

Publication highlights

Listed below are some noteworthy IMRE research publications.

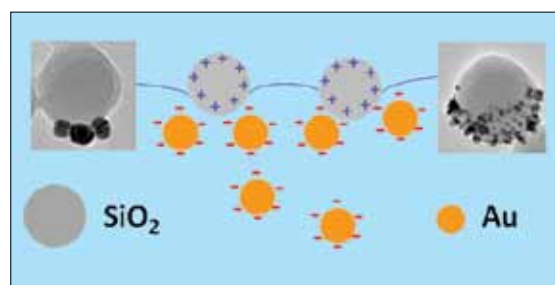
Simpler method for making Janus nanoparticles

PEG-POSS Assisted facile preparation of amphiphilic gold nanoparticles and interface formation of Janus nanoparticles; Chem. Commun., 2011, 47, 767-769; Fuke Wang, Noppawan Phonthammachai, Khine Yi Mya, Weng Wee Tjiu and Chaobin He

Abstract: Non-centrosymmetric Janus structures like spheres, disc, snowman shape or dumbbell particles are currently prepared using techniques such as masking/unmasking, Pickering emulsion, and triblock terpolymers assembly. These techniques were achieved by trapping the particles in a solid medium to partially protect the particle surface to act as a dissymmetrization tool, which requires special techniques and a long processing time.

“These nanoparticles have possible applications in controlled drug delivery and cancer cell therapy.”

IMRE researchers have developed a quick and easy method for preparing Janus nanoparticles. These nanoparticles have possible applications in controlled drug delivery and cancer cell therapy. The researchers had created a general approach for transferring water-



Schematic illustration of Janus nanoparticles formation at the interface of the aqueous and organic solution, together with TEM images of the formed Au-Silica Janus particles.

soluble nanoparticles with different shapes, sizes, and surface charges into organic solvents, retaining their surface charge properties. This was used to make hybrid Janus particles with opposite charges in solution. A coating of amphiphilic poly(ethylene glycol)-polyhedral oligomeric silsesquioxane, or PEG-POSS, on negatively charged gold nanoparticles allowed the particles to be suspended in organic solvents. Mixing with an aqueous solution containing positively charged silica nanoparticles causes an interfacial conjugation of the two

nanoparticles due to electrostatic attraction. Janus nanoparticles with single and multiple small gold nanoparticles attached to one large silica nanoparticle are created.

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Ultrasound deters barnacle fouling

Effect of ultrasound on cyprids and juvenile barnacles; Biofouling Vol. 27, No. 2, February 2011, 185-192; Shi Feng Guo, Heow Pueh Lee, Kuan Chun Chaw, Jason Miklas, Serena Lay Ming Teo, Gary H. Dickinson, William R. Birch and Boo Cheong Khoo

Abstract: The prevention of barnacle (*Amphibalanus amphitrite*) cypris larvae settlement on solid surfaces was achieved by exposing the organisms to ultrasound. This systematic study used three ultrasound frequencies (23, 63, and 102 kHz), at three acoustic pressure levels (9, 15, and 22 kPa), for exposure times of 30, 150, and 300s. 23 kHz was the most effective frequency and it also induced the highest cyprid mortality. Cyprid settlement following exposure to 23 kHz at 22 kPa for 30s was reduced by a factor of two. Exposure to ultrasound also altered cyprid exploration behaviour, significantly increasing step length and reducing step duration, walking pace, and the fraction of cyprids exploring the surface. The basal area of juvenile barnacles metamorphosed from ultrasound-treated cyprids was

initially smaller than unexposed individuals, but recovered over two weeks' growth. Thus, while ultrasound exposure effectively reduced cyprid settlement, juvenile

“This research provides key engineering parameters for implementing an alternative to the current chemicals and biocides used in preventing marine biofouling.”

barnacles recovered from its effects. This research provides key engineering parameters for implementing an alternative solution to the current chemicals and biocides used in preventing marine biofouling. Biofouling incurs billions of dollars in cost spent on additional maintenance and increased fuel consumption. Moreover, the ability to activate this



A cyprid exploring a solid surface - One antennule generates a temporary attachment point, while the other senses the substrate properties.

treatment on demand minimises its energy consumption and may be expected to mitigate its environmental impact.

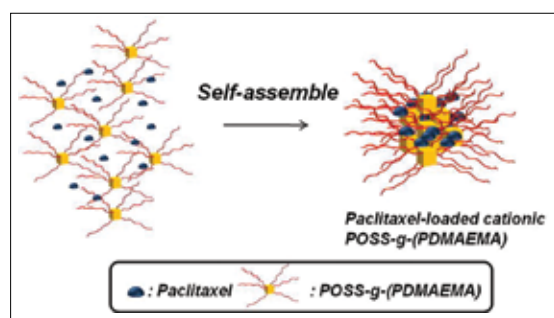
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Allowing insoluble drugs to be soluble

Efficient gene delivery with paclitaxel-loaded DNA-hybrid polyplexes based on cationic polyhedral oligomeric silsesquioxanes; J. Mater. Chem., 2010, 20, 10634-10642; Xian Jun Loh, Zhong-Xing Zhang, Khine Yi Mya, Yun-long Wu, Chao Bin He and Jun Li



Paclitaxel is encapsulated within a synthetic organic-inorganic cationic polymeric nanocarrier based on POSS-g-PDMAEMA. Paclitaxel-loaded DNA polyplexes display significantly better gene transfection efficiency compared to the non-loaded DNA polyplexes. This approach could offer a way to more effective gene transfection of cells using synthetic polycations.

Abstract: A novel hybrid cationic polymer based on polyhedral oligomeric silsesquioxanes (POSS) has been developed. This is the first report of using a cationic POSS-based material for gene delivery. Due to its amphiphilic properties, hydrophobic drugs such as paclitaxel can be encapsulated within the hydrophobic core of this polymer. Our research shows that paclitaxel-encapsulated hybrid POSS-based polyplexes show superior gene transfection efficiency in human breast cancer cells than the non drug-loaded polyplexes. Conventional cationic polymers used as gene carriers contain long sequences of covalently bonded repeating units. However, such cationic polymers are usually toxic to cells. The use of a POSS core masks the toxicity effect of these polymers

and disperses the cationic charge. Our systems are less toxic to cells tested resulting in more effective gene therapy and less side effects for some patients. This also makes the system more cell friendly for gene delivery. In addition,

“These ‘nanocontainers’ are able to solubilise drugs that are otherwise insoluble in water”

the incorporation of a hydrophobic sensitising agent is possible within the core of these ‘nanocontainers’. These ‘nanocontainers’ are able to solubilise drugs that are otherwise insoluble in water. Excellent DNA binding ability, low cytotoxicity and high gene transfection efficacy can be achieved using these novel supramolecular gene carriers.

This work can be further applied to the delivery of other hydrophobic drugs for chemotherapeutic treatments.

For more information about the publication, please contact

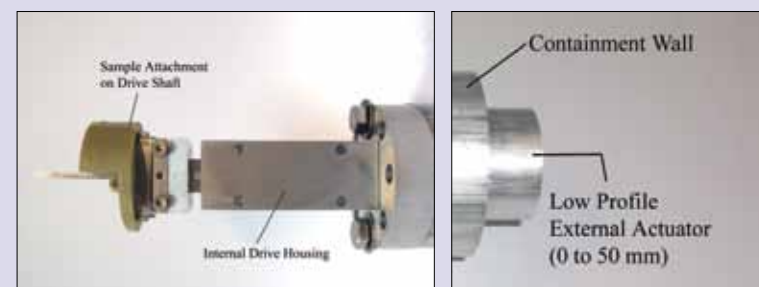


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Note: Dr Loh Xian Jun is an A*STAR scholar who was working with IMRE looking at biomaterials for drug delivery and tissue engineering with Dr Li Jun. He is currently pursuing his post-doctoral fellowship at the University of Cambridge, UK.

New magnetic actuator removes need for breaches in vacuum containment

The patented invention relates to a two-part magnetically-actuated drive that does away with the need for a breach in airtight chambers of ultra-high vacuum (UHV) systems.



Two parts are better than one – The internal drive mechanism (left) and low profile external actuator (right).

IMRE researchers have invented a new two-part mechanical drive system that can be magnetically-actuated. Consisting of an internal drive and an external actuator module, the new system does not require a breach or opening to be created in the design of UHV chambers. In current vacuum chamber design, a port has to be catered for to fit in a conventional mechanical actuator before being sealed again. The mechanical drives in UHV systems are quite commonly used in materials characterisation tools.

“Without the need to penetrate the vacuum chamber, designs can be made simpler and the integrity of a complete seal can be maintained”

Chambers with vacuum or hermetic seals generally have bulky external controls to drive the instruments within. In situations where external space is limited due to design constraints, these drives cannot be used. These drives also penetrate the vacuum chamber and require hermetic seals, which can compromise the integrity of the chamber. Though there are existing products that use magnetic coupling,

all of these still require a hole or port in the wall of the system and typically have protrusions outside the system (e.g. the external actuators) that extend beyond 10 cm. Our invention features the ability to limit the external actuator to below 5 cm and in some designs could even be incorporated into a sufficiently thick system wall.

Our innovation places the drive mechanism on the inner wall of the hermetic chamber and magnetically couples it to a low profile external actuator. Without the need to penetrate the vacuum chamber, designs can be made simpler and the integrity of a complete seal can be maintained. This can reduce design and maintenance cost in building new systems. The new technology can be used in drive systems operating in vacuum environments, hazardous gas or liquid environments, and consumer products requiring an external drive actuation minus the need for extra hermetic sealing.

For more information about this patent, please email



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AWARDS

An outstanding chemist



Prof Andy Hor

Executive Director, IMRE
Outstanding Chemist Award 2010
National University of Singapore (NUS)

IMRE's Executive Director, Prof Andy Hor, was the recipient of the NUS Department of Chemistry's Outstanding Chemist Award 2010.

The award is given annually to senior researchers (Associate Professor and above) based on their impact and strong research publication record in their area of expertise in the previous year.

VISITS & EVENTS

Molecular Materials Meeting (M3) @ Singapore

The first scientific conference of its kind in Singapore on Molecular Materials was held from 10-11 January 2011.



IMRE's Executive Director, Prof Andy Hor, welcoming delegates to the conference.

Some 70 scientists came together to take part in a two-day conference on research that can greatly impact technologies in health, lifestyle, high-value manufacturing and sustainability. The M3 @ Singapore, with the theme "Big Ideas in Molecular Materials", was aimed at seeding new ideas for tackling major energy, sustainability and health issues.

The event was also the first major scientific event in Singapore that was held in conjunction with the International Year of Chemistry 2011. The borderless nature of molecular materials research combines chemistry with other burgeoning fields of research to make low-cost, highly-efficient solar-energy harnessing devices, multi-functional 'smart' materials, and novel building materials that are lighter and more durable.

The speakers covered research topics that focused on four main themes; Sustainable Materials, Materials for High-value Manufacturing, Health Technologies and Lifestyle Materials. Plenary speakers for the conference included well-known scientists like Prof Allan S Hoffman from the University of Washington, USA and Prof Samuel Stupp from Northwestern University, USA.

The next M3 @ Singapore will be held from 9 – 11 January 2012.

IMRE Scientific Advisory Board (SAB) Meeting

The board members were updated on recent R&D developments in IMRE and some of the research plans and strategies going forward.



SERC and IMRE representatives with SAB members. (L-R) Dr Yoshiharu Doi (RIKEN, Japan), Prof Harold Craighead (Cornell University), Dr Tan Geok Leng (Deputy Executive Director, SERC), Dr Raj Thampuran (Executive Director, SERC), Dame Prof Julia Higgins (Imperial College London), Prof Andy Hor (Executive Director, IMRE), Prof Michael J. Aziz (Harvard University), Mr David Duncan (Unilever, UK), Prof Andrew Holmes (University of Melbourne) and Prof Anthony Ryan (University of Sheffield).

The recently held SAB meeting from 28 February to 1 March updated the board members on the developments at IMRE in the past year as well as to brief the meeting on key programmes and research activities. Insights on challenges ahead and the proposed strategies to tackle these challenges

were also discussed. More opportunities were made available for the SAB to interact and have dialogues with management and researchers on a more personal level. This allowed the SAB to meet IMRE's scientific talent and early career researchers to get a more detailed assessment of the progress and development of research in IMRE.

20 years of Science and Technology



A*STAR celebrates two decades of science and technology in Singapore this year. The celebrations were officially announced at the A*STAR 20th Anniversary Kick-Off Event on 15 April with the A*STAR Chairman, Mr Lim Chuan Poh, unveiling a special logo to mark the event. A series of activities including outreach events and conferences have also been planned in conjunction with the celebrations and will last till the end of 2011.

VISITS & EVENTS

Workshop on "Advances in Organic Electronics"

12 Jan 11

The joint IMRE-Hong Kong Baptist University workshop brought some 80 researchers together to address the recent developments in organic electronics including device design and organic semiconductor advancement for potential applications in organic light emitting diodes (OLEDs), organic photovoltaics (OPVs), organic thin-film transistors (OTFTs) and printed electronics.

Engineering for a 'greener' future

21 Jan 11



Speakers from the Singapore-Kyoto Forum visiting IMRE's laboratories.

The Singapore-Kyoto Forum on Nanotechnologies and Engineering for the Green Future was jointly organised by IMRE and the Kyoto Environmental Nanotechnology Cluster, Japan. Singapore and Kyoto are keen to accelerate the development of nanotechnology that leverage on functional nanomaterial systems for structural, coating and barrier applications, printed electronics, power electronics, smart

environmental sensors as well as next generation solar cell initiatives. The nearly 130 research and industry experts gathered to share nanomaterials and application developments and to identify strategic areas for future collaboration.

IMRE-Industry Gallium Nitride Scientific Workshop

02 Mar 11

The workshop that was attended by close to 150 participants was organised by IMRE to generate awareness in A*STAR's gallium nitride (GaN) activities and to seek industry interests in collaborating on potential 200mm GaN epiwafer developments. Industry partners like Aixtron, aNexus, Analytical Technologies were on hand to display their GaN-related capabilities. GaN-based materials systems have potential applications in high brightness light emitting diodes (LEDs) and high power electronics. The development of LED chips from 150 and 200mm wafers in mass production of LEDs could lead to a reduction in the cost of LEDs.



Participants interacting at one of the industry partner booths.

Advising partners on safe business practices

11 Mar 11



IMRE staff attending a training on the use of fire extinguishers during IMRE's EHS Awareness Day.

IMRE organised a bizSAFE Seminar together with Singapore's Workplace Safety and Health Council to raise the awareness of the bizSAFE programme to industry. The seminar was held in conjunction with IMRE's annual Environment, Health and Safety (EHS) Awareness Day. The bizSAFE Partner programme promotes sharing of resources, training and other common activities between client companies and their respective contractors, vendors and suppliers. As a bizSAFE Partner, IMRE acts as a 'consultant' to small and medium enterprises (SMEs) and helps to raise SMEs' awareness on safety and health matters at the workplace.

UPCOMING EVENTS

Diary of upcoming events @ IMRE

28-29 June 11
International Workshop on Atomic Scale Interconnection Machines
IMRE, Singapore

01 July 11
Workshop on Metamaterials
IMRE, Singapore

09 – 11 January 2012
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

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