

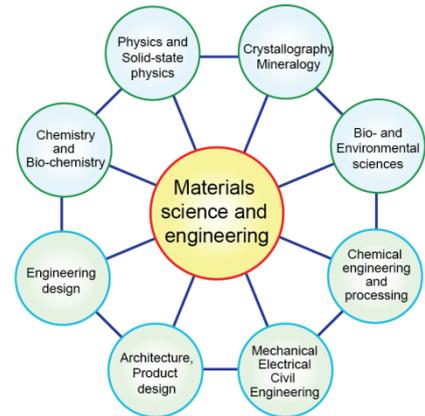


Materials Education Symposia

1st Asian Materials Education Symposium

National University of Singapore
December 11-12, 2014

December 2014 saw the inaugural Materials Education Symposium in Asia. Following the success of the North American and International Materials Education Symposia, this event brought together educators from Asia and beyond to discuss and explore materials science teaching. Those teaching undergraduates about materials within engineering, design, architecture, sustainability, and other science subjects, engaged in two days of talks, workshops, discussion sessions, networking, poster sessions, and a social program. The Symposium provided opportunities to meet other educators and exchange ideas, while discussing the trends and ideas impacting materials teaching.



This report summarizes highlights from the speaker program.





Materials Education Symposia

Foreword by Prof Mike Ashby

Chair of the Symposium's Academic Advisory Committee

Materials have played an enormous part in the technology advances of the 20th century. Emerging structural, functional, and bio-materials are poised to play an even larger part in the technology of the 21st century. Almost all the “Grand Challenges” identified as the essential technological and social advances for the next three decades have a material dimension. The part materials play in global and national economics and security is, today, so important that governments list the materials they perceive as “critical” and seek to assure access and to identify substitutes or alternatives should their supply chain be disrupted. For these (and many other) reasons, the education of materials-literate engineers and of informed and innovative materials scientists is essential for future economic development and growth. It is therefore with pride and pleasure that we report on the success and impact of the 1st Asian Symposium on Materials Education, hosted by the Department of Materials Science at the National University of Singapore (NUS) on 11th and 12th December 2014.



The Symposium was opened by Professor John Wang, Professor Seh Chun Lim, and myself, and we welcomed just over 100 delegates from 13 countries that included Australia, Brazil, China, Japan, India, Portugal, Singapore, and the U.K., making the Symposium truly international. There is a very large and strong materials research community in Singapore. Taking NUS as an example, there are more than 100 faculty members across different Engineering and Science Departments actively pursuing research on a wide range of materials. The QS University Subject Rankings has ranked Materials Science at NUS as the best in Asia and number 6 globally for the past two years. Thus it is both appropriate and timely that NUS host the 1st Asian Materials Education Symposium.

Professor Seh Chun Lim, who, alongside Professor John Wang, was instrumental in initiating this Symposium, explained that while still a faculty member with the NUS he was thinking about how the subject of engineering materials could be more effectively taught, especially at the undergraduate level. Introducing students to the very wide spectrum of today's materials has to be done without them viewing the subject as dry, a mere catalogue of materials properties and characteristics. While NUS has developed an outstanding research track-record in the materials area, he realised that there has been no parallel push to raise the level of pedagogy in this subject. While his colleagues at the NUS Centre for Development of Teaching and Learning (CDTL) have explored a range of pedagogical issues, these have been more general in nature and usually not subject-specific. Global excellence in both research and teaching of engineering materials is a worthy aspiration for NUS. These observations prompted him to look around for a catalyst to ignite a stronger interest in the materials community within NUS to explore and experiment with fresh pedagogy in this important subject. He found the “catalyst” in this series of Materials Education Symposia. We are delighted that this has led to the first Asian event.

On behalf of the Advisory Committee, I would like to thank all those whose presentations and contributions made the 1st Asian Materials Education Symposia such an interactive and collaborative event. I am personally grateful to all those who joined me on the Advisory Committee, helping to put together the program from so many excellent submissions.



Materials Education Symposia

I'm particularly pleased to acknowledge the support of our sponsors, Materials Research Society, Singapore, and continuing support from:

- American Society for Engineering Education (ASEE), Materials Division;
- ASM International (the Materials Information Society);
- European Society for Engineering Education (SEFI);
- Federation of European Materials Societies (FEMS);
- International Federation of Engineering Education Societies (IFEES);
- The National University of Singapore (Department of Materials Science and Engineering);

Finally, I would like to add my appreciation to that expressed by so many of the attendees for the quality of the presentations, to the attendees who created an atmosphere in which communication flowed, and to the team from Granta Design, who, as ever, oiled the wheels and smoothed the path on which the Symposia roll.



Materials Education Symposia



Highlights from the 1st Asian Symposium

SESSION 1:

Chair: Prof. Sybrand van der Zwaag

The session on Thursday morning had 5 contributions and 12 poster presentations under the professional supervision of Dr. Arlindo Silva. The five talks focused on Materials and Sustainability.

An inspirational introductory talk by **Professor Fong Shih** focused on the differences between the current “brown” economy and the desired “green” economy, made clear by a number of well-chosen case studies.

Professor Ashby developed the idea of “mapping” ideas as a way of stimulating deeper exploration, using the evolution of maps of the known world and Mendeleev’s mapping of the elements to illustrate how visual thinking can stimulate discovery, bring this into Materials perspective with illustrations of how material property maps can stimulate creative thinking.

Dr. Chaobin He focused on case studies in polymeric material selection, showing how the analysis of unplanned failures (the embrittlement of colored toothbrushes) sharpened student understanding of the effect of glass transition temperature and its consequences for polymer behavior.

Dr. Wu Ping explained how his course on applied thermodynamics was enlivened with observations on the salaries of differing types of professionals and insights into sustainable technologies. The morning concluded with an introduction to a “blended” approach to learning by **Mr. Aaron Blichbau** who stressed the benefits of addressing on the one hand digital natives and on the other hand solid materials engineering and construction.



Materials Education Symposia

SESSION 2:

Chair: Prof. Peter Goodhew

The session on Thursday afternoon featured contributions from seven countries and touched on several of the symposium's recurring topics. Many speakers were keen to increase student motivation, particularly of students whose major discipline was not Materials. **Dr. Perez and Dr. Camburn** used chalk, not for writing but to demonstrate fracture topography – particularly the contrast between bending and torsion – and to introduce us to the new term “designette”.



Dr. Jian Chen's students made a bow (no mention of arrows) to demonstrate the remarkable properties of laminates.

Professor Matthew Barnett described a course where students deconstruct and then make a screwdriver from scratch, learning much about manufacture in the process.

Dr. Andre Marques from Brazil showed us how to inspire students through life cycle analysis.

Professor V. S. Raja cautioned that restraint in the use modern computer-based techniques if they discourage students from thinking deeply (which tends to be hard).

Dr. Yoshinao Kobayashi, Professor Gan Moog Chow, and Dr. Teik-Cheng Lim gave illustrations of sustainable engineering, interdisciplinary modules, and an industrial PhD programme.

Mr. Marc Fry then presented a wide-ranging and thoughtful view of the development of materials education, finally putting forward ideas for what will be needed in the 21st century.





Materials Education Symposia

SESSION 3:

Chair: Dr. Hugh Shercliff

Professor Freddy Boey covered many of the underlying themes of the meeting in describing the redevelopment of Materials Science and Engineering at NTU in Singapore. He explored student motivation, career progression and teaching methods. The opportunities represented by their new buildings have allowed classrooms designed specifically to enable flexible “flipped classroom” teaching. His experience with online teaching (virtual SEM and MOOCs) reached two clear conclusions: that MOOCs are expensive in both time and money to generate, and that, to be successful, they must be good – a poorly prepared or presented MOOC damages the reputation of the school. Elsewhere, at NTU, the topics of nano/biomaterials have been adopted as core subjects in Materials Science and Engineering.

Dr. Louise Smith addressed the different challenge of teaching these subjects as options for students in any discipline. This highlighted some interesting synergies, such as the underlying mechanisms of cell attachment to implant materials, and the accumulation of biological contamination on marine structures.

Professors Sybrand van der Zwaag and **Martin Dunn** presented excellent ideas for exciting student interest. Sybrand uses self-healing materials as inspiration for aerospace engineers, to convince them that it is not just designing aircraft that is exciting, but so is designing materials. Professor Dunn showed how he has used 3D printing of thermoplastic/elastomeric materials to produce models for hands-on investigation of deformation in hybrid materials such as foams and composites – a demonstration of how additive manufacture can bring material processing and design into the classroom.

Two other aspects of student motivation were discussed: **Professor Deliang Zhang** showed the practical steps being taken towards international Materials Science and Engineering education at Shanghai Jiao Tong University in China; and **Dr. Zuruzi Abu Samah** showed a prize-winning design of a water filter, made by high school students coming in to NTU on an outreach program.





Materials Education Symposia

SESSION 4:

Chair: Prof John Wang

Professor Peter Goodhew opened the session with a talk about materials education in a changing climate – meaning both the changing global climate and the rapidly changing education climate. This creates the need for a new generation of engineers able to deal with complex environments, available technologies, and ways of exploiting big data. There is also a need to generate motivation, as there are more choices for the new generation now than in the past (increasingly students with engineering degrees enter the worlds of finance or management or – you might hope – politics). Goodhew presented an interesting chart showing the percentages of time for an average person expected to spend in education, working, etc., together with potentially interesting career areas in the coming decades, as has been published by some media/press.

“I regard this as the best venue to share and develop my thoughts on materials education.”

Dr. Krishnan Kannoorpatti from Charles Darwin University, Australia, presented the education program in his institution, where there is a need to bring education to small communities in remote area.

Professor Xu Wei from Tongji University China shared his experience of his students’ innovation training program for undergraduates, as a bridge between education and research. The idea is to benefit education by linking it together with ongoing research programs, which becomes part of a problem-based learning environment, strengthening their innovative ability.

Dr. Yi Long from Nanyang Technological University, Singapore, shared her experience of teaching a course on Materials and Manufacturing consisting of different topics and several groups of students, which requires students to give presentations. E-posters and presentations designed by using free software, cloudshare apps, and LAMS allow students to present their studies and create an environment for raising questions and feedback.

Ms. Genevieve Lin from Singapore Republic Polytechnic presented an interesting study on the effectiveness of an advanced elective module in generating students’ interest in materials science. It has proved challenging to attract students who do well in mathematics and science to study science and engineering courses at university level. In efforts to inspire secondary school students to develop their interests, the Republic Polytechnic offers an Advanced Elective Module (AEM) consisting of 40 hours by in-house lecturers, taking the problem based learning (PBL) approach. Surveys showed that the applied and experiential learning approach of the AEM was effective in generating interest among students in materials science.

The session ended with a talk by **Dr. Arlindo Silva** (University of Lisbon, Portugal) on misconceptions in materials science commonly found among students of mechanical engineering, and how to correct them. Given the multidisciplinary nature, a different approach is required to teach some of the fundamental concepts about materials science to other engineering disciplines.



Materials Education Symposia

Concluding Remarks

“A broad spectrum of views and opinions on the topics of teaching.”

The Symposium was brought to a close by Professor John Wang, who thanked all speakers, poster presenters and participants for their contributions over the very stimulating two days of the meeting. Symposia like these, when successful, nucleate and then expand a sense of community, of sharing of ideas, and of mutual encouragement, which are powerful motivators. This 1st Asian Symposium has had all of those qualities. The delegates expressed enthusiasm for the format and the ability to interact in a relaxed atmosphere with other educators from remarkably diverse backgrounds.

See you all in 2016!

Following the success of the Symposium it was agreed that a 2nd Asian Materials Education Symposium will be organized in 2016. This second Symposium aims to build on the sense of community established by this first Symposium and, we hope, may attract a still wider participation and interaction. It will be co-organized by National University of Singapore, Singapore University of Technology and Design, Shanghai Jiao Tong University, and Granta Design. In the meantime, the North American and International Symposia are fast approaching - to find out more, and register your interest, please visit www.materials-educations.com.

- **7th International Materials Education Symposium**
University of Cambridge, UK, April 9-10, 2015
- **6th North American Materials Education Symposium**
The Ohio State University, March 25-27, 2015

