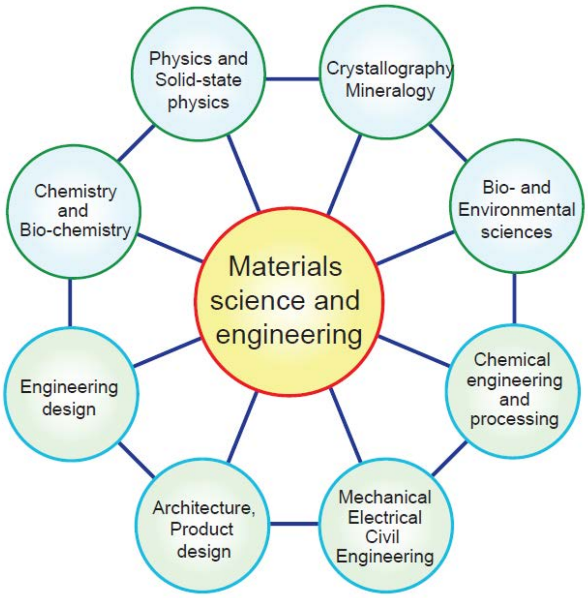
1st ASIAN MATERIALS EDUCATION SYMPOSIUM



December 11-12, 2014

The National University of Singapore

NUS National University of Singapore

The Symposium is coordinated by Granta Design

GRANTA MATERIAL INSPIRATION

It is supported by the advisory committee, ASEE Materials Division, ASM International, Cambridge University (Department of Engineering and Department of Materials Science and Metallurgy), FEMS, MRS, and SEFI

FEMS SEFI UNIVERSITY OF CAMBRIDGE ASM INTERNATIONAL The Materials Information Society MRS Materials Research Society SINGAPORE

1st Asian Materials Education Symposium

National University of Singapore
Singapore

December 11-12, 2014

Information Booklet

Section 1:

Participants

Attendee list

(Correct on December 3, 2014)

	Name	Institution	Country	Speaker	Poster	Attending
1	Prof Servet Turan	Anadolu University	Turkey			Full event
2	Dr Kyozo Arimoto	Arimotech Ltd	Japan			Full event
3	Dr Jayalakshmi Subramanian	Bannari Amman Institute of Technology	India			Full event
4	Dr Arvind Singh Ramachandra	Bannari Amman Institute of Technology	India			Full event
5	Assoc Prof Krishnan Kannoorpatti	Charles Darwin University	Australia	Y		Symposium
6	Dr Arvind Sinha	CSIR - National Metallurgical Laboratory	India			Symposium
7	Professor Matthew Barnett	Deakin University	Australia	Y		Symposium
8	Professor Sybrand Van der Zwaag	Delft University of Technology	The Netherlands	Y		Symposium
9	Marc Fry	Granta Design	UK			Full event
10	Rebecca de Rafael	Granta Design	UK			Full event
11	Dominic Mikulin	Granta Design	UK			Full event
12	Professor Arlindo Silva	IDMEC	Portugal	Y		Symposium
13	Dr Rampada Manna	Indian Institute of Technology (BHU)	India			Full event
14	Prof N C Santhi Srinivas	Indian Institute of Technology (BHU)	India			Full event
15	Prof. Devendra Kumar	Indian Institute of Technology (BHU)	India	Y		Symposium
16	Prof Srinivasan Raja Vngaranahalli	Indian Institute of Technology Bombay	India			Symposium
17	Assoc Prof Sujeet Sinha	Indian Institute of Technology Delhi	India	Y		Full event
18	Prof. Srinivasa Ranganathan	Institute of Science	India	Y		Symposium
19	Prof Cemil Hakan Gur	Middle East Technical University	Turkey		Y	Symposium
20	Dr Varghese Swamy	Monash University Malaysia	Malaysia			Full event
21	Ms Eunice Goh	Nanyang Polytechnic	Singapore		Y	Symposium
22	Dr Sridhar Idapalapati	Nanyang Technological University	Singapore		Y	Symposium
23	Dr Yi Long	Nanyang Technological University	Singapore	Y		Symposium
24	Assoc. Prof Freddy Boey	Nanyang Technological University	Singapore	Y		Symposium
25	Assoc Prof Chaobin He	National University of Singapore	Singapore	Y		Symposium
26	Prof John Wang	National University of Singapore	Singapore			Symposium
27	Gan Moog Chow	National University of Singapore	Singapore	Y		Symposium
28	Ding Jun	National University of Singapore	Singapore			Symposium
29	Daniel John Blackwood	National University of Singapore	Singapore			Symposium
30	Stefan Adams	National University of Singapore	Singapore		Y	Symposium
31	Ouyang Jianyong	National University of Singapore	Singapore			Symposium
32	Chiu Cheng Hsin	National University of Singapore	Singapore		Y	Symposium

	Name	Institution	Country	Speaker	Poster	Attending
33	Tan Swee Ching	National University of Singapore	Singapore			Symposium
34	Loh Xian Jun	National University of Singapore	Singapore			Symposium
35	Kong Hui Zi	National University of Singapore	Singapore			Symposium
36	Liyanage Chamila Nishanthi	National University of Singapore	Singapore			Symposium
37	Gu Wenyi	National University of Singapore	Singapore			Symposium
38	Assoc Prof Daniel Chua	National University of Singapore	Singapore			Full event
39	Prof Choon Fong Shih	National University of Singapore	Singapore	Y		Symposium
40	Dr Eugene Wong	Newcastle University	Singapore		Y	Symposium
41	Dr Kheng Lim Goh	Newcastle University International Singapore	Singapore		Y	Symposium
42	Mr Shu Cheng Wu	Ngee Ann Polytechnic	Singapore			Full event
43	Prof Zhili Dong	Nanyang Technological University	Singapore			Symposium
44	Mrs Jul Endawati	Politeknik Negeri Bandung	Indonesia			Symposium
45	Dr Wong Luh Cherng	Republic Polytechnic	Singapore			Symposium
46	Ms Song Sin Nee	Republic Polytechnic	Singapore			Symposium
47	Ms wu Jing Yi	Republic Polytechnic	Singapore			Symposium
48	Ms sally Ang	Republic Polytechnic	Singapore			Symposium
49	Ms Vicky Wu	Republic Polytechnic	Singapore			Symposium
50	Ms Chen Shui Ling	Republic Polytechnic	Singapore			Symposium
51	Mr Rajiv Kashyap	Republic Polytechnic	Singapore			Symposium
52	Ms Avelyn Toh	Republic Polytechnic	Singapore			Symposium
53	Ms Sebrina Chua	Republic Polytechnic	Singapore			Symposium
54	Mr Che Ser Tong	Republic Polytechnic	Singapore			Symposium
55	Ms Genevieve Lin	Republic Polytechnic	Singapore		Y	Symposium
56	Prof Swaminathan Sethuraman	Sastra University	India			Symposium
57	Dr Lingti Kong	Shangahi Jiao Tong University	China		Y	Symposium
58	Professor Deliang Zhang	Shanghai Jiao Tong University	China	Y		Symposium
59	Professor Min Wang	Shanghai Jiao Tong University	China			Symposium
60	Assoc. Prof. Chui Ping Ooi	SIM University	Singapore			Symposium
61	Assoc. Prof Philip Chang	SIM University	Singapore			Symposium
62	Dr Teik-Cheng Lim	SIM University	Singapore	Y		Symposium
63	Dr Aaron Goh	Singapore Institution of Technology	Singapore			Symposium
64	Mr James Lee	Singapore Polytechnic	Singapore			Symposium
65	Mr Gilbert Teo	Singapore Polytechnic	Singapore			Symposium
66	Dr Shwu Lan Ngoh	Singapore Polytechnic	Singapore			Symposium
67	Mr Pai How Nee	Singapore Polytechnic	Singapore			Symposium
68	Dr Zuruzi Abu Samah	Singapore University of Technology and Design	Singapore	Y		Symposium
69	Professor Seh-Chun Lim	Singapore University of Technology and design	Singapore			Symposium
70	Prof Ping Wu	Singapore University of Technology and Design	Singapore	Y		Symposium
71	Mr Blake Perez	Singapore University of Technology and Design	Singapore	Y		Symposium

	Name	Institution	Country	Speaker	Poster	Attending
72	Mr Bradley Camburn	Singapore University of Technology and Design	Singapore	Y		Symposium
73	Prof. Martin Dunn	Singapore University of Technology and Design	Singapore	Y		Symposium
74	Dr Jian Chen	Southeast University	China	Y		Full event
75	Dr Yinsheng Dong	Southeast University	China			Full event
76	Dr Yurong Dai	Southeast University	China			Symposium
77	Professor Yamei Zhang	Southeast University	China			Full event
78	Miss Danping Dong	SUTD	Singapore		Y	Symposium
79	Miss Julie Sabaratnam	SUTD	Singapore		Y	Symposium
80	Mr Aaron Blicblau	Swinburne University of Technology	Australia	Y		Symposium
81	Assoc Prof Yoshinao Kobayashi	Tokyo Institute Technology	Japan	Y		Symposium
82	Prof Zhenzi Jing	Tongji University	China		Y	Symposium
83	Prof Wei Xu	Tongji University	China	Y		Symposium
84	Prof. Dr. Deping Wang	Tongji University	China			Symposium
85	Professor Andre Canal Marques	UNISINOS	Brazil	Y		Full event
86	Dr Khairul Azwan Ismail	Universiti Malaysia Perlis	Malaysia			Course
87	Prof Hugh Shercliff	University of Cambridge	UK			Full event
88	Prof Mike Ashby	University of Cambridge	UK	Y		Full event
89	Dr Christian Della	University of Glasgow - Singapore	Singapore			Symposium
90	Prof Peter Goodhew	University of Liverpool	UK	Y		Full event
91	Dr Louise Smith	University of South Australia	Australia	Y		Full event

Section 2:

Agenda

At-A-Glance Agenda & Locations

WEDNESDAY		
2:30pm-4:00pm	Public Lecture	**National University of Singapore,** Faculty of Engineering, *Engineering Auditorium*
4:00pm-5:00pm	Tour of NUS Department of Materials Science and Engineering	**Meet:** Faculty of Engineering, *Foyer of Engineering Auditorium*
5:45pm 6:30pm	Presenters' Drinks Reception Presenters' Dinner	**The Scholar Chinese Restaurant**
THURSDAY*: SYMPOSIUM, DAY ONE*		
TIME	***EVENT***	***VENUE***
8:00 am	Registration, Refreshments and Poster setup	**National University of Singapore**, the Education Resource Centre, University Town, *Ngee Ann Kongsi Auditorium*
8:45 am	Symposium Day One Starts	
9:55-10:30 am	Poster Teasers	
10:30-11:15 am	Poster Session & Refreshments	
12:20-1:50 pm	Lunch and Poster Session continued (1pm)	
3:25-3:55 pm	Afternoon Tea & Poster Session continued	
5:45 pm	Symposium Day One Closes	
6:30 pm	Symposium Drinks Reception /Free Evening	**Kent Ridge Guild House**
7:00pm	Symposium Dinner/ Free Evening	
FRIDAY*: SYMPOSIUM, DAY TWO*		
8:30 am	Registration, Refreshments	**National University of Singapore**, the Education Resource Centre, University Town, *Ngee Ann Kongsi Auditorium*
9:00 am	Symposium Day Two Starts	
10:15-11:00 am	Refreshments	
12:30-2:15pm	Lunch	
3:15-4:00 pm	Afternoon Tea	
5:30 pm	Symposium Day Two Closes	
SATURDAY: *SHORT COURSE*		
9:00am	Registration, Refreshments and software installation	**National University of Singapore,** E1A-04-02, *Smart Classroom*
9:30am	Short Course Starts	
12:30-1:30pm	Lunch	
3:15-4:00pm	Coffee and Refreshments	
5:30pm	Close	

Please see **Section 5** for maps and more details on venues.

Symposium Day One: Thursday December 11, 2014

LOCATION: EDUCATION RESOURCE CENTRE, NATIONAL UNIVERSITY OF SINGAPORE

8.00 am	**Registration,** Coffee, and Poster setup
8.45 am	**Prof. John Wang** - National University of Singapore, Singapore **Prof. Seh Chun Lim** - Singapore University of Technology and Design, Singapore **Prof. Mike Ashby** – Engineering, University of Cambridge, UK *Welcome Address*
	SESSION 1:
9.00 am	**Session chair: Prof. Sybrand van der Zwaag** - Delft University of Technology, The Netherlands *Session Introduction*
9.05 am	**Prof. Shih Choon Fong** – National University of Singapore, Singapore *A New Paradigm in Materials Education: Materials for a Green Economy*
9.30 am	**Prof. Mike Ashby** –University of Cambridge, UK *Materials and Maps*
9.55 am	**Poster Teasers** *Poster Presenters invited to give a one minute presentation about their poster*
10.30 am	**Poster Session**, **Coffee and Introductions**
11.15 am	**Assoc. Prof. Chaobin He** – Materials Science and Engineering, National University of Singapore, Singapore *From Research to Teaching: Using Case Study as an Effective Tool to Reinforce Basic Physical Concepts in Polymer Science*
11.30 am	**Assoc. Prof. Wu Ping** –Singapore University of Technology and Design, Singapore *Involving Sustainable Technology Development in the Graduate Teaching of Applied Thermodynamics*
11.45 am	**Mr. Aaron Blicblau** –Swinburne University of Technology, Australia *A Blended Approach to Learning and Teaching about Materials in the 21st Century*
12.00 pm	**Session discussion** led by the session chair
12.20 pm	**Lunch** **Poster Session continued (starts 1.00 pm)**
	SESSION 2:
1.50 pm	**Session chair: Prof. Peter Goodhew** - Universities of Liverpool and Derby, UK *Session Introduction*
1.55 pm	**Prof. Blake Perez** – Singapore University of Technology and Design, Singapore *Innovations in Materials Education: Hands-on Activities, Active Learning and Designettes*
2.20 pm	**Prof. Srinivasa Ranganathan** – Indian Institute of Science, Bangalore, India *Title and abstract still to be confirmed*
2.45 pm	**Prof. V.S Raja** – Metallurgical Engineering and Materials Science, Indian Institute of Technology, Bombay, India *Connecting Science to Typical Engineering Problems: An Effective Pedagogy to Teach Complex and Diverse Concepts in Corrosion*
3.00 pm	**Assoc. Prof. Yoshinao Kobayashi** – Tokyo Institute of Technology, Japan *Sustainable Engineering Special Education Course in Tokyo Institute of Technology*
3.25 pm	**Poster Session continued** **Coffee/Afternoon Tea**
3.55 pm	**Prof. Gan Moog Chow** – National University of Singapore, Singapore *Teaching Interdisciplinary MSE modules*
4.10 pm	**Prof. MsC. André Canal Marques** – UNISINOS, Brazil *Introduction of life cycle assessment (LCA) using software CES EduPack with Eco Audit Tool in design course*
4.25 pm	**Assoc. Prof. Jian Chen** – Southeast University, China *The design and performance of a project-based learning course for materials undergraduates at Southeast University*
4.40 pm	**Dr. Teik-Cheng Lim** - SIM University, Singapore *Industrial PhD Programme in SIM University: Special Focus on Materials Engineering in Industry*
4.55 pm	**Prof. Matthew Barnett** – Deakin University, Australia *Deconstruction to engage mechanical engineering students in materials topics*
5.10 pm	**Session discussion led by the session chair**
5.35 pm	**Concluding remarks**
5.45 pm	**Close**

Evening

Formal Symposium Dinner: The Scholar Chinese Restaurant, NUS, Drinks Reception at 6:30pm.

Symposium Day Two: Friday December 12, 2014

LOCATION: EDUCATION RESOURCE CENTRE, NATIONAL UNIVERSITY OF SINGAPORE

8.30 am	Registration and coffee
	SESSION 3:
9.00 am	**Session chair: Dr. Hugh Shercliff** - University of Cambridge, UK *Session Introduction*
9.10 am	**Prof. Freddy Boey** – Nanyang Technological University, Singapore *Materials Science and Engineering Education: Challenges, Opportunities and some perspectives from NTU*
9.35 am	**Prof. Sybrand van der Zwaag** – Aerospace Engineering, Delft University of Technology, The Netherlands *Using "self healing materials" as a suitable topic for getting students to think as materials designers*
10.00 am	**Prof. Martin Dunn** – Engineering Product Development, Singapore University of Technology and Design, Singapore, *3D Multimaterial Printing for Teaching Composite Materials*
10.15 am	**Coffee**
11.00 am	**Dr. Louise Smith** – Information Technology, Engineering and the Environment, University of South Australia, Australia, *Biomaterials education for a multidisciplinary audience*
11.15 am	**Assoc. Prof. Sujeet Sinha** – Indian Institute of Technology Delhi, India *Use of case studies and students' classroom-participation in learning the importance of materials in mechanical engineering design*
11.30 pm	**Prof. Deliang Zhang** – Materials Science and Engineering, Shanghai Jiao Tong University, P.R.China *The Roles of Internationalisation in Materials Science and Engineering Education*
11.45 pm	**Dr. Zuruzi Abu Samah** – Singapore University of Technology and Design, Singapore *Reaching out to future materials scientists and engineers: Experiential learning through application driven projects*
12.00 pm	Session discussion led by the session chair
12.45 pm	**Lunch**
	SESSION 4:
2.15 pm	**Session chair: Prof. John Wang** - National University of Singapore, Singapore *Session Introduction*
2.20 pm	**Prof. Peter Goodhew** – School of Engineering, Universities of Liverpool and Derby, UK *Materials Education in a Changing Climate*
2.45 pm	**Assoc. Prof. Krishnan Kannoorpatti** – Engineering and Information Technology, Charles Darwin University, Australia, *Experiences in Teaching Materials Engineering in a remote area of Australia*
3.00 pm	**Prof. Wei Xu,** Tongji University, China *SITP (Students Innovation Training Program) for undergraduates as a bridge between education and research*
3.15 pm	**Coffee/Afternoon Tea**
4.00 pm	**Dr. Yi Long** – Materials Science and Engineering, Nanyang Technological University, Singapore *E-poster/presentation for group project/assessment in school of materials science and engineering*
4.15 pm	**Ms. Genevieve Lin** – School of Applied Science, Republic Polytechnic, Singapore *Effectiveness of Advanced Elective Module in Generating Students' Interest in Materials Science*
4.30 pm	**Assist. Prof. Arlindo Silva** – Mechanical Engineering, University of Lisbon, Instituto Superior Tecnico, Portugal *Mechanical engineers' typical misconceptions in materials science, and how to correct them*
4.45 pm	**Session and day discussion led by the session chairs**
5.15 pm	**Prof. John Wang** - National University of Singapore, Singapore **Prof. Seh Chun Lim** - Singapore University of Technology and Design, Singapore **Prof. Mike Ashby** – Engineering, University of Cambridge, UK *Concluding remarks*
5.30 pm	**Close**

Shuttle Schedule

TIME	FROM	TO
Wednesday, December 10		
2:00pm	Park Avenue Rochester Hotel	National University of Singapore, Faculty of Engineering
5:30pm	National University of Singapore, Faculty of Engineering	National University of Singapore, Kent Ridge Guild House
9:00pm	National University of Singapore, Kent Ridge Guild House	Park Avenue Rochester Hotel
Thursday, December 11		
7:30am	Park Avenue Rochester Hotel	National University of Singapore, University Town
6:00pm	National University of Singapore, University Town	National University of Singapore, Kent Ridge Guild House
9:30pm	National University of Singapore, Kent Ridge Guild House	Park Avenue Rochester Hotel
Friday, December 12		
7:45am	Park Avenue Rochester Hotel	National University of Singapore, University Town
6:00pm	National University of Singapore, University Town	Park Avenue Rochester Hotel
Saturday, December 13		
8:15am	Park Avenue Rochester Hotel	National University of Singapore, Faculty of Engineering
5:30pm	National University of Singapore, Faculty of Engineering	Park Avenue Rochester Hotel

Section 3:

Presentation Abstracts

Day One: Thursday December 11, 2014

Day One, 9:05am

A New Paradigm in Materials Education: Materials for a Green Economy

Shih Choon Fong
National University of Singapore, Singapore

“Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history. Human actions are depleting Earth’s natural capital, putting such strain on the environment that the ability of the planet’s ecosystems to sustain future generations can no longer be taken for granted.” (Millennium Ecosystem Assessment, 2005, UN).

In short, ecological degradation is now putting all forms of life at risk.

Take the built environment for example. As developing countries race towards industrialization, towns are mushrooming into cities, and cities are fast becoming megacities. At the same time, urban sprawl in fast-growing metropolitan areas in the industrial world are also threatening their social and physical environments. Some have suggested that our industrial-age values and practices have placed humanity in a progress trap – one that could endanger our very own existence and certainly those of future generations. In this respect, the built environment presents some of the most serious challenges facing humanity.

How can materials education across the range of disciplines in engineering, science, and design make a difference? After all, materials are the stuff that created our built environment and enabled economic life to get on its feet in our industrial world.

To begin with, a holistic curriculum for materials education should include both economic and ecological aspects. Could post-industrial-age values and practices of conservation, stewardship and sustainable development inform materials education, e.g. in materials selection for design and construction of the built environment? Should educators give more attention to the use of natural and eco-friendly materials as well as innovative design and construction that utilizes such materials? Just as important, students also need to develop an understanding that a green economy is not a non-growth economy. By adopting a long-term approach and implementing it well, a green economy can generate growth, positively impact our quality of life, and reverse the degradation of the planet’s ecosystems.

“The reform that is needed is not anti-capitalist, anti-American, or even deep environmentalist; it is simply the transition from short-term to long-term thinking.” (An Illustrated Short History of Progress, Ronald Wright)

Day One, 9:30am

Materials and Maps

M. Ashby
University of Cambridge, UK

Maps condense information; they distil; they capture essentials and reveal relationships. They collapse, onto a single sheet, data that would take pages to report as text or tables. Above all, they are *visual*; they reveal shape, connections and disconnects.

What has this to do with materials? Start at the beginning: the Periodic Table of the elements is a map – you might think of it as having axes of atomic number and outer-electron configuration. When the known elements were first plotted in this way, the gaps revealed what we did not know: undiscovered elements, some attributes of which could even be predicted from the position of the gap even before they were discovered.

You can map onto maps. Governments, concerned about security of material supply, identify certain elements as "critical", meaning that security of supply is essential for reasons of economy or national security. Mapping these and bills of materials for products onto the Periodic Table reveals where dependencies exists; and mapping the countries of origin of the materials onto another map– that of the world – reveals vulnerability to supply constraints.

Materials can be mapped in many other revealing ways. Materials have properties – mechanical, thermal, electrical, environmental. Think of these properties as the axes of a multi-dimensional *material-property space*. Pairs or combinations of these properties can be mapped; each map is a section through material-property space. Doing so reveals patterns and relationships. Material processing, such as thermal or mechanical treatments, changes the properties, shifting the position of the material in material-property space and reconfiguring the patterns.

The maps reveal that, for any section, part of the material-property space is filled but part is empty. Certain parts of the space are inaccessible for fundamental reasons, but blocking these off still leaves holes that could, in principle, be filled. From this emerges the idea of *vectors for material development*, focusing attention on directions for material research that might prove most fruitful.

The talk will illustrate these points with examples, opening the way for possible discussion.

Day One, 11:15am

From Research to Teaching: Using Case Study as an Effective Tool to Reinforce Basic Physical Concepts in Polymer Science

Chaobin He
National University of Singapore, Singapore

For teaching polymer science, it is important to provide real world inter-disciplinary examples, in which problem solving does not depend just on recall of factual material in textbooks but requires digesting, analysing and evaluating the information, and critical thinking. Such examples, together with open-ended questions, could be used to reinforce the fundamental concepts of materials science.

In this presentation, I will highlight how my research collaboration with a company provides an excellent case study in lecture to teach the basic concepts of polymer science such as glass transition temperature and crystallization.

A company produces thermoplastic elastomers which were used to make tooth brushes. It used blue and red dye for its thermoplastic elastomers. However, it was found that the blue dye worked fine while the red dye led to hardening of thermoplastics in winter. And as a result, the company had to recall its product.

Through active discussion, the students are guided to appreciate that different dyes have different ability to initiate crystallization of polymers, and when thermoplastic elastomers does crystallize, they tend to leak out silicone oil which was incorporated into the elastomers to reduce Tg. When silicone oil content is low and the crytsallinity is high, the Tg increases. As a result, the thermoplastic elastomers become hard in winter when the room temperature drops to or is below the Tg of elastomers.

The solution: using a red dye with low nucleation capability. The company now could produce new red colour thermoplastic elastomer which is still soft in winter by using different type of red dye. Through this case study, it has been found that most of the students are able to grasp the following important concepts:

1. Tg is an important parameter of polymers which affects their viscoelasticity behaviours. When Tg higher than the operation temperature, materials has a glassy-like behaviour, while when Tg lower than the used temperature, polymer is rubbery-like.

2. Small molecule additives (such as silicone oil) lower Tg of the polymers (Fox equation)

3. Crystallinzation of polymers will lead to leak out of small molecules, which could lead to high Tg of the polymers

4. Crystallinity also plays a part in influencing the Tg, This is because that crystalline region act as ‘physical crosslinking” of polymer chains and hence mobility of polymer chains were hindered.

5. Additives, such as dye could affect the crystallization of polymers.

Day One, 11:30am

Involving Sustainable Technology Development in the Graduate Teaching of Applied Thermodynamics.

Wu Ping
Singapore University of Technology and Design, Singapore

The ever increasing global investment in sustainable R&D activities directly challenges today's graduate educations worldwide. Therefore, as highlighted by Prof. Mike Ashby, it is important to incorporate in our teaching the involvement (i.e., problems/solutions/skills) with the industrial, economic, environmental, and social systems. SUTD, a newly established technology based design university, practices towards this goal ever since its first day in operation. The author is honored to design and teach the "Applied Thermodynamics" course in SUTD, which not only bridges science and applications but also trains students using real-life problems/solutions.

New pedagogy practices are adopted to achieve the above teaching objectives while coping with the diversified student interests and background. In-depth knowledge/skills in computational thermodynamics are taught, and their linkages to student research fields are emphasized, from biology to quantum computing, solid state physics to aircraft design, heat engine design to chemical/pressure sensors, microchip design/fabrication to surface plasmonic optics, electron spin (storage) to battery, and solar cells design to thermoelectric devices.

In this talk the author will first try to review the current R&D practices and identify a few key technology/methodology components that may enable a sustainable society/economy. The talk, then, will cover knowledge/skills that have been identified of potential beneficial to the working lives of our students in a world of sustainable economy and society. And subsequently, the author will highlight the so developed syllabus of the Applied Thermodynamics course, its teaching method, assessment modes, and student survey results.

New teaching resources (like computational thermodynamics) and new teaching pedagogy (like interactive learning and optimized balancing between class lecture and small group hands on activities) are effective tools in graduate education to train the needed manpower for sustainable R&D, economy and society as whole. The methodology highlighted here may be used not only in the development of graduate course structures in general but also for a specific course.

Day One, 11:45am

A Blended Approach to Learning and Teaching about Materials in the 21st Century

Aaron S Blicblau
University of Technology, Hawthorn Victoria Australia

BACKGROUND

Learning is a complex issue. When students need to learn a new field they are often puzzled by the subject content. This is especially so for the area of Materials Science and Materials Engineering (MSME, which is not taught in schools where the seeds can be found in physics, chemistry, and mathematics. The learning process in these fields involves extensive theoretical, experimental, and mathematical applications. With the vast advances in information technology (IT) teaching tools not available one hundred years ago are integrated with those currently accessible to provide a blended approach to the learning and associated teaching process. Today's students are brought up with the information age at their fingertips, the so called "digital natives", yet still need to live in an environment where engineers need to construct, and it is materials which are the base source of all their requirements.

PURPOSE

We are trying to understand if students learn better about MSME concepts of dislocations and crystallography if they are taught in a blended learning environment.

DESIGN/METHOD

Employing a selection of teaching technologies from the world of IT, animation, illustration, and construction, students bring their digital native experiences to their learning. An intermingling of teaching approaches to dislocations, and crystallography rather than one main approach, is employed in lecturing, tutoring and laboratory work. An initial preliminary survey of student perceptions of their learning was measured on a Likert-like scale.

RESULTS

As a result of the change in teaching practice to blended learning, student familiarisation with subject has improved as has their approach to learning. It is anticipated that further implementation of the blended teaching will result in an improvement in academic grades.

CONCLUSIONS

The teaching approaches we have adopted into a blended learning environment utilise the capabilities of the students together with imparting across a selection of materials learning styles. Initial results are encouraging, and we intend to implement analysis of focus groups allied with an exploration of academic grades to determine the usefulness of this approach.

Day One, 1:55pm

Innovations in Materials Education: Hands-on Activities, Active Learning and Designettes

Blake Perez
Singapore University of Technology and Design, Singapore

Teaching of subject matter, such as literature, history, social sciences, science, engineering fundamentals, and mathematics are often taught in isolation and within dedicated courses. There is also, typically, very little connection of the subject matter to society and real-world challenges. Thus, an opportunity exists to motivate subject matter with integrated applications and 21st Century skills for our students. In this session, we explore powerful pedagogical approaches for realizing this opportunity: active learning and design-based learning (DBL). The focus here is on materials education, where active learning and DBL foster a culture of inquiry, connection, and multidisciplinary problem solving throughout engineering curricula. Active learning products (ALPs) have been developed for materials' course modules. Likewise, designettes, defined as brief, vignette-like design challenges, have been developed to exploit opportunities to integrate design learning experiences in class, across courses, across terms, and across disciplines. We present examples of these active learning products and designettes in materials education, including extensive experimental results to understand their effectiveness, and applications across a number of international institutions.

Day One, 2:20pm

TBC

Srinivasa Ranganathan
Indian Institute of Science, India

TBC

Day One, 2:45pm

Connecting Science to Typical Engineering Problems: An Effective Pedagogy to Teach Complex and Diverse Concepts in Corrosion

V.S. Raja
Department of Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay

The discipline materials science and engineering is not the prime choice of the subject of engineering education for students who enter university after their higher secondary education in India. The subject neither adds glamour nor does pay higher compared to the other branches of engineering to choose materials engineering as professional career. When it comes to the subject of corrosion, it is the last option for a student to study. The subject doesn't fascinate as much as the ones related to biosciences, nanosciences, electronic materials and the like. In stark contrast, if one is to talk to practicing engineers it would be easy to realize that they have great appreciation to the subject of corrosion and feel that it wasn't emphasized in the curriculum when they studied. So it becomes imperative that conventional subjects are not only emphasized in engineering curriculum but taught in a way that their importance is realized.

Teaching a multidisciplinary course such as corrosion science and engineering has some inherent problems. Addressing corrosion issues requires that a person acquires adequate understanding of electrochemistry, metallurgy and design related issues. The science and engineering of these three subjects are somewhat mutually exclusive although there are intertwined in any typical corrosion failure. The industrial conditions are so divorce that addressing a corrosion problem is possible not only when fundamentals of electrochemistry and metallurgy is understood but also the relationships between the two are appreciated. However, most non-chemistry and even a few chemistry students consider the electrochemical concepts such as polarization "repelling" though it is one of the key sciences that govern the most forms of industrial corrosion failures. So it is imperative to illustrate, with typical industrial corrosion failures, as to how the electrochemistry is connected to corrosion failures to emphasis the need for understanding this subject, and the same must be done with respect learning the required metallurgy and or design for understanding corrosion phenomena. The talk will highlight the pedagogy adopted by the author for teaching corrosion science engineering to undergraduates and postgraduates.

Day One, 3:00pm

Sustainable Engineering Special Education Course in Tokyo Institute of Technology

Yoshinao Kobayashi and Jiro Takemura
Tokyo Institute of Technology

Tokyo Institute of Technology launched its International Graduate Programs (IGPs) in October 2007. In particular the students in Graduate School of Engineering have been highly educated in Sustainable Engineering Program (SEP), which aims to produce internationalized engineers (IEs) having a wide spectrum of technical knowledge from fundamentals to their applications. A number of students have already graduated from SEP and also successfully got the next opportunity to devote themselves to the related work fields.

This fruitful activity continues to the second phase for further promoting the SEP objective, namely fostering IEs who can participate in international projects, such as overseas deployments by Japanese companies and development projects by international organizations as a leader. Collaboration with engineers of different specialties and nationalities is a key for accomplishing the project missions. Therefore, overseas students and Japanese students should more collaborate with each other in the program consequently to achieve mutual growth.

Day One, 3:55pm

Teaching interdisciplinary MSE modules

Gan Moog Chow
National University of Singapore, Singapore

Understanding the properties and engineering design of advanced functional materials requires a broad education background of materials physics and materials chemistry, in addition to the traditional core MSE courses. In this talk, I will discuss teaching an interdisciplinary course such as magnetism and magnetic materials that focuses on both science and engineering. The interplay of condensed matter physics, quantum mechanics, molecular orbital theory, interfacial and crystal engineering in magnetic oxides for spintronics applications is used as an example.

Day One, 4:10pm

Introduction of life cycle assessment (LCA) using software CES EduPack with Eco Audit Tool in design course

Prof. MsC. André Canal Marques
Coordenador do Tecnólogo em Design de Produto
Coordenador da IMateria-Biblioteca de materiais

The search for innovation coupled with the fact that the products carry a lifetime that has been reduced, are today producing a large number of different products, generating waste and greatly increasing the volume of the dumps and landfills. The activity of industrial design is adding tools focused on sustainability to contribute to traditional design methodology. One such tool is the life cycle assessment (LCA) which are several software alternatives and different methods of analysis. The life cycle assessment plays a very important role to understand the best alternatives of selecting of materials and processes in a product. Confronting with consumer activity, with an estimated useful life of the product increasingly short, reflect on the selection of materials and processes appropriate to each project through the LCA provides a powerful tool to support the project, making it essential when talking about sustainability. In this work intend to reflect on the material selection in product life cycle, exploring an analysis tool life cycle in one type of product with low technological complexity, “squeeze bottle”.

Through exercises in disciplines of sustainability in design courses show up different analyzes for the same type of product, reflecting on the choice of materials and processes these.

It was used for the analysis of life cycle of assessment the software CES EduPack with Eco Audit Tool. Students become stimulated to study more stiffness the correct selection of materials in the design phase, covering all stages of the life cycle of these products, which allowed students to visualize more clearly the necessity to have a systemic view of the entire life cycle of this product. The results show the complexity and importance of proper selection of materials and processes for sustainability.

Keywords: Industrial Design, Sustainability, Life Cycle Assessment, Education.

Day One, 4:25pm

The design and performance of a project-based learning course for materials undergraduates at Southeast University

Jian Chen[1,], Yinshen Dong[1], Yamei Zhang[1], Jun Cui[2], Yurong Dai[3]*
[1] School of Materials Science and Engineering, Southeast University, P.R.China
[2] Centre for Faculty Development, Southeast University, P.R.China
[3] Department of Physics, Southeast University, P.R.China

We present a newly launched project-based learning course in the School of Materials Science and Engineering (MSE) at the Southeast University since 2013. The targeted learning outcomes are to provide the primitive research experience including analysis, experimentation, data mining, team work, seminar, presentation and project management for all 110 second year undergraduates in MSE who have limited knowledge and no practice training in MSE. Through this course, it is expected to promote their study motivation and improve the ability to apply theory to practice.

Ten projects were selected, monitored and analysed during the whole course. They can be divided into three categories, including the materials theory (conceive dominated study), materials preparation and properties (design dominated study) and fabrication of products (implementation and operation dominated study). The attributes, principles and educational value of this course were discussed in terms of the learning effectiveness. Both formative and summative assessments are used during the whole process of the course.

We found that the project-based learning can effectively help the students understand what and how the research is in MSE. The students have the opportunity to understand the course well and know how to apply classroom knowledge into workplace practice, especially in the "implementation and operation dominated study" types of projects. Although some students were puzzled at the beginning of the course, they adapted well and quickly. There were a large volume of positive comments and suggestions confirming the fact that materials students at SEU enjoyed this project-based learning course.

Key words: Project-based Learning, Seminar, Undergraduate education, Materials Science and Engineering

Day One, 4:40pm

Industrial PhD programme in SIM University: Special Focus on Materials Engineering in Industry

Teik-Cheng Lim and Philip Cheang
School of Science and Technology, SIM University, Singapore 599491

The Industrial PhD programme in SIM University (UniSIM) was launched in July 2013 to meet the educational and training needs of working adults who are committed to contributing to the continuing discovery, application and refinement of knowledge in their chosen industry and practice. This presentation reports the challenges encountered and the strategies adopted by UniSIM to attract suitable PhD candidates and their industry supervisors. Case studies on the progress of the inaugural PhD intake will then be discussed, with special emphasis on those doing research projects in materials engineering and processing.

Day One, 4:55pm

Deconstruction to engage mechanical engineering students in materials topics

Matthew Barnett and T. Hilditch
Deakin University, Australia

One of our objectives at Deakin University is to equip our mechanical engineering students with a particularly keen appreciation of materials related topics. A key driver this is to bolster student suitability for both manufacturing, sustainability and design related employment. The present talk/poster outlines a number of device deconstructions we have trialled in conjunction with an increasing level of project based learning. The key modules examined include: a chain saw dismantle, a commercial screw driver assessment and reconstruction (with a twist) and a multi-tool manufacture. Examples are presented on how these deconstructions were exploited to deliver both basic learning outcomes in the topics: phase diagrams, phase transformations, metal working and process-structure-property relations, as well learning outcomes related to the broader challenges facing material manufacturing. Finally, a reflection is presented on the approach, informed by student feedback and levels of teaching assistant fatigue.

Day Two: Friday December 12, 2014

Day Two, 9:10am

Materials Science and Engineering Education: Challenges, Opportunities and some perspectives from NTU

Freddy Boey
Nanyang Technological University, Singapore

TBC

Day Two, 9:35am

Using "Self Healing Materials" as a Suitable Topic for Getting Students to Think as Materials Designers

Sybrand van der Zwaag
Delft University of Technology, The Netherlands

Bsc and Msc students in the mechanical and related engineering disciplines invariably receive a relatively large amount of teaching in the field of materials in which they become familiar with the key parameters to quantify the mechanical and physical performance of materials as well as with some of the underlying physical and microstructural principles. The students are expected to learn a bit about the properties of existing materials too. While certainly defendable, the net result of this approach is that students associate the field of materials science and engineering more as the art of collecting factual information than as a design study to build materials with desirable properties on the basis of atomic and microstructural building blocks. the design principle underlying the emerging field of 'self healing' materials 'create a material with local temporary mobility" is found to be well suited to make engineering students think as (new) materials designers rather than as material users. The module is ideally suited as an introduction to a typical advanced materials course for engineering students at msc level.

Day Two, 10am

3D Multimaterial Printing for Teaching Composite Materials

Martin L. Dunn
Singapore University of Technology and Design

Two key concepts in any beginning course on composite materials are heterogeneity and anisotropy. There are many ways to introduce and teach these concepts, ranging from theoretical to hands---on labs. The latter often involves working with samples of composite lamina and laminates in qualitative and quantitative ways. We demonstrate how modern 3D multipaterial printing can be used to directly fabricate composite materials with well---defined microstructures (fiber orientation, volume fraction, shape) with desired material properties that can be varied over a significant range. This permits the rapid fabrication of samples to study various composite concepts in more detail than can generally be done with standard composite fabrication methods. We use these to: i) demonstrate concepts of heterogeneity and anisotropy by hands---on examples with printed lamina, ii) demonstrate concepts in lamination theory such as various deformaiton couplings, iii) compare experimental results to well---developed theory to describe the mechanical behavior of lamina and laminates; iv) demonstrate failure modes in composite lamina and laminates. An interesting aspect of our efforts is that theory and experiment agree better than usual for the mechanical behavior of composites and we think this is due to the high control of the microstructure details. While our efforts focus on some basic concepts in the mechanical behavior of composite materials, our approach can be easily extended to study other physical phenomena as well as different composite concepts.

Day Two, 11:00am

Biomaterials education for a multidisciplinary audience

Louise Smith
University of South Australia, Australia

In 2012 The University of South Australia (UniSA) launched its Batchelor of Science (Advanced Materials) degree. One of the courses developed for this was a second year course Nano and Biomaterials. This course is a compulsory course for students in the Advanced Materials degree but is also a university wide elective. As such there can be no prerequisites for students wishing to participate in this course. Using CES EduPack a problem based learning element was incorporated into the course. Three assessed assignments were prepared with a design focus. The assignments were 1) a total hip replacement focusing on reducing bone resorption due to stress shielding, 2) total hip replacement focusing on surface treatments for improved osseointegration, and 3) development of biodegradable wound dressings. These allowed students to explore the differences in the material properties of the human body, both hard and soft tissues, and the material properties of current biomaterial implants. It also encouraged independent research. Students were split in their acceptance of the problem based learning methods. This may be due to the need to use the specific CES EduPack software which is only available on campus. Therefore those students who attended lectures and would use UniSA resources to support their work excelled. Those who chose not to attend campus struggled as they then struggled to find other online resources to allow them to complete assignments. By focusing on selecting materials with appropriate material and surface properties for different applications, students who did not have a strong maths or physics background grasped the core concepts. They were therefore able to finish the course with a solid foundation in materials science as well as an appreciation of the added complexity when designing for the human body.

Day Two, 11:15am

Use of case studies and students' classroom-participation in learning the importance of materials in mechanical engineering design

Sujeet K Sinha
Indian Institute of Technology Delhi, India

Engineering materials play a pivotal role in the success of any engineering product design, manufacturing and life-cycle. However, often this aspect of engineering materials education is difficult to teach as this falls in the multi-disciplinary domain of engineering and technology. Use of actual engineering case studies and then getting students involved in the design and thinking process can enhance learning and particularly the interest of the students in this field. In this talk, we will present how such strategies in the classroom teaching have helped make this subject interesting to the students. We will use the example of materials' performance in the fatigue design of the axle of high speed trains. Students are asked to read a published paper and then watch half of a video on certain aspects of the performance of a high speed train. This is followed by a group work and then the students are asked to present their design solutions. This is followed by watching complete video to help them understand the consequences if the materials selection goes wrong.

Day Two, 11:30am

The Roles of Internationalisation in Materials Science and Engineering Education

Deliang Zhang, Lingti Kong, Min Wang
Shanghai Jiao Tong University, China

In modern increasingly globalised human society, materials science and engineering (MSE) education in universities and other tertiary education institutions need to train graduates who are not only capable of analyzing and solving materials related science or engineering problems and developing new materials that can enable the solutions of science or engineering problems but also capable of doing these by optimum or most effective ways. The demands of raising the bottom line living standard of human society with an increasingly larger population with increasingly smaller amounts of natural resources and smaller impacts to the environment render a strong driving force for scientists and engineers to optimize solutions of science and engineering problems. For these reasons, it is important to inernationalise the materials science and engineering education in universities and other tertiary education institutions. We propose that the aspects which reflect the internationalisation are (i) internationalisation of the student study experience by experiencing the study in two or more universities in different countries and cultures; (ii) facilitation of international interactions among students through having students from several different countries in the same subject class and/or through virtual reality international classes established vie internet based platforms; (iii) internationalisation of teaching faculties to combine wisdoms of tertiary education systems developed in different countries and cultures in developing curriculum and teaching courses; (iv) incorporating global and international perspectives in teaching and learning. The internationalisation of the MSE education is not in conflict with the functions of tertiary education in serving the needs of the countries where the universities and other tertiary education institutions are located, and rather better fulfill these functions since the graduates are highly capable of using the intellect and resources from all over the world rather than their own countries. At Shanghai Jiao Tong University (SJTU), we start to put the internationalisation of MSE education in practice by starting to establish an internationalised education experimental class of MSE in the undergraduate Bachelor of Engineering (BE) in MSE programme for which we have developed a specialized curriculum for this class. To start with, this class will have 30-40 students each year, being selected from 140-145 students enrolled in the BE in MSE programme at SJTU. All MSE subject courses will be taught in English to allow overseas degree and exchange students to join the class, and gradually other subject courses in the curriculum will also be taught in English. The students will have at least half year overseas study or internship experience during the four year study. More detailed introduction of the internationalised education experimental class and the curriculum development for this class will be given in a poster presentation that the authors wish to give at the same symposium. This talk will focus on introduction and discussion of the thoughts, theories and practice on the roles of internationalisation in MSE education

Day Two. 11:45am

Materials science and sustainability education in Singapore polytechnics

Abu Samah Zuruzi[1] and Valdew Singh[2]
[1]Singapore University of Technology and Design, Singapore
[2]Nanyang Polytechnic, Singapore

Under the umbrella of technical, vocational education training (TVET), polytechnics in Singapore play a unique and crucial role to train industry-ready graduates with the necessary skillset, knowledge and competency to support technological and economic development. Primarily, the five local polytechnics offer post-secondary pre-employment training for fresh school leavers where each offers about 50 courses and collectively they train about 80,000 students.

Due to the dynamic economic landscape, the polytechnics have to be responsive and aligned to rapid advances in technology and changing business requirements so as to meet manpower development needs of industry. As many polytechnic graduates are expected to work in specialised areas of industry, their foundation knowledge in science, technology, engineering and mathematics (STEM) must, therefore be up to the mark. Increasingly, material science and engineering is becoming the bedrock which underpins a number of important industry sectors in Singapore, e.g. aerospace, biomedical, nanotechnology, food technology and build environment. While STEM is a key prerequisite here, there is general decline in its popularity globally.

This presentation shall provide an overview of how polytechnics respond to the challenge of providing appropriate education and training related to sustainability and materials science. The authors will share their experience in the design, development and delivery of the training curriculum and also in facilitating outreach programs to raise awareness for materials science among secondary school students and teachers.

Day Two, 2:20pm

Materials Education in a Changing Climate

Peter Goodhew
Universities of Liverpool and Derby, UK

The climate is changing in more than one way: Firstly it will be obvious that our planetary climate is gradually changing, and this will be the backdrop to education in any engineering discipline (including Materials) over the next several decades – indeed probably for the remainder of this century. This will alter the perceived priorities of those setting the engineering curriculum for the future.

Secondly the education climate is changing, principally to address three issues:

The need for engineers to deal with complex systems which embrace both theoretical ("book") knowledge and the practice of engineering in producing products and inventing processes.

The rapid changes in available technology (in engineering and to support learning), and

The rapid expansion of, and easy access to, "knowledge" and "data".

In this paper I will suggest how Materials Education might respond to both of these climate changes.

Day Two. 2:45pm

Experiences in Teaching Materials Engineering in a remote area of Australia

Krishnan Kannoorpatti, Mirjam Jonkman, Daria Surovetsva
Charles Darwin University, Australia

Charles Darwin University, being a major tertiary provider in a remote location, attracts students of highly diverse backgrounds in terms of age, cultural as well as educational background. Additionally, many students live away from the city and study via online. This introduces certain difficulties in structuring and delivering the instructional material.

This research identified four problem areas in the development and delivery of instructional material in Materials Engineering and Mechanics of Solids at CDU. These are two core subjects taught to engineering students undertaking degrees in Civil, Chemical and Mechanical engineering streams. First issue arises from the differences in social background of students. Younger students with western background tend to rely more on the instructor and lack reading interest and skills compared to the mature age students and students from cultures with strong traditions. Additionally, younger students find it more difficult to manage the online study. Online teaching in itself forms the second group of issues, one of which is finding the approach to ensure the students have acquired fundamental knowledge and mastered the threshold concepts. Thirdly, with the large demand for maintenance engineers and in the light of the latest developments in the Engineering Education, there is a problem of balancing traditional lecture-based curriculum and a more applied project-based teaching strategy. Students in the second year, particularly younger students, often do not have the necessary skills to make connections between theory and application. Lastly, there is a need for continuous professional development of staff, not only in terms of the subject matter, but also in terms of the teaching and course development skills.

This paper discusses these four areas in detail and provides examples of the best practices for the development and delivery of Materials Engineering subjects in remote areas with particular emphasis on the online instructional material.

Day Two, 3:00pm

SITP (Students Innovation Training Program) for undergraduates as a bridge between education and research

Wei Xu
Tongji University, China

Student Innovation Training Program (SITP) and undergraduate tutorial system are the important initiatives performed by Tongji University to build innovative training system, further to implement education and teaching reform and to strengthen the cultivation of students' innovative ability. SITP plan focuses primarily on the participation of undergraduates, which enables undergraduates to master the basic scientific methods, cultivates rigorous scientific attitude and sense of innovation and teamwork, and provides guidance for the further development of undergraduates by involving them in participating research programs. Meanwhile, the undergraduate tutorial system emphasizes the impact of the guidance of teachers on students' ideological formation, scientific research and career development on the basis of a two-way choice between the experienced professors and students. Both initiatives fully reflect great efforts Tongji University has made in training the comprehensive ability of undergraduates and the implementation has been fruitful and yet needs to be further explored and improved in the future.

Day Two, 4:00pm

E-poster/presentation for group project/assessment in school of materials science and engineering

Yi Long
Nanyang Technological University, Singapore

There is an increasing need in engineering school to engage student to conduct mini-project for specific topic as one of the assessment methods. For example, in year one course MS8301 Materials and Man in Nanyang technological university (NTU), the lecturer set 15 topics of different transportation means for groups of five students and required them to give a presentation of how the materials usage and evolution influence the transportation performance. Due to the time constraint and large population of class (up to 240 students), their peers were not allowed to ask questions in class and the feedback of their peers was not easily collected. In order to promote student learning and create seminar-type atmosphere for presentation, E-poster/presentation was designed to allow students present their work in a virtual environment and other groups were required to ask questions and explain to another subgroup. Based on the answering and presentation quality, students need mark for their peers, which acted as one part of the marking scheme. E-Poster/E-presentation has been designed using free software, cloudshare, app and current software such as LAMS to provide student with new interactive and learning experience, which encouraged student critical thinking, active engagement and collaboration in learning.

Day Two, 4:15pm

Effectiveness of Advanced Elective Module in Generating Students' Interest in Materials Science

Genevieve Lin
School of Applied Science, Republic Polytechnic

Attracting students who did well in mathematics and science to study Science and Engineering courses has been a challenge in Singapore. This may be even more so for the discipline of Materials Science and Engineering as it is a relatively young field and therefore there is lack of public awareness. In efforts to inspire secondary school students to develop interest in Materials Science, Republic Polytechnic offers an Advanced Elective Module (AEM) that is conducted over 40 hours by in-house lecturers at the polytechnic's premises, using the problem based learning (PBL) approach. Real life case studies, hands on activities and laboratory experiments were incorporated in the lessons to challenge and engage the students through experiential learning. This is a preliminary study to examine the effectiveness of the AEM in generating interest in secondary school students for Materials Science and to identify the contributing factors. A total of 203 participants responded to a student satisfaction survey. The correlational analyses found that whether the students found the AEM course a rewarding learning experience is strongly correlated to whether they have perceived that they have learnt new skills and knowledge, discovered practical ways in which concepts and skills can be used and discovered new areas of study that they may want to take up. This suggests that the applied and experiential learning approach of the AEM may effective in generating interest in Materials Science.

Day Two, 4:30pm

Mechanical engineers' typical misconceptions in materials science, and how to correct them

Arlindo Silva
University of Lisbon, Portugal

At Instituto Superior Tecnico (IST), the University of Lisbon, Portugal, students of mechanical engineering take two courses related to materials: materials science (MS) and materials in engineering (ME). However, certain misconceptions about materials still persist after these two courses, and this is visible in other downstream courses like mechanical design and product development. Using hardness, strength, stiffness and toughness interchangeably to mean the same thing are just the tip of the iceberg of these misconceptions. Another misconception is the effect that thermal treatments have on the mechanical properties of steels: what are the properties affected and why. A different approach to the teaching of fundamental concepts about materials science is presented, in which these typical misconceptions are tackled directly. The use of available software tools is exemplified to clear these misconceptions, with examples and case studies. Plotting properties like Young's modulus against yield strength helps in explaining why materials with the same composition but different thermal treatments can have properties with a range of variation while other properties remain almost constant, as an example. Another example can be taken from plotting strength against elongation for different carbon steels, and understanding what is happening at the micro and macro levels. The implications of this fundamental knowledge can then be used in mechanical design and materials selection by the students. The presentation will show how this will be done in class.

Section 4:

Poster Abstracts

Posters

#	Name	Affiliation	Abstract Title
1	ZhiLi Dong	Nanyang Technological University	Teaching Crystallography, X-ray Diffraction and Transmission Electron Microscopy to Students from Different Engineering Disciplines
3	Stefan Adams	University of Singapore	A bond valence approach to teaching chemical bonding
4	Sridhar Idapalapati	Nanyang Technological University	Materials Selection for Wind Turbines : Ashby's Approach
5	Eunice Goh	Nanyang University	Implementation of Flipped Classroom for Teaching Materials Science
6	Kheng-Lim Goh	Newcastle University International Singapore	Teaching materials science and engineering in a two-year mechanical engineering degree programme
7	N.C Santhi Srinivas	Indian Institute of Technology (BHU)	Education in Mechanical Behaviour of Materials at BHU: Historical Perspectives and Future Challenges
8	Eugene Wong	Newcastle University International Singapore	Integrating Design, Materials Selection and Mechanics in Mechanical Design and Manufacturing Engineering
9	Lingti Kong	Shanghai Jiao Tong University	Materials Education at Shanghai Jiao Tong University
10	Chen-hsin Chiu	National University of Singapore	The Final-Year Design Project in the Materials Science and Engineering Department at NUS
11	Zhenzi Jing	Tongji University	Mimicking nature to design materials for undergraduates at Tongji University in SITP
12	Cemil Hakan Gur	Middle East Technical University	Improving the Design Component of Undergraduate Program in Metallurgical and Materials Engineering Department
13	Danping Dong	Singapore University of Technology and Design	Support Teaching Materials Science with a Touch and Feel Experience

Poster Abstracts

Poster 1

Teaching Crystallography, X-ray Diffraction and Transmission Electron Microscopy to Students from Different Engineering Disciplines

ZhiLi Dong
Nanyang Technological University, Singapore

Teaching Crystallography, X-ray Diffraction and Transmission Electron Microscopy is challenging when students are from different disciplines. Recently, NTU MSE revised the course syllabus in order to provide the undergraduate students very fundamental knowledge in crystal structures and powder x-ray diffraction techniques, and to equip the postgraduate students with in-depth understanding in crystallography and transmission electron microscopy theories as well as applications.

Currently, MS4660 Advanced Analysis of Materials is a fourth year undergraduate course, and MS7003 Materials Characterization is a post graduate course in NTU. We are facing challenges as some undergraduate students do not have enough physics knowledge to follow the course. In addition, it is also challenging to teach postgraduate students from different engineering backgrounds and countries. Under such circumstance, some bridging lecture notes are provided, and a list of reference books suitable to students from different backgrounds are prepared. We believe that more efforts made from both lecturers and students can promote a more effective teaching and learning.

Poster 3

A bond valence approach to teaching chemical bonding

Stefan Adams
National University of Singapore, Singapore

The simplicity of the bond valence approach and its predictive power make it ideally suited for introductory-level teaching on the nature of chemical bonding. Here it is demonstrated how the approach may be presented in a classroom starting from a critique of currently used models of bonding. Different aspects of the concept may be introduced step by step, starting from simple exercises such as plotting the lines of field for an array of charges like those found in the classical model of ionic solids. The generation of stable bonds using the valence matching rule and the generalisation sing the concept of Lewis acids and bases leads naturally to a discussion of the nature of bonding and bonding geometry, which may be extended to cover the influence of lone pairs. Deriving classic ball-and-stick models from bond valence theory gives an opportunity to further discuss what defines a covalent bond. The explanation can seamlessly proceed to cover more advanced topics such as dynamics in solids and include demonstration applications to energy storage materials[2)] or the prediction of chemical reactivity.

References:

1. Stefan Adams, "Practical Considerations in Determining Bond Valence Parameters" in Bond Valences (I.D. Brown et al., Eds.), Structure and Bonding 158, pp. 91-128, Springer Berlin (2014).
2. Stefan Adams and R. Prasada Rao, "Understanding Ionic Conduction and Energy Storage Materials with Bond-Valence-Based Methods" in Bond Valences (I.D. Brown et al., Eds.), Structure and Bonding 158, pp. 129-159, Springer Berlin (2014).

Poster 4

Materials Selection for Wind Turbines : Ashby's Approach

Idapalapati Sridhar and AM Rashedi
Nanyang Technological University, Singapore

The world today is continuously striving towards carbon neutral clean energy technology. Hence, renewables like wind power system is increasingly receiving the attention of mankind. Energy production is now no more the sole criterion to be considered when installing new megawatt (MW) range of turbines. Rather some important design parameters like material choice, cost, carbon footprint, embodied energy, life cycle impact efficiency and, above all, the structural rigidity needs to be considered holistically.

This study aims to distinguish best blade and tower materials in comparison to presently used ones in line with multiple constraint and compound objective based design optimization principle whereby mass, carbon footprint, material cost and embodied energy minimization are achieved simultaneously from material indices derived of aerodynamic and structural performance equations. In this way, final onshore wind turbine blade material ensures 74% mass, 17% carbon footprint, 30% embodied energy reduction in comparison to existing Vestas 3.0 MW glass/epoxy blade. In turn, a cast iron BS 900/2 material tower ensures 6% mass, 81% carbon, 80% energy content and 90% cost reduction in comparison to present tower material. Natural composite materials like oak, lignumvitae also enter into small scale onshore blade design space for low wind regions. Composite materials appear as one of the most potential material families from both material indexing and life cycle assessment study.

Poster 5

Implementation of Flipped Classroom for Teaching Materials Science

Eunice Goh Shing Mei
Nanyang Polytechnic, Singapore

This work hopes to identify the effective method to use flipped classroom for teaching the Materials Science subject. The focus of this work is on the implementation of flipped classroom to the current batch of first year students learning the Materials Science subject. The hypothesis is that such method will aid students in better understanding the topics taught in the module, thus giving them a better foundation for the future subjects.

The approach that has been used in this work is an action research. Action research covers four steps, which are Reflect, Plan, Act and Observe. The lessons were planned and conducted while the effectiveness of the flipped classroom method for the students were reflected and observed. With the contact hours spared from the flipped classroom session replacing lecture, classroom activities mixed with real-world applications was conducted to enhance students' understanding towards the materials learnt.

This work is done for a semester and the results so far have been encouraging. From the mid-semester survey conducted, students favoured flipped classroom method as it gave them flexibility to study with own-time-own-target to finish the learning materials. Also, the classroom activities has helped to enrich their learning journey and enhanced their interest in the subject.

The implementation of the flipped classroom is in line with the advancement of technology and incorporating such method could inject some novelty to educators' teaching and also students' learning. It is with high hopes that the outcome of this work could give an overview of possible ways to implement flipped classroom, which is a technology in learning methodology method, to the polytechnic students.

Poster 6

Teaching materials science and engineering in a two-year mechanical engineering degree programme

Kheng-Lim Goh[1] ,S Mahmood[1], D Talamona[1], WLE Wong[1], CK Liew[2]
[1]Newcastle University International Singapore, Singapore
[2]Singapore Institute of Technology, Singapore

A key activity in the design and manufacturing process is the selection of materials for the product. In recent years, the advent of 3D printing technology and industry has lend to the development of new materials and new paradigms for effective deployment of materials for design and manufacturing using 3D printers. The Mechanical Design & Manufacturing Engineering (MDME) degree programme is a two-year BEng (Honours) degree programme, run by NUIS (for Newcastle University, Newcastle Upon Tyne) in partnership with SIT (the fifth university in Singapore), aimed at the polytechnic graduates who wish to further their education in Singapore. Normally a BEng (Honours) degree spans three years (stage 1, 2 & 3) in England—mechanical engineering programmes are no exception. However, on the basis of good GPA scores and having satisfactory passed diploma subjects related to Mathematics, Physics, Materials and Mechanics (Statics and Dynamics), polytechnic graduates (with mechanical engineering related diplomas) who wish to further their study in Mechanical Engineering have been able to enroll at 'stage 2', and finishing at 'stage 3'. The lecture and lab classes operate at the Nanyang Polytechnic campus, by leveraging the polytechnic facilities. The students are taught materials-related subjects in stage 2 and stage 3. A major difficulty facing the students addresses the unfamiliarity with basic principles in materials science because the students have been used to studying this subject from a practical fact-based approach; generally, the students regard theories with apprehension. Here, we have adopted an approach that aims to tear down their apprehension by emphasizing the application of the theories to failure analysis and design considerations. The common thread, metals, is used as an example in both the lectures and lab sessions. As part of this approach, it is important to facilitate time for the students to reflect on their understandings and picking up new information, where needed, around the subject area related to the lab experiments that they have carried out. In particular, the lab experiments involve tensile testing of steel to rupture prepared to different temperatures (to create variability, and to get students to apply simple descriptive statistics for data analysis). The key aspect here is the report-the students are expected to be able to apply the knowledge learnt during lectures (from atoms, crystal structure, to phase diagrams, phase transformation, fracture studies, materials selection) to develop arguments for their observations and to present them in the report which takes the form of a typical research paper. This module is delivered in semester 1 of stage 2 and aims to encourage them to continuously apply a learning approach that is open-ended driven and not bound by regurgitating facts.

Poster 7

Education in Mechanical Behaviour of Materials at BHU: Historical Perspectives and Future Challenges

N.C. Santhi Srinivas, G.S. Mahobia, K.Chattopadhyay and V.Singh*
Indian Institute of Technology (BHU), India

Mechanical behavior of materials is very important area in the field of materials education. Though the undergraduate programme in Metallurgy was started at BHU in 1923, the syllabus was then heavily oriented towards Chemical Metallurgy to take care of industrial requirements. Postgraduate programme was implemented in 1958 with minor revisions in the syllabus. Strengthening of post graduate and research programmes took place between 1966-73. It was in this period, the necessity of teaching mechanical behavior of materials was felt and the Department implemented balanced instruction of various approaches in the curriculum in a similar fashion as suggested by international experts namely, i) Continuum Mechanical approach ii) Microstructural approach and iii) Atomistic approach. The syllabus till today covers various aspects of mechanical behavior such as mechanics of deformation and fracture, strengthening mechanisms and theory of dislocations etc.

Research on mechanical behavior of materials was initiated at BHU during 1966 and the first Ph.D thesis on mechanical behavior was completed in 1972. In this work, Hounsfield Tensometer was modified for constant cross head speeds and tensile behavior of Cr-Mn-N austenitic steel was studied using a split electric resistance heating furnace from 293K-1273K. Later, several areas with diverse topics such as: Low Cycle Fatigue and Creep of Metallic Materials; Superplastic Forming; Effects of Corrosion; Fracture Mechanism Maps; Polar Reciprocity Model for Compression, Deformation Behavior and Effect of Salt Coating on Hot Corrosion, were investigated with invaluable knowledge addition to the field of mechanical behavior of materials. One remarkable achievement in recent years was Dynamic Strain Ageing and development of Corduroy Structure under cyclic loading at room temperature in Zircaloy-2. This has been the first observation of this kind. In the present paper, all these notable accomplishments will be discussed in detail. Some of the future challenges lying ahead, such as understanding of Ratcheting Fatigue, mechanisms of Creep-fatigue interaction, in-situ deformation and effects of surface nano crystallization on mechanical behavior in particular the fatigue will be addressed briefly.

Poster 8

Integrating Design, Materials Selection and Mechanics in Mechanical Design and Manufacturing Engineering

Eugene Wong, KL Goh, MWS Lau
Newcastle University International Singapore

Mechanical Design, Materials Selection and Mechanics are typically taught as separate modules in a mechanical engineering undergraduate programme. The existing approaches for teaching do not provide an adequate emphasis on the connectedness of these topics and students often find it difficult to correlate these topics.

In the Mechanical Design and Manufacturing Engineering (MDME) programme offered by Newcastle University (a partner university of Singapore Institute of Technology) in Singapore, an integrated approach has been developed to teach mechanical design, materials selection and mechanics to undergraduate students by combining aspects from three modules in a beam design assignment where they work together in small groups to optimize the shape of the beam based on various constraints assigned to them.

To work on the assignment, students will need the knowledge from strength of materials in mechanics where they learnt simple beam theory, performed a cantilever beam laboratory experiment and compared the results with a computer simulation model using Autodesk Inventor software. They were taught materials engineering concepts and made use of CES EduPack software for material selection in the materials module, and design methodologies in the design module.

In the beam design assignment, they are required to perform material selection based on a given target application (e.g. aerospace, marine, transportation, building etc), use material indices to fulfil constraints (lightweight, stiffness, strength), optimize the shape of the beam to improve mechanical efficiency and lastly to construct a small-scale model of their final design using cardboard.

Poster 9

Materials Education at Shanghai Jiao Tong University

Lingti Kong, Min Wang, Deliang Zhang
Shanghai Jiao Tong University,, China

Beginning with Department of Metallurgy in 1958, Shanghai Jiao Tong University (SJTU) is one of the universities that pioneered in setting up the discipline of Materials Science and Engineering (MSE) in China. Nowadays, with 260 faculty and staff members, 7 buildings of 35,000 m^2 floor area for offices and laboratories, the School of Materials Science and Engineering (SMSE) of SJTU becomes one of the largest entities that carry out education and research in the field of MSE.

During the last ten years, SMSE of SJTU has been consistently ranked as one of the top 5 nationally. Especially in 2003, it was ranked No. 1 in China, as evaluated by the Ministry of Education of China.

Currently, SMSE of SJTU provides three levels of education on MSE: undergraduate, master and doctoral. Each year, the school enrolls 140-145 undergraduate students, all cultivated in the same general discipline of MSE. Around 30 of them will be trained towards “talented engineers” with some specially designed courses and practices during the last two years. Upon graduation, 1/3 of them will go abroad for further study, 1/3 will pursue a graduate degree in China, while the remaining 1/3 will go to the job market directly. Each year, the school enrolls about 140 graduate students, including 80 PhD candidates. While maintaining and further developing the traditional strength in research and education on science and engineering of metallic materials, the MSE research and education are increasingly polarized to put emphases on developing research strengths in other types of materials including polymers, ceramics, semiconductors and composites, and covering all major types of materials and stressing common materials science and engineering principles in education.

Presently, we are working on setting up an international education experimental class at the undergraduate level. With a newly designed curriculum, this class aims to cultivate excellent students on MSE with strong international vision. All the MSE courses will be given in English, and at least half of the students will have the opportunity to spend one year or so in a foreign partner university. We are open to design dual degree or exchange student programs with top universities with MSE education all over the world, with an expectation to promote future collaboration on both teaching and research. Successful models have been initiated with ParisTech in France, and Johns Hopkins University, University of California, Davis and Carnegie Mellon University in USA. This class and the undergraduate and graduate courses taught in English also provide an effective platform for overseas students to come to the School of MSE of SJTU to study as degree students or exchange students at all undergraduate and graduate levels.

Poster 10

The Final-Year Design Project in the Materials Science and Engineering Department at NUS

Cheng-hsin Chiu
National University of Singapore, Singapore

The final-year design project is an essential module for the Materials Science and Engineering students at NUS in their seventh semester. In this module, the students are divided into small groups and asked to design a product within the constraints posed by economic, environmental, social, and safety consideration. In this year the product is chosen to be a toy for children in the 7–10 age range. The toy also needs to satisfy the requirements that it is self-powered, is environmentally friendly, can be sold legally in Singapore, and the cost for manufacturing and materials is less than S$ 50. The works of the final-year design project will be presented in this poster. The implications of the works on students' understanding of design, materials selection, and environmental issues will be also be discussed.

Poster 11

Mimicking nature to design materials for undergraduates at Tongji University in SITP (Students innovation training program)

Zhenzi Jing,
Tongji University, China

SITP (Students innovation training program) was established in 2006 for training the innovation capability of undergraduates in Tongji University. The undergraduates during the first three years can apply for this program, and the better ones can also be selected to apply for the Shanghai university student innovation program and the National university student innovation program.

For undergraduates who first encounter research at university, stimulating interest, curiosity and understanding about research is very impotent. We have adopted the mimicking of nature for materials-design as a way of doing this for undergraduates in SITP and have found it an excellent way to engage students in the challenges of research.

Cave dwellings are well-known to have excellent properties in terms of warming in winter and cooling in summer throughout the year without need for the use of air conditioners. Our undergraduates have carried out research on hydrothermal synthesis of humidity regulating and VOC adsorbing building materials. Hydrothermal solidification technology has the capability simulating the slow accumulation of sedimentary rock (millions of years) in the time-scale of a laboratory experiment (several hours), and tough building materials (man-made rocks) have been solidified with building wastes and sea sand.

Because their interest and curiosity are stimulated, the undergraduates have worked with great enthusiasm, and thus obtained considerable success. Four groups, for example, have joined the National university student innovation program continuously 4 times and have obtained the third award for the 13th Shanghai university student challenge cup, the third award for Shanghai university student scientific creation cup and the special award for Tongji University student challenge cup.

Poster 12

Improving the Design Component of Undergraduate Program in Metallurgical and Materials Engineering Department

Cemil Hakan Gur
Middle East Technical University, Turkey

Since its foundation in 1966, various modifications have been made to the undergraduate curriculum of the Metallurgical and Materials Engineering Department at METU. Specific to the design concept, important changes have being done in the core program starting from 2004. The design component of the program were improved by adding two courses which also include utilization of CES Selector. This presentation will summarize these improvements as a case study.

Poster 13

Support Teaching Materials Science with a Touch and Feel Experience

Danping Dong, Julie Sabaratnam
Singapore University of Technology and Design

In materials science education, it is rare for students to get their hands on actual end products of engineered materials. However, seeing and toying with real materials could enhance students' understanding of materials and how they could be applied in real design situations. At the Library at Singapore University of Technology and Design (SUTD), we adopt an innovative approach to support teaching of materials science and architectural design by developing a substantial physical collection of design materials. The SUTD Library aims to me the Asian Materials Hub showcasing materials from Asia and the world. Library patrons may visit the library to see and play with material samples, or alternatively, search for different types of materials (polymers, glass, metals, ceramics, etc.) with certain desirable properties (physical, electrical, processing, etc.) with the online database. This could offer good help in the material selection process for engineering design.

Section 5:

Contact Details &

Venue Information

Important Local Contact Information

Venue details

Further details, directions, and maps are provided on the following pages.

The National University of Singapore—venue for Short Courses

Faculty of Engineering,
9 Engineering Drive 1
Singapore, 117575

The National University of Singapore—venue for Symposium

University Town,
Education Resource Centre
8 College Avenue West,
Singapore, 138608

The Scholar Chinese Restaurant—venue for the Presenters' Dinner

Kent Ridge Guild House
9 Kent Ridge Drive
Singapore, 119241

The Guild House—venue for Symposium Dinner

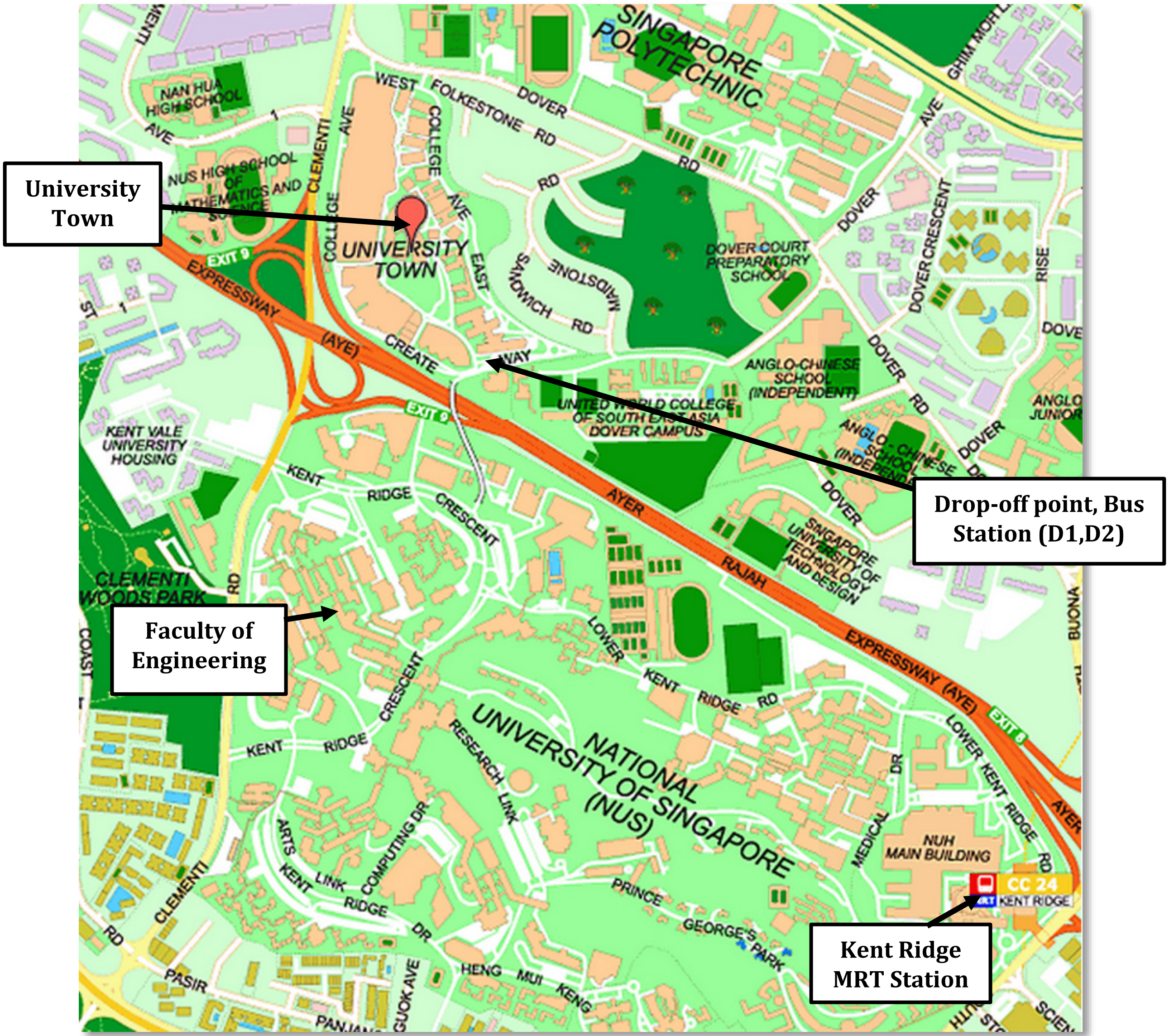
Kent Ridge Guild House
9 Kent Ridge Drive
Singapore, 119241

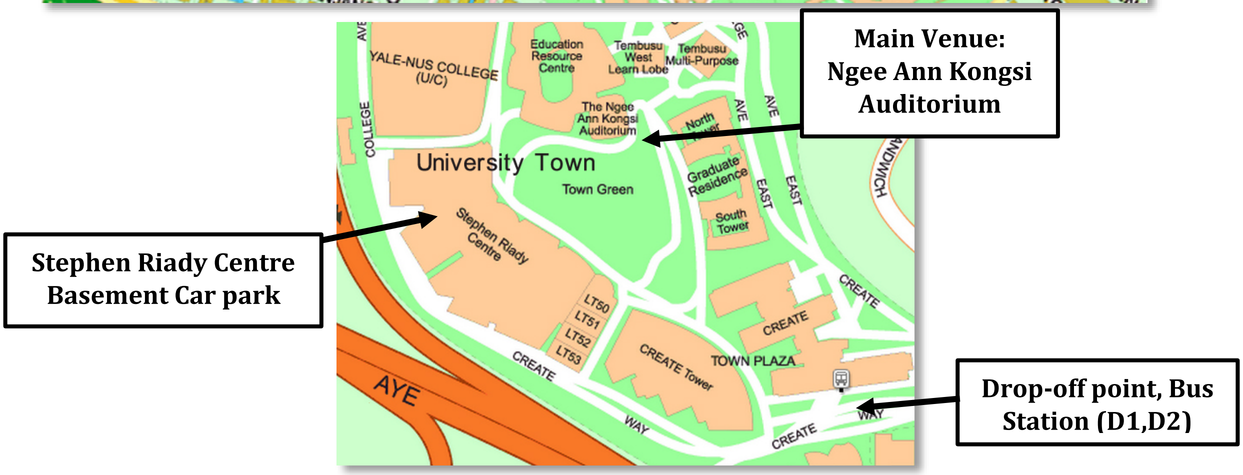
Rooms

Thursday & Friday (Symposium): University Town, Education Resource Centre, Ngee Ann Kongsi Auditorium

Saturday (Short Course): Faculty of Engineering, E1A-04-02

Map of Venues





The National University of Singapore University Town—Ngee Ann Kongsi Auditorium

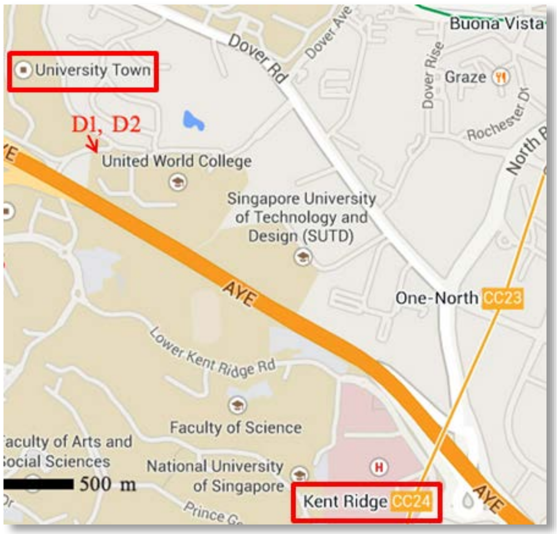
http://utown.nus.edu.sg/contact/getting-here/
(65) 6601 2135

Access by public transport or on foot

The University Town is the venue for the **Symposium**. The main room is the Ngee Ann Kongsi Auditorium, located on Level 2 of the Education Resource Centre.

From the bus station:

- *From Kent Ridge MRT Station – NUS internal bus shuttle*
  Exit the station via Exit A. Walk towards Kent Ridge Bus Stop (Bus Stop No. 18331). Take the NUS internal bus shuttle D2 for 5 stops unitl you reach University Town.



By taxi:

- Get dropped off at the drop-off point or the D2 bus station near Create Tower (address: 1 Create Way, Singapore, 138602).

By car:

- *Via Ayer Rajah Expressway towards Tuas*

  Along AYE towards Tuas, exit at Exit 9, turn left onto Clementi Road, turn left onto Kent Ridge Crescent, and then turn left onto College Link roundabout.
- *Via Dover Road from Celmenti Road*
  Head onto Dover Road and then turn right into University Town.

Parking is available at University Town in the Stephen Riady Centre's basement car park. Please refer to the parking policies and rates at **http://utown.nus.edu.sg/assets/Uploads/Documents/KRC-Parking-Rates.pdf**

Further maps and directions can be found on the ***University Town's website.***

A brief introduction—University Town

University Town is one of the latest green building projects undertaken by NUS. An educational hub, complete with residential spaces, teaching facilities, and study clusters. University Town has created a lively, intellectual, social and cultural environment that distinguishes the University through excellence in learning and student engagement.

A brief introduction—National University of Singapore

A leading global university centred in Asia, the National University of Singapore (NUS) is Singapore's flagship university which offers a global approach to education and research with a focus on Asian perspectives and expertise.

Its 16 faculties and schools across three campus locations in Singapore – Kent Ridge, Bukit Timah and Outram – provides a broad-based curriculum underscored by multi-disciplinary courses and cross-faculty enrichment. NUS' transformative education includes programmes such as student exchange, entrepreneurial internships at NUS Overseas Colleges, and double degree and joint degree programmes with some of the world's top universities, offering students opportunities and challenges to realise their potential. The learning experience is complemented by a vibrant residential life with avenues for artistic, cultural and sporting pursuits. Over 37,000 students from 100 countries further enrich the community with their diverse social and cultural perspectives.

NUS has three Research Centres of Excellence (RCE) and 23 university-level research institutes and centres. It is also a partner for Singapore's 5th RCE. The University shares a close affiliation with 16 national-level research institutes and centres. Research activities are strategic and robust, and NUS is well-known for its research strengths in engineering, life sciences and biomedicine, social sciences and natural sciences. Major research thrusts have been made recently in several fields such as quantum technology; cancer and translational medicine; interactive and digital media; and the environment and water. The University also strives to create a supportive and innovative environment to promote creative enterprise within its community.

NUS is actively involved in international academic and research networks such as the Association of Pacific Rim Universities (APRU) and International Alliance of Research Universities (IARU).

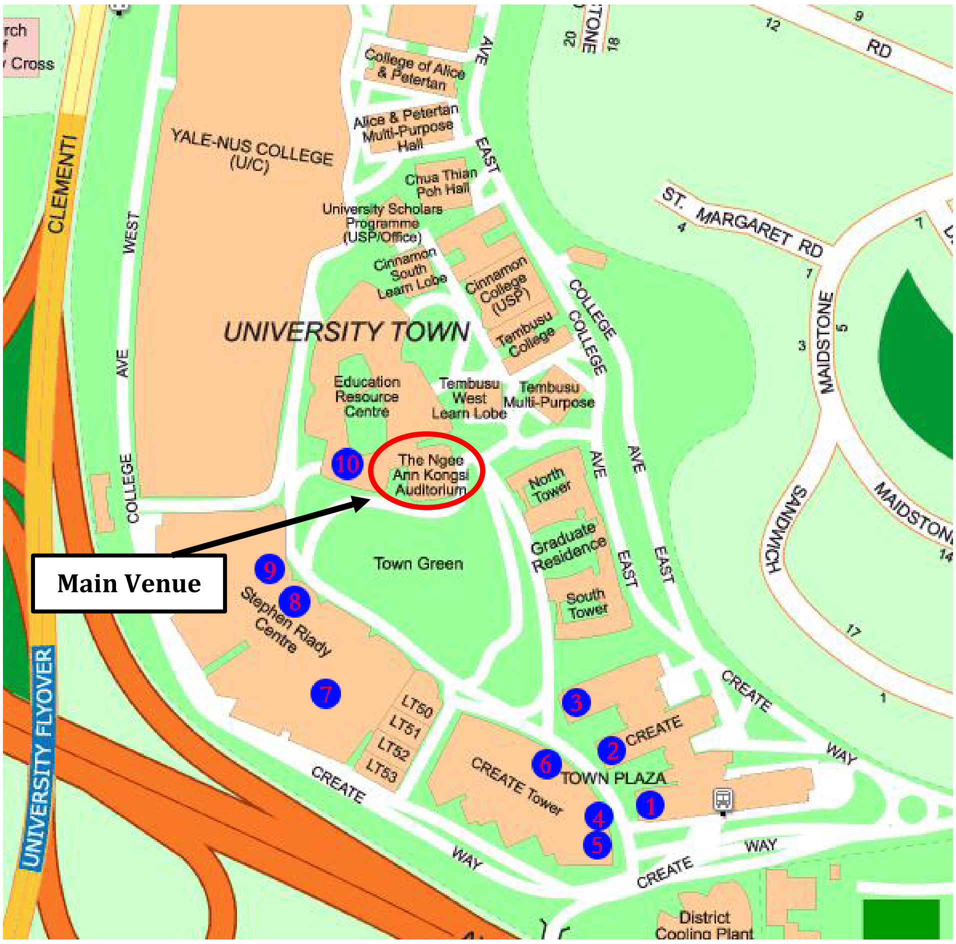
Singapore: Local Information

While you are in Singapore, why not take the time to explore the beautiful city? Local websites provide many guided tours, and experiences, or just head out and start exploring.

Useful links:

- Your Singapore's tourist website
  www.yoursingapore.com/
- Singapore City Tours
  www.citytours.sg/
- Singapore Weather
  www.accuweather.com/en/sg/singapore/300597/weather-forecast/300597

Restaurants and Cafes within University Town



Nearby Restaurants and Cafes

There are plenty of restaurants in the Town Plaza and Stephen Riady Centre; a short walk from the Ngee Ann Kongsi Auditorium.

	Restaurants/ Cafes	Cuisine Style	Location	Opening Hours
1	Spice Table	Vietnamese	Town Plaza	11am-10pm
2	Hwang's Korean Restaurant	Korean	Town Plaza	10am-10pm
3	Sapore Italiano	Italian	Town Plaza	11am-10pm
4	Wendy's	Halal/Burger	Town Plaza	10am-10pm
5	SUBWAY	Sandwich	Town Plaza	10am-8pm
6	Koufu	Food court	Town Plaza	7am-10pm
7	Flavors @ UTown	Food court	Stephen Riady Centre	7.30am-10pm
8	Fortune Village	Taiwanese	Stephen Riady Centre	9am-8pm
9	Sakae Sushi Express	Japanese	Stephen Riady Centre	11.30am-9pm
10	Starbucks	Coffee	Education Resource Centre	24 Hours

Section 6:

Symposium Organization

Organization

The International, North American, and Asian Materials Education Symposia are coordinated by Granta Design with support from the advisory committee and the following organizations:

- **American Society for Engineering Education (ASEE), Materials Division**
- **ASM International**
- **Department of Materials Science and Metallurgy, University of Cambridge**
- **Department of Engineering, University of Cambridge**
- **European Society for Engineering Education (SEFI)**
- **Granta Design**
- **The Federation of European Materials Societies (FEMS)**
- **The National University of Singapore**
- **The Ohio State University**

The program for these events was guided by the following Advisory Committee:

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