mechanism in the understanding of FOLED device lifetime and degradation phenomenon.
Inventors: Chua Soo Jin, Ramadas Senthil Kumar, He Xinbo
Date filed: 31 Mar 05 (Taiwan)
Country filed: PCT

Sustained-release tablet formulation

The invention provides a sustained-release tablet that can release caffeine and other xanthine derived stimulants at a nearly constant rate. The tablet comprises a hydrophilic polymer of high molecular weight and in one embodiment, the tablet includes caffeine and poly(ethylene oxide) of molecular weight of about 4 x 106 to 8 x 106. Sustained delivery of caffeine and other xanthine-derived stimulants is possible with a low concentration of the polymer and moreover, a wide range of concentration of caffeine and other stimulants can be released at a nearly constant rate.
Inventors: Yang Yiyan, Tan Cherng Wen, Shabbir Moochhala, Wang Li Shan, Donna Tan
Date filed: 29 Mar 05 (PCT)
Country filed: US

Method of imprinting shadow mask nanostructures for display pixel segregation

The invention describes the imprinting of integrated shadow mask nanostructures, and in particular T-Bar column nanostructures, on an Indium Tin Oxide (ITO) substrate to facilitate pixel segregation in active- and passive-matrix displays. A direct patterning method is used, hence high resolution photolithographic techniques are not required to properly pattern the resist on the ITO.
Inventors: Jarrett Dumond, Low Hong Yee
Date filed: 24 Mar 05
Country filed: US

Group III nitride white light emitting diode

The invention provides a method of fabricating a white LED that can emit white light itself by the growth of self-organised InGaN quantum dots with different In composition. The white LED can emit white light itself and does not require combining many LEDs, so that the high cost and the difficulty of fabricating the white LED lamp can be avoided. The white LED can also emit white light itself without having to excite the fluorescent material to produce the desired hue. Thus the lifetime of the white LED is not affected by the limitation in the lifetime of the fluorescent material. Another advantage of the invention is that the white LED can exhibit a high color rendering as the emission band is broad and covers the whole visible range.
Inventors: Chua Soo Jin, Chen Peng, Eiryo Takasuka
Date filed: 24 Mar 05
Country filed: PCT

Photovoltaic device

The invention relates to ferroelectric thin film that can generate high voltage under UV illumination through the orientation of the polarization of the ferroelectric thin film along the surface plane of the film. The light-generated high voltage can be exploited for many light driven devices such as piezoelectric and electrostrictive actuators, light-controlled optical modulators and switches etc.
Inventors: Yao Kui, Santiranjan Shannigrahi, Chen Meima, Gan Bee Keen
Date filed: 22 Mar 05
Country filed: US provisional

Semiconductor devices grown in spherical cavity arrays

The invention uses micro- or nano-spheres as template to obtain micro- or nano-scaled cavities on semiconductor substrates. Nanostructures of semiconductor materials are then grown into the spherical cavities. The spherical cavity provides almost all directional confinement of light, which efficiently reduces the threshold for lasing and enhances absorption of light for detectors by making use of photonic crystal effects.
Inventors: Wang Ben Zhong, Chua Soo Jin
Date filed: 21 Mar 05
Country filed: US provisional

A method for fabricating periodic nano-structure-arrays with different feature sizes

The present invention relates to a method of forming patterned arrays with different feature sizes and nanostructures fabricated using the patterned arrays. The method is a simple, one step method for fabricating micro- or nano-metre scaled patterned arrays, with potential applications in the fabrication of multi-wavelength semiconductor light sources and, wide spectral responsivity photodetectors.
Inventors: Wang Ben Zhong, Chua Soo Jin
Date filed: 17 Mar 05
Country filed: US provisional

Silicide formed from ternary metal alloy films

The invention relates to a method for fabricating semiconductor structures and more particularly to a method of forming a high quality and reliable NiSi silicide on a silicon semiconductor device. The proposed process is commercially applicable to the fabrication of 0.1um and sub-0.1um CMOS silicon devices.
Inventors: Chi Dongzhi, Rinus Lee, Chua Soo Jin
Date filed: 15 Mar 05 (PCT)
Country filed: US

Tunable masks for pattern transfer and nanostructure array formation

The invention relates to a method of preparing an ordered array of nano-dots and nano-holes having controlled dimensions. The process is inexpensive and has high through-put. Potential applications include the fabrication of low dimensional optical, electronic, magnetic and optoelectronic devices, filters, biosensor etc.
Inventors: Zheng Yuebing
Date filed: 14 Mar 05
Country filed: US provisional

Composite optical destructive electrode for high contrast electroluminescent devices

The invention relates to an optical destructive anode which can achieve a high contrast OLED/PLED. The enhancement in light contrast is attributed to the reflection-reducing stack of a light-absorbing layer and a transparent conductive oxide (TCO) anode. The invention will have application in displays used in handphones and palm-tops, outdoor instrument displays etc.
Inventors: Zhu Furong, Ong Kian Soo, Hao Xiao Tao
Date filed: 3 Mar 05 (Taiwan)
Country filed: PCT

Conjugated organic molecules for molecular electronic devices

The invention relates to two terminal conjugated oligomeric material, which can be used in molecular scale electronics, and their preparation methods. The molecules can be fabricated into molecular electronic devices, for example, molecular wires, diodes, switches, transistors and memories, in which the alligator clip at one end of the molecule will be linked to the first electrode through self-assembly process, while the second electrode will be deposited on the top of the self-assembled molecules or their monolayer through vacuum deposition or nano-imprinting to form a crossbar structure.
Inventors: Chen Zhikuan, Huang Chun, Yang Jianshu, Sean O'Shea, Loh Kian Ping
Date filed: 2 Mar 05
Country filed: PCT

Solution processed organometallic complexes and their use in electroluminescent devices

The invention relates to the field of electrophosphorescent materials and to light-emitting devices prepared by spinning or inkjet printing a thin film from solution. The electrophosphorescent materials comprise a heavy metal cation and highly branched bi-denate coordinating groups containing spiro bifluorenyl structure. The invention can be used in electroluminescent devices.
Inventors: Chen Zhikuan, Huang Chun, Zhan Changgua, Yao Junhong
Date filed: 1 Mar 05
Country filed: PCT

Method of low temperature imprinting process with high pattern transfer yield

The invention relates to a method of low temperature imprinting process with high transfer yield by using a sacrificial film. This sacrificial film could be inorganic or organic materials that would be easily removed by simple wet etching method. By using such a sacrificial film, a near 100% imprinting transfer yield could be achieved, and a free standing structure would be easily obtained even under a low process temperature.
Inventors: Xu Yongan, Low Hong Yee
Date filed: 17 Feb 05
Country filed: US provisional

Cationic supramolecular macromolecules for delivery of nucleic acids

The invention describes a new way to design polymeric carriers for the delivery of genetic materials such as nucleic acids, by taking advantage of the supramolecular approaches involving inclusion complexation and self-assembly between macrocyclic oligosaccharides and polymer chains. The material will have low cytotoxicity, high biogradability and high transfection activity. The invention will have potential applications in the delivery of genetic materials into living systems.
Inventors: Li Jun, Yang Chun, Li Hongzhe, Wang Xin, Goh Suat Hong, Leong Kam W
Date filed: 2 Feb 05
Country filed: US provisional

Method and structure for fabricating III-V nitride layers on silicon substrates

The invention relates to an improved process for producing nitride layers on silicon substrates by the means of MOCVD technique. High quality epitaxial III-V nitride layers of monocrystalline materials can be grown on overlaying large silicon wafers by first growing an accommodating structure as the buffer on a silicon substrate. The accommodating structure compensates thermal strain and reduces the lattice mismatch between GaN and Si. The invention could be used in the fabrication of GaN-based optoelectronic and microelectronic devices on Si.
Inventors: Chen Peng, Chua Soo Jin, Miao Zhonglin, Sudhiranjan Tripathy
Date filed: 2 Feb 05
Country filed: US provisional

Identification tag, object adapted to be identified, and related methods, devices and systems

The invention aims to provide for an inexpensive and easily produced identification label and associated system for identification and tracking of genuine items. It is also the aim that the fingerprint be extremely difficult (if not impossible) and/or extremely expensive to reproduce by design. This is achieved by selecting a range of complex particles, making use of very small features (such as pores) and having an in-plane structure that influence the signature of the fingerprint.
Inventors: Adrian P Burden, Peter M Moran, Kong Yen Peng, Zhao Ya
Date filed: 19 Jan 05
Country filed: PCT

Thin films of ferroelectric materials and a method for preparing same

The invention relates to methods of obtaining (001)-oriented, epitaxial, perovskite thin films with high concentration of PZN (45-90% in mole). The perovskite PZN-based thin film was obtained using a low-cost, mass-production-compatible solution deposition method, in which a polymer modification of the solution precursor is conducted . The invention will have application in integrated piezoelectric micro-actuators.
Inventors: Yao Kui, Yu Shuhui, Francis Tay
Date filed: 18 Jan 05
Country filed: Singapore

Novel water-soluble nanocrystals and methods of preparing the same

The invention relates to methods of preparing novel water-soluble nanocrystals and the uses of such nanocrystals, including but not limited to, various analytical and biomedical applications such as the detection and/or visualization of biological materials or processes, e.g., in tissue or cell imaging, in vitro or in vivo. The invention also relates to compositions and kits containing such nanocrystals which can be used in the detection of analytes such as nucleic acids, proteins or other biomolecules.
Inventors: Han Mingyong, Wang Fuke
Date filed: 17 Jan 05
Country filed: PCT

Thermoplastic polymer based nanocomposites

The invention relates to a new approach for the preparation of thermoplastic polymer/pristine clay nanocomposites. The approach uses a versatile masterbatch to facilitate the uniform dispersion of clay particles and the exfoliation in different polymer matrices. The

invention will have potential applications in aircraft parts, food packaging, wires etc.
Inventors: Wang Ke, He Chaobin, Chen Ling, Toh Meiling, Khine Yi Mya
Date filed: 14 Jan 05
Country filed: PCT

Polyalkylenimine (PAI)-graft-biodegradable polymers for delivery of bioactive agents

The invention involved a feasible and reproducible method of producing polyalkylenimine (PAI)-graft-polymers using cationic polymerisation of ethylene imine (aziridine) in the presence of polymers containing amine groups. The invention allowed PEI-graft-polymers with controllable structures such as the length of the grafting PEI chain and the ratios of PEI/polymers. The polymers, with good biocompatibility, are useful for the delivery of bioactive agents.
Inventors: Liu Ye, Wong Kok Hou, Sun Guobin, He Chaobin
Date filed: 12 Jan 05 (US, Singapore)
Country filed: US provisional

Patents Granted

Light emitting polymers and polymer light-emitting diodes

This invention relates to light-emitting polymers and more particularly relates to silylated poly(phenylenevinylene) compounds and their use in the manufacture of polymer light emitting diodes (PLED).
Inventors: Huang Wei, Chen Zhi Kuan, Chua Soo Jin
Date granted: 26 Apr 05
Country granted: US

Reversal imprint technique

The invention involves a new imprinting technique that avoids the need to spin-coat polymer layers on the substrate. A polymer layer was spin-coated directly on a mold, and transferred to a substrate by imprinting under suitable temperature and pressure conditions.
Inventors: Bao Lirong, L Jay Guo, Albert Yee, Huang Xudong, Stella Pang, Chen Xing
Date granted: 11 Apr 05
Country granted: Taiwan

A solder interconnection having a layered barrier structure and method for forming same

The present invention relates to solder interconnection having a layered barrier structure which inhibits reaction between a solder material and a substrate, and a method for forming the solder interconnection.
Inventors: Li Ming, William Chen
Date granted: 31 Mar 05
Country granted: Singapore

Method for electroless deposition of a metal layer on selected portions of a substrate

The invention describes a method of depositing a desired metal layer on one or more selected portions of an indium tin oxide (ITO) surface of a substrate. A masking layer is applied onto the glass surface, having ITO patterns on it. This substrate is then exposed to a colloidal suspension of catalytic particles followed by washing with water and drying. Finally, this substrate is immersed in a solution containing ions of the desired metal to enable formation of the metal layer. The electroless plating occurs selectively only on exposed ITO surface and does not occur on glass and the masking layer.
Inventors: Sunil Madhukar Bhangale, Li Zhongli, Peter Moran
Date granted: 31 Mar 05
Country granted: Singapore

Method for forming a nickel silicide layer on a silicon substrate

The invention provides a method to effectively reduce the residual interfacial oxide that subsequently retards silicidation reaction as well as oxidation from annealing ambient for NiSi formation without causing adversary effects on the electrical properties of the NiSi films.
Inventors: Chi Dongzhi, Rinus Lee, Syamal Kumar Lahiri, Chua Soo Jin
Date granted: 31 Mar 05
Country granted: Singapore

Method of creating patterns on substrates and articles of manufacture resulting therefrom

This invention describes a patterning technique suitable for micro- and nano-scale patterns. This patterning process is similar to a stamping process using liquid ink, whereby the ink on the protrusions of the stamp is transferred to a substrate, thereby creating the patterned structures on the substrate.
Inventors: Bao Lirong, Li Tan, Huang Xudong, Kong Yen Peng, L Jay Guo, Stella Pang, Albert Yee
Date granted: 1 Mar 05
Country granted: US

Gate electrodes and the formation thereof

This invention relates to ultra-large scale integrated (ULSI) circuits and more specifically to CMOS (complementary metal oxide semiconductor) transistors and mid-gap CMOS technology and the formation of silicide gate electrodes.
Inventors: Dominique Mangelinck, Syamal Kumar Lahiri, Chi Dongzhi
Date granted: 31 Jan 05
Country granted: Singapore

GaN-single-crystal substrates, nitride type semiconductor epitaxial substrate, nitride type semiconductor device, and methods of making the same

The invention relates to a GaN single-crystal substrate, a nitride type semiconductor epitaxial substrate, a nitride type semiconductor device, and methods of making them for use in light-emitting devices. The GaN single-crystal substrate has a polished surface flattened by heat treatment at a substrate temperature of at least 1020°C in a mixed gas atmosphere containing at least an NH3 gas.
Inventors: Chua Soo Jin, Chen Peng, Masaki Ueno, Eiryo Takasuka
Date granted: 11 Jan 05
Country granted: US

Method for electroless metalisation of polymer substrate

The invention describes a method of activating the surface of aromatic polymer film for electroless metalization. The polymer film surface is first given a wet chemical treatment followed by activation with catalytic palladium particles. This film surface is then subjected to electroless plating of desired metals such as nickel and copper. The invention also reveals selective plating as well as simultaneous metalization of micro-vias while drawing the circuitry.
Inventors: Bhangale Sunil Madhukar, Peter Moran
Date granted: 28 Feb 05
Country granted: Singapore

Hollow fibre membrane and methods for their production

The invention describes a method for providing defect-free hollow fibers with ultra-thin dense selective layer for application in gas separation membranes.
Inventors: Neal Chung, Lin Wenhui, Rohit Vora
Date granted: 30 Dec 04
Country granted: Singapore

RESEARCH

Nanoclay Composites that Enhance Strength of Polymers

by Dr He Chaobin

IMRE's novel 'slurry-compounding' approach for the preparation of polymer/clay nanocomposites vastly improves polymer strength and performance.

The addition of nanoclay composites has the ability to upgrade the mechanical and barrier properties, flame resistance, ablation performance, environmental stability, and solvent uptake of commercially available resins. The enhancements can be achieved with less than a 10% weight addition of 1nm thick silicate layers, with diameters between 20–500nm, and is in stark contrast to conventional polymer fillers, such as talc, mica, silica, and carbon black. The conventional fillers require high concentrations (>30 wt %) and may cause the deterioration of fracture toughness and processability.

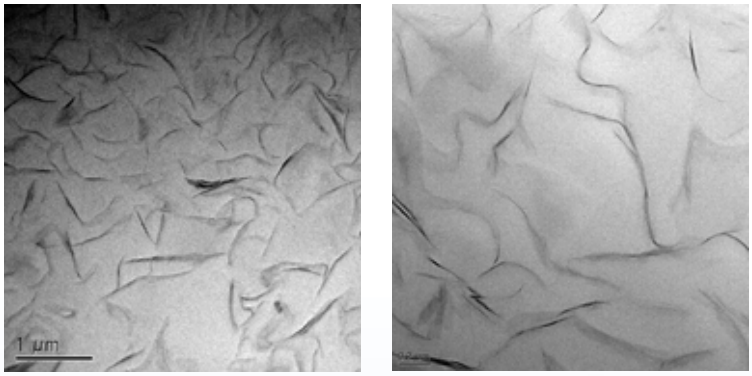


Figure 1-1. TEM micrographs of the epoxy/clay nanocomposites (clay content: 2.5 wt%) prepared using the new method, which show that clay is highly exfoliated and uniformly dispersed in the polymer matrix.

The exfoliation and dispersion of clay in the polymer matrix is the key to maximising the performance of the enhanced polymers. However, clay is hydrophilic and is only miscible with hydrophilic polymers, such as poly(ethylene-oxide) and poly(vinyl-alcohol). To allow the exfoliation of clay in other polymers, clay can be modified with organic surfactants, such as alkyl-ammoniums in a complicated procedure, which uses high concentration of organic modifiers. This deteriorates the performance of the nanocomposite and adds to the cost of processing.

IMRE has developed a novel approach using a 'slurry-compounding' process for the preparation of polymer/clay nanocomposites. This allows the hydrophilic clay particles to disperse in hydrophobic polymer matrices, such as epoxy, polypropylene, polystyrene and polymethyl methacrylate. With the 'slurry-compounding' process the dispersed state of clay in water can be partially transferred to the polymer matrix. The clay was first exfoliated, suspended in water, treated with an organic solvent to form a 'slurry' and then chemical modified using a common coupling agent. A polymer is then mixed with the modified slurry, the form the polymer nanoclay composites, after the solvent was removed.

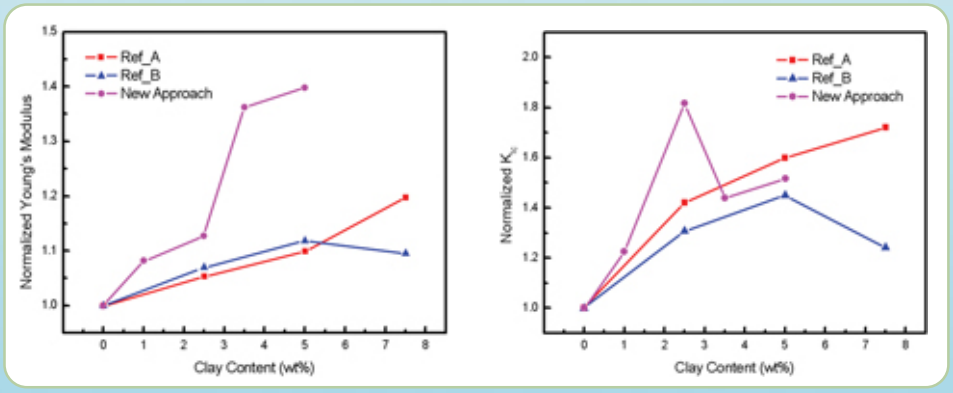


Figure 1-2. Normalised Young's modulus and fracture toughness of epoxy/clay nanocomposites prepared using different approaches, which shows that the new approach results in enhanced performance compared to existing ones.

The 'slurry-compounding' approach involves a new exfoliation mechanism, which is an exfoliation-dispersion-polymerisation process. The most impressive feature of the new technique is that only a minute amount of organic modifier (<5

wt% of clay) is required to facilitate the high exfoliation and effective dispersion of the clay.

To demonstrate, we have fabricated epoxy/clay nanocomposites using this new approach. As shown in Figure 1-1, the clay is exfoliated into single layers or thin tactoids that consist of 5 to 10 clay layers. These single layers and thin tactoids disperse uniformly in the matrix, indicating that the new approach is very effective in promoting both the exfoliation and dispersion of clay. Studies have shown that both the Young's modulus and fracture toughness of the material have increased significantly with the incorporation of clay (Figure 1-2). The new nanocomposites show better reinforcing effects compared with epoxy/organoclay nanocomposites prepared using existing techniques. Moreover, the nanocomposites containing 2.5 wt% of clay show the best fracture toughness, compared to that of the nanocomposites prepared with the existing approach that contains more than 5 wt% of organoclay.

By studying the crack tips with transmission electron microscopy (TEM) and scanning electron microscopy (SEM), we have deduced that the formation of massive amounts of microcracks and the increase of the fracture surface area due to crack deflection are the major toughening mechanisms in the epoxy/clay nanocomposite.

Potential applications of these nanocomposites include aircraft and automobile precision parts, printed circuit boards, electronic packaging, electrical components, beverage and food containers, barrier films and coatings, and more.

Dr He Chaobin *graduated with a BSc and MSc from South China University of Technology, China, and obtained his PhD from the University of Cambridge in 1995. After graduation, he worked as a postdoctoral fellow at Cavendish Laboratory, University of Cambridge for two year and then at USM, USA for another two years before he joined IMRE in 1999. He is currently a Senior Scientist as well as the Manager of the Molecular and Performance Materials research group. His research interests include functional organic-inorganic hybrids and nano-composites, liquid crystalline polymers, morphology and structure of polymer materials, and polymers for electronics.*

Upcoming Seminars / Workshops / Symposia

Date	Event	Location	Remarks
1 July 05	**Workshop on Semiconductor Nano Materials for Photonic Devices**	IMRE Seminar Room 1	By Invitation
1 July 05	**IMRE Seminar: Nanostructured Materials from Polymeric Building Blocks: From Fabrication toFunctions** *by Dr Dong Ha Kim, Max Planck Institute for Polymer Research*	IMRE Seminar Room 1	Register On-site
5 July 05	**IMRE Seminar: Status of Nanophosphor Synthesis** *by Dr Harish Chander, Electronic Materials Division*	IMRE Seminar Room 1	Register On-site
6 July 05	**IMRE Seminar: Ballistic Electro Photonics** *by Prof Venkatesh Narayanamurti, Harvard University*	IMRE Seminar Room 1	Register On-site
8 July 05	**Workshop on Ceramic Processing and Reliability Issues for Solid Oxide Fuel Cells** *By Prof Fred Lange, University of California, Santa Barbara*	IMRE Seminar Room 1	Register Online*
2 Aug 05	**Atom Technology Symposium**	IMRE Seminar Room 1	By Invitation
4 Aug 05	**MPM Industry Symposium**	IMRE Seminar Room 1	Coming Soon
30 Sep 05	**IMRE Industry Symposium**	IMRE Seminar Room 1	Coming Soon

*Register Online at IMRE's Events website: www.imre.a-star.edu.sg/events
For enquiries about IMRE's events, please write in to events@imre.a-star.edu.sg

Contributors to this issue
Dr He Chaobin, Ms Kwan Cai Nan, Mr Eugene Low

Institute of Materials Research and Engineering
3 Research Link, Republic of Singapore 117602
Tel: (65) 6874 8111 Fax: (65) 6872 0785
Email: enquiry@imre.a-star.edu.sg Website: www.imre.a-star.edu.sg

Printed by First Printers Pte Ltd