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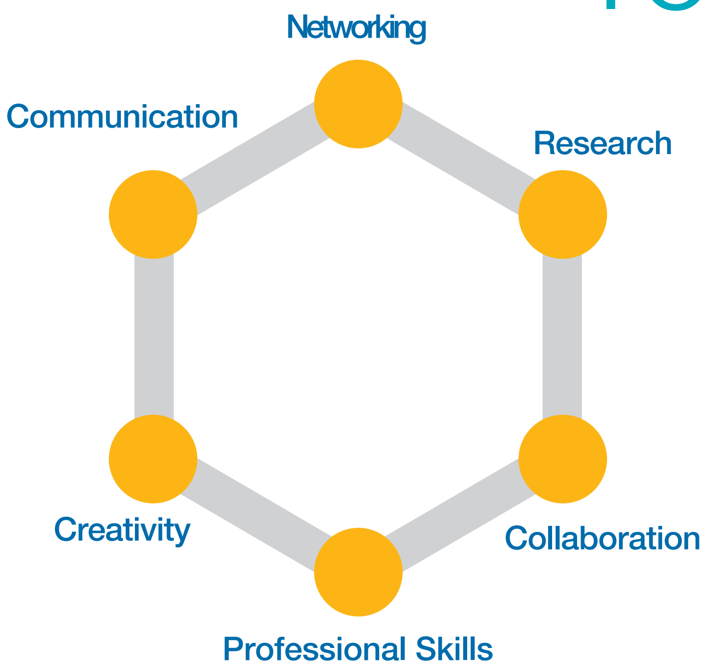
MCATM

Young Researcher Forum

06 October 2016

CAREER BRANDING



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Welcome

MCATM **You**ng **R**esearchers **Forum**, brings together young researchers in STEM disciplines at Monash and the local scientific community. **YouR Forum** offers early careers researchers and HDR students an opportunity to:

- Exchange your expertise and research ideas
- Enhance your scientific presentation skills
- Expand your professional skills toolkit
- Extend your professional network

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10:00	**Registration & Morning Tea**	**Foyer of G29/G30**
10:30	Welcome	Dr. Tich-Lam Nguyen
10:35	Ultralight graphene-based elastomers	Dr. Ling Qiu
11:05	Diffusion Wave Spectroscopy Study of Oil/Water Emulsions Stabilized by Graphene Oxide Nanosheets	Mr. Muthana Ali
11:20	Structural Characterisation of Layered Graphene Assemblies using Small Angle X-Ray Scattering	Ms. Ashley Roberts
11:35	Metal Link: A Strategy to Combine Graphene and Titanium Dioxide for Enhanced Hydrogen Production	Ms. Zhouyou Emily Wang
11:50	Progress towards laterally confined electronic devices using 2D semiconductors	Mr. Jimmy Kotsakidis
12:05	**Lunch**	**Foyer of G29/G30**
13:05	Identifying & Building Skill Set	Mrs. Lisa Happell
13:50	CV Writing | Job Searching	Ms. Lynda Rohan
14:35	Pitching & Marketing Yourself	Dr. Laura Faulconer
15:20	**Afternoon Tea**	**Foyer of G29/G30**
15:50	Templated CVD growth of Ohmic graphene/WS_2 contacts	Dr. Changxi Zheng
16:20	Photo-controllable dispersion and recovery of graphenes and carbon nanotubes	Mr. Thomas McCoy
16:35	Graphene coated scaffold - Is it biocompatible for neurons	Ms. Patcharin Chen
16:50	Computational studies on imaging and probing graphene encapsulated cells	Mr. Jiayao Li
17:05	**Closing**	

Ultralight graphene-based elastomers

Dr. Ling Qiu
Department of Materials Science & Engineering

Graphene, a two-dimensional carbon material, possesses a combination of exceptional mechanical, electrical, and thermal properties. These extraordinary properties make graphene an excellent building block for three dimensional (3D) macroscopic materials for widespread applications, ranging from structural materials to flexible electronics. The ability to maintain structural integrity upon large deformation is essential to ensure a macroscopic material which functions reliably for many applications. However, it has remained a great challenge to achieve high elasticity in three-dimensional graphene networks.

Here, we report recent progress on development of graphene-based elastomers and exploration of their applications. By elaborate control of the chemistry and assembly behavior of graphene, we recently developed an ultralight superelastic graphene-based elastomer. For the first time in graphene bulk material research, superelasticity is observed in the synthesized graphene monolith.

This unique hierarchical structure control technique also enables us to produce extremely low density graphene elastomer (≥0.5 mg/cm^3, even lower than half of the density of air).

By utilizing the electrically conductive function, the dynamic electromechanics of graphene elastomer is investigated. The high frequency responsive and ultra-sensitive piezoresistive behavior of graphene elastomer is revealed. In particular, this excellent dynamic response feature is rarely observed in flexible electronics research.

Additionally, our research demonstrates that using a very small volume fraction of cork-like graphene elastomer (as low as 0.045 vol.%) as reinforcing scaffold is able to significantly enhance the mechanical strength and electrical conductivity of smart hydrogel without compromising its functionality. Such high efficiency reinforcement has proven difficult to be achieved by other nanofiller reinforcement approaches.

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Diffusion Wave Spectroscopy Study of Oil/Water Emulsions Stabilized by Graphene Oxide Nanosheets

Mr. Muthana Ali
School of Chemistry

This work details the use of a 2-dimensional carbon nanomaterial in the form of graphene oxide as a stabiliser for oil-in-water emulsions, and how certain parameters such as concentration, oil type, salt, sonication time and pH can influence the stability of these systems. To analyse the effects and evolution of these emulsions based on the varying parameters, diffusing wave spectroscopy (DWS) has been exploited to this purpose.

DWS is an underused and very specialised technique that can underpin the behaviour and properties of concentrated or turbid dispersions based on backscattered radiation. The DWS results showed that the dynamics of the emulsions in this study have been significantly affected by these parameters, and also demonstrated that the emulsion dynamics depend greatly on the emulsion viscosity and the concentration of graphene oxide. The mean droplet size of the dispersed phase was also investigated by this technique as well as light microscopy imaging, and it was found that clear size trends also existed in relation to pH, sonication time and grapheme oxide concentration.

These data provide important insight into the fundamental phenomena governing graphene oxide emulsion properties and may allow for more informed development of technologies based around the material.

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Structural Characterisation of Layered Graphene Assemblies using Small Angle X-Ray Scattering

Ms. Ashley Roberts
Department of Materials and Science Engineering

Due to potential applications in separation science and capacitive energy storage, this project seeks to determine the structure of graphene hydrogel and graphene paper layered assemblies using x-ray scattering techniques available at the Australian Synchrotron.

Morphology-related research questions can be answered by determining models to describe the structure of graphene-based assemblies and their transport related phenomena. A short introduction to SAXS and WAXS experimental conditions and data analysis will be given, followed by some results obtained from various graphene layered materials.

Metal Link: A Strategy to Combine Graphene and Titanium Dioxide for Enhanced Hydrogen Production

Ms. Zhouyou Emily Wang
Department of Chemical Engineering

Efforts to enhance the efficiency of photocatalytic hydrogen production from water have continued since the discovery of photoelectrochemical water splitting on a titanium dioxide (TiO_2) electrode in 1972. However, several issues need to be addressed before it can be fully implemented.

The high recombination rates of the photo-generated electron-hole pair is one of the major reasons leading to detrimental effects over its photocatalytic H_2 production performance. In addition, the large band gap (3.2 eV) restricts its use only to the narrow light-response range of ultraviolet (about 4% of total sunlight).

Thus, to inhibit the recombination of photo-generated electron-hole pairs and to extend the optical absorption to visible light region are two key ways to improve the efficiency of hydrogen production of TiO_2.

To address the issue of charge recombination, noble metals have been employed as co-catalysts for many years. For such combined metal/TiO_2 system, photo-induced electrons within TiO_2 can be collected by metals, achieving effective separation from holes with hydrogen generation on the metal co-catalysts.

Although Pt has been widely employed as co-catalyst due to the low overpotential for hydrogen production, the high cost prohibits its industrial scale use. Therefore, Pt-free co-catalysts with high performance are of considerable interest.

Recently, graphene and its derivatives, graphene oxide (GO) and reduced graphene oxide (rGO), have been considered as promising co-catalysts for H_2 production due to the high specific area and superior electron mobility. In this project, we will fabricate a novel structure consists of TiO_2, metal and rGO and investigate the function of the selected metal (such as Ag, Cu, Ni and Co) in this structure.

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Progress towards laterally confined electronic devices using 2D semiconductors

Mr. Jimmy Kotsakidis
School of Physics & Asronomy

Working with transition metal dichalcogenides to fabricate new electronic devices and probe the physics of these interesting material systems.

The project is in its early stages but I have already managed to fabricate and measure the properties of monolayer WS_2 transistors at low temperature, paving the way for further exciting experiments.

Identifying & Building Skill Set

Mrs. Lisa Happell
Careers Education Consultant (Science) | Careers, Leadership & Volunteering

Lisa's LinkedIn Profile Summary: A qualified Career Practitioner with extensive experience in working with early to mid career professionals to help them 'Find a Cure' for their career. Knowledge extends across a range of sectors including; corporate, community and education.

Lisa's currently role involves developing and implementing career education programs and provide intensive career counselling, job seeking support and coaching to Faculty of Science students in order to maximise positive career outcomes.

She has expertise in the following key areas:

- Designing and developing career programs and seminars based on the needs of the individual and organisaion.
- Providing individual career counselling to people from a wide variety of backgrounds.
- Assisting individuals with job search strategies such as; networking, interview techniques, job applications and career direction.
- Keeping informed and up-to-date with the latest career trends and ideas.
- An ability to guide people through career uncertainty to help them take action and make the right career choice.
- Developing a career model 'Career STOPPS' that can be used as a tool to draw out career discussion and help with the decision making process.

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CV Writing | Job Searching

Ms. Lynda Rohan
Careers Education Consultant | Careers Connect | Careers, Leadership & Volunteering

Lynda's LinkedIn Biography:

Lynda has >15 years experience as a Careers Education Consultant at Monash University. She joined Monash in 2001 after her role as a Careers Counsellor at Deakin University.

Lynda holds a Bachelor of Arts and a Master of Social Science in Career Education and Development.

She has expertise in the following key areas:

- Career Counseling
- Career Development
- Resume Writing
- Public Speaking
- Workshop Facilitation
- Staff Development

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Pitching & Marketing Yourself

Dr. Laura Faulconer
Head of Operations, Small Technologies Cluster | Monash The Generator

Laura's The Generator Biography:

Laura likes to build things-- whether that is technology and innovation management initiatives, entrepreneurship support programs, elbow grease for fledgling start-up companies, or tackling a home renovation. Laura loves the feeling when you stand back and look at what you've created, both the accomplishment as well as seeing opportunities for improvement next time around.

Laura is currently the COO for STC -- an incubator, accelerator and advocate for advanced technology (micro/nano/bio) entrepreneurship. Several of the projects Laura has designed and developed are being rolled out currently, including an advanced technology coworking space, a student entrepreneurship challenge, and an intensive program to support fledgling medical device companies. Laura is continually inspired by the intelligence and dedication of the innovators and entrepreneurs in her network; they motivate and support her in the ongoing quest for self-improvement.

Laura completed a PhD in Biomedical Engineering (Medical Imaging concentration) at UNC Chapel Hill in 2009 and holds certificates in Business Essentials (UNC Kenan Flagler School of Business), Fundamental of Management, and Project Management.

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Templated CVD growth of Ohmic graphene/WS_2 contacts

Dr. Changxi Zheng
Department of Civil Engineering

Graphene and WS_2 are two prominent members in the family of two-dimensional materials and exhibit profound potentials for novel electronic and optoelectronic applications. Here we report the growth of an in-plane graphene-WS_2 heterostructure using ambient pressure chemical vapor deposition without seeding.

Monolayer WS_2 selectively grows on the bare region of sapphire until connecting to graphene to form large-scale heterostructures. This selective growth is due to the lack of nucleation sites on the van der Waals surface of graphene.

Atomic force microscopy, Kelvin probe force microscopy, transmission electron microscopy, and scanning photoluminescence spectroscopy are applied to investigate the structural, electronic and optical properties of the graphene-WS_2 heterostructure. Our results demonstrate that graphene can be used as the Ohmic contact metal to WS_2 due to its favorable band lineup.

Photo-controllable dispersion and recovery of graphenes and carbon nanotubes

Mr. Thomas McCoy
School of Chemistry

A key problem hindering the large scale production and use of carbon nanomaterials is in finding efficient methods for handling them in liquid suspensions and dispersions. Crucially, low energy and clean methods for reliably dispersing and capturing these materials from water are lacking, with most current approaches relying on costly magnetic particles or energy-intensive centrifugation.

In this work, a method is demonstrated whereby the addition of small amounts of a photosensitive surfactant can be used to reversibly disperse and separate carbon nanomaterials – namely graphene oxide, reduced graphene oxide and carbon nanotubes – from water (Fig. 1). The only stimulus required to effect complete recovery of the carbon nanomaterials is light, offering a facile and low energy method for their capture and redispersion.

By using a combination of phase behaviour studies, atomic force microscopy and small-angle neutron scattering, it is possible to follow the morphology of the carbon nanomaterial aggregates as they flocculate and redisperse, shedding light on the mechanism of surfactant-assisted recovery.

Significantly, due to the reversible nature of the photoisomerisation of the surfactant, both flocculation and dispersion can be induced, offering reproducible deployment and capture on demand. These findings present a unique method for the handling of aqueous dispersions of carbon nanomaterials.

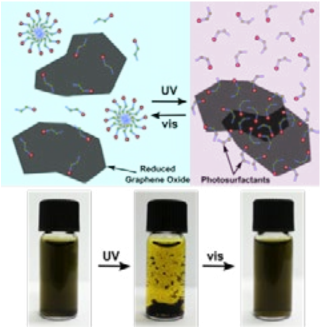

Figure 1.

(Top) Schematic showing the dispersion/aggregation states of reduced graphene oxide sheets in aqueous photosurfactant solutions under certain illumination conditions.

(Bottom) The corresponding sample images.

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Graphene coated scaffold - Is it biocompatible for neurons?

Ms. Patcharin Chen
Department of Materials Science & Engineering

A novel biomaterial was engineered by combining an electrospun polycarpolactone (PCL) scaffold and graphene. Graphene is used as a source of electrical conductivity while electrospun scaffold will provide the 3-dimensional structure for cell attachment.

Graphene oxide was reduced to its conductive form using ascorbic acid. The in vivo application would require PCL scaffold coated with reduced graphene oxide to be biocompatible. It is hypothesised that the hybrid material will enhance axonal extension, support the formation of neurite network and synaptic communication of primary cortical neurons.

Computational studies on imaging and probing graphene encapsulated cells

Mr. Jiayao Li
Department of Mechanical & Aerospace Engineering

Graphene, as a material with superior mechanical properties and nanometre thickness, has been proposed to encapsulate cells and maintain a native environment for both imaging and probing. In addition to a more conventional approach that uses silicon nitride membrane, graphene encapsulation keeps the hydrated samples transparent to incident electron/light with desired charge reduction and minimal electron scattering.

The characteristic of being impermeable to any gases and liquid allows the encapsulated samples to be investigated in a vacuum environment, a long standing hurdle for high resolution electron imaging. Monte Carlo (MC) simulation of the incident electrons has been performed to investigate the mechanisms of how electron beam interacts with the target samples with the involvement of a graphene layer. Results suggested that graphene has minimal effects on the transmission of electron penetration during imaging the hydrated sample.

However, extra liquid between the cell and graphene may significantly prevent the travel of secondary or backscattered electrons, and imaging parameters such as accelerating voltage should be tuned accordingly for a successful acquisition of hydrated cells. Finite element analysis (FEA) was also performed to investigate the role of graphene in determining the actual stiffness of the encapsulated cells.

The contact between graphene-wrapped cell and an Atomic Force Microscope (AFM) tip has been simulated, and the “composite” model has been recursively refined with the experimental results. It has been revealed that force-displacement curves are significantly affected with the addition of a graphene layer, due to the extremely high modulus of graphene.

As a conclusion, a conventional AFM or other nanoindentation approaches will be able to probe live cells by using the graphene encapsulation approach, and mechanical properties measured will require corrections.

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