Young Persons' World Lecture Competition

ONLINE FINAL 2020

12 NOVEMBER 12.00 GMT

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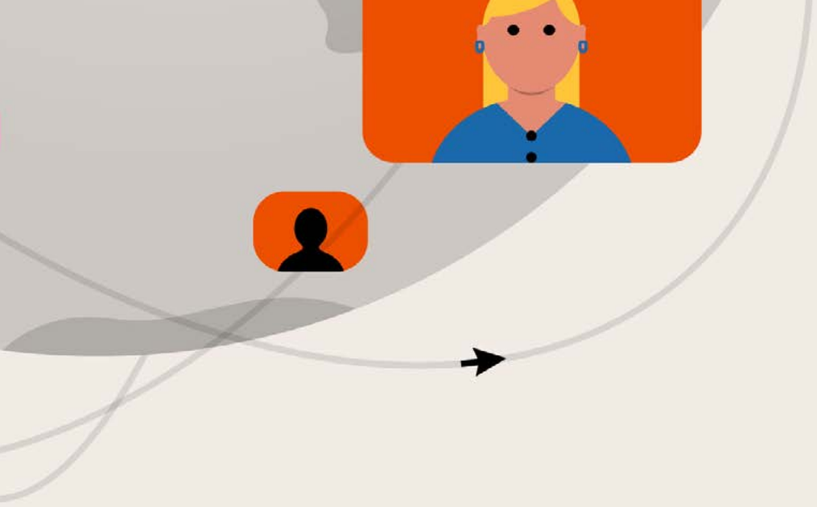

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WELCOME

On behalf of the Institute of Materials, Minerals and Mining (IOM3), I would like to welcome you to the 2020 final of the Young Persons' World Lecture Competition. The annual final is a flagship event for the Institute which sees the culmination of many local, regional and national heats held in 7 countries around the world. Each competitor today has won their respective national final and I would like to congratulate each of them on behalf of the Institute for this impressive achievement.

This year's competition has had to be very different to previous years due to the global pandemic. Most heats and national finals have had to take place online, which has added new skill sets to both the competition organisers and competitors. Also the normal YPWLC final event, where all international competitors take part in a week-long series of talks, tours and visits in one of the competing countries, could not take place. I feel particularly sad about this as we don't have the opportunity to meet and network with each other as we normally do.

The competition began in the UK as a way of encouraging young materials scientists and engineers to develop their communication and presentation skills. The ability to convey complex technical information in an enthusiastic and understandable way to a non-specialist audience has become an essential requirement in today's rapidly changing world. The competition today is the sixteenth international event, with previous finals having taken place in the UK, Singapore, USA, South Africa, Malaysia, Brazil, Hong Kong, Ireland and Australia.

I would like to thank all the local society and academic members, both within the UK and abroad, for their help in coordinating all the heats and national finals. May I also add my personal thanks to the IOM3 organising team, who have worked so hard, under the present difficult circumstances to ensure that this world final takes place.

This event has been made possible by the generous support of sponsors, Companhia Brasiliera de Metálurgia e Mineração (CBMM), who have provided a wealth of support enabling this international competition to become such a successful annual event.

Finally, I would like to thank you, our audience, for supporting this event. I am sure you will find all the presentations both entertaining and informative. A simplified marking sheet has been included within this programme for you to have a go at scoring each of the candidates.

I wish all the candidates the very best of luck for the competition and hope they perform at the best of their abilities. Your efforts will enable everyone involved in this competition to learn something new, either about ourselves or the ever expanding world of materials, minerals and mining.

Dr Phil Bischler CEng FIMMM APM
Chair of the judging panel

ORGANISED BY

I·M3 Institute of Materials, Minerals & Mining

THE INSTITUTE OF MATERIALS, MINERALS AND MINING

The Institute of Materials, Minerals and Mining (IOM3) is the professional body for the international materials, minerals and mining community. It promotes all aspects of materials science and engineering, as well as geology, mining, extraction metallurgy, minerals and petroleum engineering.

IOM3 plays an important role in the professional development of engineers and scientists. It provides information and library services, events and publications, and promotes the materials discipline to younger generations through various educational resources. IOM3 has strong links with other professional bodies and makes important contributions at Government and international levels in areas such as education and training, standards, test procedures, research programmes and environmental issues.

www.iom3.org

ON BEHALF OF

I·M3 SECC

SECC – STUDENT & EARLY CAREER COMMITTEE

The SECC represents the views of student, younger and early career* members to the Institute's Executive Boards and Advisory Council. We aim to represent the diverse range of members by ensuring Council representatives cover the different disciplines, regions and career pathways of student and early career members.

Since the Committee was founded in 1967 (as the Younger Members' Committee), we have developed a range of events to encourage networking and early career members' involvement with IOM3. Our greatest successes to date include the Young Persons' Lecture Competition, Matopoly, Professional Development events and Future Materials Conference. While we have been successful in the past, we aim to provide more events in the future. These include regular informal networking opportunities, along with new skills seminars, conferences and regional events.

* The Institute defines 'early career' as meaning someone who is, as of 1 September 2020 (and allows for career breaks, e.g. parental leave):

1. within 10 years of the start of their first employment (or self-employment) in a materials, minerals or mining related role, or

2. within 6 years of completing their PhD (in a relevant subject), whichever is sooner.

Note - the 10 years from the start of first employment would not normally include any apprenticeships (or equivalent training scheme).

bit.ly/IOM3_SECC

JUDGING PANEL

Dr Philip Bischler
CEng CSci FIMMM

Chair of Judging Panel

Phil Bischler is the Senior Consultant in the Customer and Solutions Department of Magnox where he acts as Portfolio Development Manager for a number of nuclear reactor sites. Other duties involve Strategy Analyst, Intelligent Customer and Design Authority roles in a number of large company projects. In the past, he has worked for Alcan International, British Steel, the Royal Aircraft Establishment and Oxford University. He has also set up and operated a small biomedical consultancy company. He is a member of the IOM3 Council, Managing Board and chairs the Local Affairs Board. He has helped to organise and judge the UK Young Persons' Lecture Competition for over 20 years and has chaired the judging panel for the world event since 2006.

Phil is a Fellow of the Institute, a Chartered Engineer, a Chartered Scientist and a member of the Association for Project Management. In his spare time he is a keen international mountaineer, marathon/mountain marathon runner who likes mountain biking, power kiting and travel. He also actively supports and raises funds for a number of charitable organisations.

Prof Serena Best
CBE FREng CEng FIMMM

President, IOM3

Serena Best is currently Deputy Head of the Department of Materials Science and Metallurgy at the University of Cambridge, UK. She also co-directs the Cambridge Centre for Medical Materials and is a Fellow of St John's College, Cambridge. She studied Materials Science and Engineering at the University of Surrey, UK and in 1986 moved to Queen Mary College, University of London to study a PhD on the development of a bioactive ceramic – hydroxyapatite. Best headed up bioceramics activity for the Interdisciplinary Research Centre in Biomedical Materials under the Directorship of Professor Bill Bonfield at Queen Mary College in 1991, before moving to the University of Cambridge in 2000. There she researched bone replacement materials and has more recently focused on collagen scaffolds for a range of different applications for soft tissue repair.

Mr Martyn Jones
CEng MIMMM

Chair, Student & Early Career Committee

Martyn is currently working for Rolls-Royce plc in Repair Technology, where his role is to develop strategic repair technologies and to support current repair capability acquisition programmes. He is also reading for his PhD with the University of Sheffield which is part-time and industrially based. Prior to working for Rolls-Royce plc he graduated from the University of Sheffield with a first class honours degree in Aerospace Materials, which included a 5-month internship which was completed with Rolls-Royce. It was following this placement that he gained a place on the Rolls-Royce plc graduate scheme. During his time on the graduate scheme, he became a STEM ambassador, leading a project aimed at encouraging school children to go on to study STEM subjects by enthusing them about science and maths - one of his passions!

His other academic achievements include being awarded the Nesthill medal for work on physical metallurgy and the Armourers and Brasiers medal for greatest distinction shown by candidates reading for BEng (Level 3) or MEng (Level 4).

In his spare time he regularly officiates in grass roots football and also enjoys travelling.

Dawn Kelly

Communications Specialist, CBMM

Dawn has worked with CBMM intermittently for over two decades in a variety of roles, first as a technical translator and more recently as a communications specialist focusing on digital content delivery and platforms. Among a range of other activities, she has been an active member of the company's Sustainability Report Working Group, since its inaugural publication in 2009. Dawn holds a Master's degree in Public Health, a specialisation certificate in Environmental Impacts and an undergraduate degree in Social Sciences.

PROGRAMME

12.00pm	**Login**
12.10	**Welcome & Introductions**
12.15	**Tan Kai Xin – Malaysia** *Metastable phases and mechanisms in the dehydrogenation process of titanium hydride*
12.35	**Anand Jyothi – Australia** SSBC: Self-regulating Suspended Biogas Collectors
12.55	**Morgan Lowther – UK** *Head, shoulders, knees and microbes: 3D printing better implants*
1.15	**Bianca Gevers - South Africa** *Engineering photo-active materials for renewable energy generation*
1.35	**Break**
1.45	**Wen Di Chan - Hong Kong** *Molecular study on formation of multicompartment structures by self-assembly amphiphillic terpolymer with Dissipative Particle Dynamics (DPD) simulation*
2.05	**Andrey Polyakov – Russia** *Primary aluminium production: How the wettability of carbon anodes influences the energy efficiency?*
2.25	**Mariana Alver Ribeiro – Brazil** *Greenhouse gases management and energy efficiency in an oxygen steelmaking plant*
2.45	**Q&A with the finalists**
3.15	**Results**
4.00	**End**

TAN KAI XIN
MALAYSIA

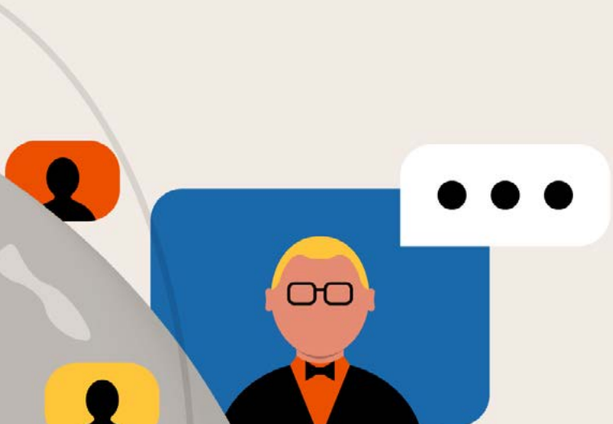
Tan Kai Xin graduated with a Bachelor's degree in Metallurgical Engineering from Universiti Malaysia Perlis. She also holds a Diploma in Mechanical Engineering with first class honours from Politeknik Shah Alam Malaysia. She has participated in and won several medals in national and international competitions, namely iCompEx2017 (gold medal), ITEX2017 (gold medal) and Seoul International Invention Fair (bronze medal). She has been actively involved in students' society and public speaking competitions. She loves sports in which she holds a black belt in WuShu martial arts. She has participated in several performances and a national singing competition. She enjoys singing and plays musical instruments.

METASTABLE PHASES AND MECHANISMS IN THE DEHYDROGENATION PROCESS OF TITANIUM HYDRIDE

Titanium hydride (TiH2), which is an intermediate product of titanium extraction, has great potential to be an alternative material to produce pure titanium powder. This research describes the characterisation of titanium powder after dehydrogenation using various techniques. Non-isothermal dehydrogenation up to 700°C has been carried out under a high-purity argon environment. High-temperature, in situ, x-ray diffraction and Rietveld refinement were used for characterisation. Cell parameters and phase changes that were determined through the Rietveld method proved that dehydrogenation occurs through heating. It was found that several metastable phases that shared the same crystal structures were formed during phase transformation. Lattice parameters increased under the influence of thermal expansion and reduced due to dehydrogenation. The effects of these two parameters on the phase transformation and crystal structures formed were studied. The non-isothermal dehydrogenation process had a sequence of phase transformations starting from **δ**-titanium to a final **α**-titanium phase.

ANAND JYOTHI
AUSTRALIA

Anand is a design engineer at Worley, working on marine pipelines and subsea engineering. Anand did his Bachelor's in Mechanical Engineering in India and completed his Master's at the University of Western Australia. He was exposed to a broad range of industries during this time, including mining, wastewater management, biogas and bulk material transport. He has a passion for dancing and photography and has won competitions in the state level for both.



SSBC – SELF-REGULATING SUSPENDED BIOGAS COLLECTORS

The global biogas industry market is expected to double over the next decade with a value of $48.8bln (USD) by 2026. Conventional biogas capturing technologies present a number of problems such as limited access to the inside of the reactors, risk of damage to the cover that can cause complete loss of methane produced, and difficulty in retrofitting to existing open reactors. The Self-Regulating Suspended Biogas Collectors (SSBC) propose a new approach to capture gas from reactors. There are significant economic and social benefits for the Australian industry and community resulting from this new technology.

The SSBC can capture and retain produced biogas while floating on top of anaerobic lagoons or reactors. The system consists of a number of small floating biogas capturing modules that operate independently. The collectors have a system that control the internal pressures, which maintains the stability of the modules and stops them capsizing. SSBC's modular design negates the need to shut down the entire anaerobic system for maintenance. Desludging and crust removal operations of the anaerobic system have been shown to be much more accessible in contrast to current technologies. The patented SSBC method presents an opportunity for business to implement biogas energy generation with reduced maintenance costs and better production efficiency using a flexible system that can be retrofitted to current reactors.

MORGAN LOWTHER
UK

Having studied for an MSci in Natural Sciences at the University of Cambridge, UK, Morgan returned to his Midlands roots to work at the Manufacturing Technology Centre in 2016. As part of the National Centre for Additive Manufacturing, he spent time characterising the feedstocks used for metal powder bed printers. This led to a fascination with how powder, printing parameters and post-processing alter the behaviour of additively manufactured materials.

Now a final year PhD student at the University of Birmingham, UK, Morgan's research uses 3D printing to deliver antimicrobials from biomedical implants, hoping to tackle the increasing challenge of implant-associated infections. Engaging with science outreach since his undergraduate days, a highlight has been helping students become human 3D printers. In his spare time, Morgan is a (very) amateur baker, climber and badminton player.

HEAD, SHOULDERS, KNEES AND MICROBES: 3D PRINTING BETTER IMPLANTS

Over 100,000 joint replacement surgeries take place each year in the UK alone, accounting for 1 in 10 hospital admissions. But the prevalence of metallic implants belies that the human body is among the most challenging environments for materials design. Implants often fail not through mechanical means, but biologically, by failing to integrate with native tissues and being colonised by microbes. With the increasing prevalence of antimicrobial resistance predicted to kill more people than cancer by 2050, making previously simple surgeries life threatening, preventing implant-associated infection is a necessity.

Conventional approaches have relied on coatings and other secondary processing to modify implants after manufacture. However, in the past decade, advances in metal additive manufacturing (AM) have opened the possibility of radically new approaches to implant design and materials. How might AM simultaneously revolutionise the production of implants and help mitigate the threat of antimicrobial resistance?

BIANCA GEVERS
SOUTH AFRICA

Bianca is a PhD student in the Department of Chemical Engineering at the University of Pretoria, South Africa. She is passionate about the environment, green technology and devising novel approaches to reduce society's dependence on fossil fuels. Her work focuses on developing materials for renewable energy applications. She loves detail and seeks to understand the materials with which she works (currently layered double hydroxides, anionic clay) on a deeper level. As a result, she has spent most of her PhD investigating the mechanism whereby these materials interact with light and the implications of this on engineering the said materials for renewable energy applications. This has led to multiple publications and conference contributions. After completing her PhD, she hopes to pursue her research interests and (one day) head her own green technology company. When not disappearing into the ever-frequent rabbit holes of new research fields, she loves to look after her plant collection, play tennis, paint, play piano or violin, cook, bake, embroider, sew and host dinner parties.

ENGINEERING PHOTO-ACTIVE MATERIALS FOR RENEWABLE ENERGY GENERATION

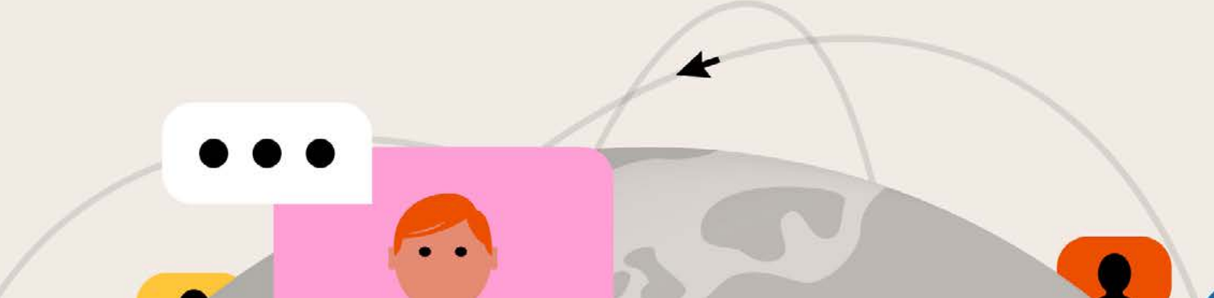
In a world where our lifestyle (unchanged) may result in self-destruction, the renewable generation of energy is ever more important. However, the development of renewable alternatives to fossil fuels is evolving too slowly to prevent some of the catastrophic effects of climate change. Many of these alternatives are based on limited natural resources and/or require large amounts of energy to produce or maintain – reducing their positive impact on the environment. In this lecture, a promising sub-category of these alternatives is explored – photo-active materials and their use in solar energy conversion. The mechanisms and applications of these materials are discussed, and their requirements and challenges explained. Layered double hydroxides – a specific class of these materials that can be produced in an environmentally friendly way – have shown promising results and exhibit potential for material engineering. These are used to illustrate the potential of the field and the challenges faced therein.

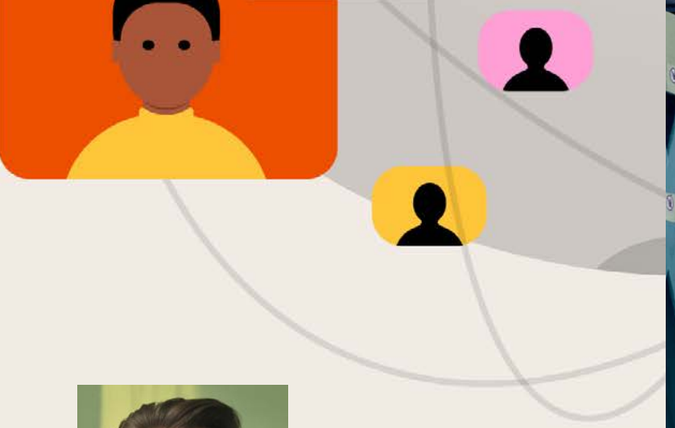
WEN DI CHAN
HONG KONG

Wen Di went to Hong Kong in 2016 to study Materials Engineering in City University. She was attracted by nanomaterials and their potential applications in a wide array of industrial sectors. After graduating, she joined Professor Lawrence Wu's Research Group as a Research Assistant, focusing on biosensing and nanomaterials. She is currently in her first year of her PhD under the supervision of Professor Wu. Her research work involves using nanomaterials to improve the sensitivity and selectivity of biosensors. In her spare time, she plays Taekwondo Sport which she finds fun and challenging.

MOLECULAR STUDY ON FORMATION OF MULTI-COMPARTMENT STRUCTURES BY SELF-ASSEMBLY AMPHIPHILIC TERPOLYMER WITH DISSIPATIVE PARTICLE DYNAMICS (DPD) SIMULATION

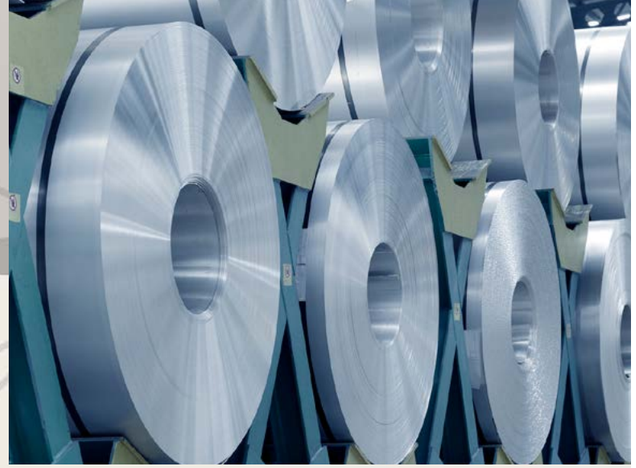
Efficient drug delivery, such as micelle and vesicles, plays a crucial role in disease treatment for cancer therapeutics. Current drug delivery research is moving from single compartment to multi-compartment structure to increase the capability of taking different drugs at one time. Dissipative particle dynamics (DPD) simulation at the molecular level was carried out to build micellar structures with more than one compartment. By monitoring the arm length of self-assembled amphiphilic star terpolymer, spherical, branched and cylindrical micelles and vesicles were obtained. Worm-like multi-compartment structures, which have a high potential for the uptake of several drugs, were obtained. Furthermore, evolution of the whole formation process can be clearly obtained and easily studied. DPD simulations have saved time and effort in developing new drug delivery mechanisms, and it is believed to be a powerful tool in driving development of the drug delivery system.





ANDREY POLYAKOV
RUSSIA

Andrey is a postgraduate student in the metallurgy department at Saint Petersburg Mining University. Before entering the postgraduate programme, Andrey received his Master's degree at the School of Non-Ferrous Metals and Material Science in Krasnoyarsk, where he was part of a research unit involved in developing high-amperage aluminium reduction cells. He continues his work dedicated to increasing energy efficiency and stability of aluminium electrolysis through designing new technological solutions. Andrey thinks that the sustainable production of aluminium is of great importance due to its constantly growing production rate and, as a result, environmental impact. Andrey likes to spend his leisure time playing the guitar, meeting his friends and travelling.



PRIMARY ALUMINIUM PRODUCTION – HOW THE WETTABILITY OF CARBON ANODES INFLUENCES ENERGY EFFICIENCY

In 2019, almost 64Mt of primary aluminium were produced, exceeding the 2010 indicators by 40%. Primary aluminium production requires a huge amount of electrical energy, which is the reason why world producers apply much effort to reduce specific energy consumption. Due to the serious environmental issues the world is facing today, it is vital to use energy and resources sustainably. This lecture introduces aluminium reduction technology and ways to improve the energy efficiency of this process. It highlights the phenomena observed during the anode process – one of the most important parts of aluminium electrolysis – and how the wettability of carbon anodes influences the anode process and its connection to specific energy consumption. The presentation also discusses existing and potential technical solutions to improve the interaction between carbon anodes and cryolite-alumina melt, hence the energy efficiency.

MARIANA ALVES RIBEIRO
BRAZIL

Mariana Alves Ribeiro is an undergraduate metallurgical engineering student at the Federal University of Minas Gerais. She studied Ferrous Metallurgy at the Montanuniversitaet Leoben in Austria and is also a Chemistry Technician. Since 2012, she has been working on mining, metallurgical and material science projects. In 2017, she started an internship in a steelmaking group, accumulating around ten science projects, which won some academic and industry relevant awards. This included R&D around steelmaking reactors using water models and Computational Fluid Dynamics simulations. The last project has an environmental focus, using cleaner production concepts on greenhouse gases for steelmaking industry reduction. Her working passions are metals reduction and refining. In her spare time, she usually reads, watch some movies, and is now starting to do some abstract watercolour painting.

GREENHOUSE GAS MANAGEMENT AND ENERGY EFFICIENCY IN AN OXYGEN STEELMAKING PLANT

Carbon emissions and climate change are increasingly in focus. Several studies have been carried out on strategies to reduce the amount of greenhouse gases. According to the World Steel Organisation, between January 2019 and May 2020, 148,775,000t of steel were produced worldwide, demonstrating the expressiveness of the steel industry. Management of greenhouse gases must be carried out to reduce carbon dioxide emissions. This presentation approaches the management of greenhouse gases for an oxygen steelmaking plant, under the standards of the Brazilian GHG Protocol. According to the results, carbon dioxide emissions in the melt shop have been reduced by 92% over the years. Pig iron consumption and gas recovery are variables with the largest impact on greenhouse gas emissions.

PRIMARY SPONSOR

Companhia Brasileira de Metalurgia e Mineração (CBMM) is the world's premier supplier of niobium and niobium technology. Fully integrated from the mine to the final customised products, CBMM also provides expert technical support to customers in the most sophisticated steel and technological segments around the globe.

As the sole niobium producer present in all market segments, the company strives to exceed the expectations of customers wherever they may be. Headquartered in Araxá, Minas Gerais, Brazil, CBMM has a technology subsidiary in Switzerland, commercial subsidiaries in Europe, Asia and North America, and an extensive worldwide network of strategically positioned supply warehouses.

The most important application for niobium is as an alloying element to strengthen steel without impairing its ductility. These steels are mainly used in the automotive industry, and to build oil and gas pipelines and large structures. Besides making steels stronger and tougher, tiny amounts of niobium also enhance steel weldability and formability. Additionally, stainless steels containing niobium are used in vehicle exhaust systems, among other applications. Non-steel applications for niobium include aircraft turbines, land-based power generation turbines, optical lenses, medical imaging devices and chemical catalysts.

CBMM has worked to develop applications where niobium is the most effective solution, where its properties improve efficiency, safety and performance, adding value particularly in addressing today's major challenges. Investments in research and development projects with customers and at independent institutions have increased the role of niobium in known applications and created new uses for the metal. As part of this program, CBMM has supported the work of hundreds of research students at Brazilian universities, as well as in France, UK, Germany, Austria, Japan, USA, Canada, Russia, Ukraine and China.

A commitment to the environment, employees and the community that dates to the company's earliest days has solidified CBMM's reputation as a sustainable enterprise. In addition to numerous certifications and honours, including the first mining and metallurgy company in the world to earn ISO 14001 certification, CBMM's mission is sustainable: expand the use of niobium technology, transforming a natural resource into solutions to build a better world.

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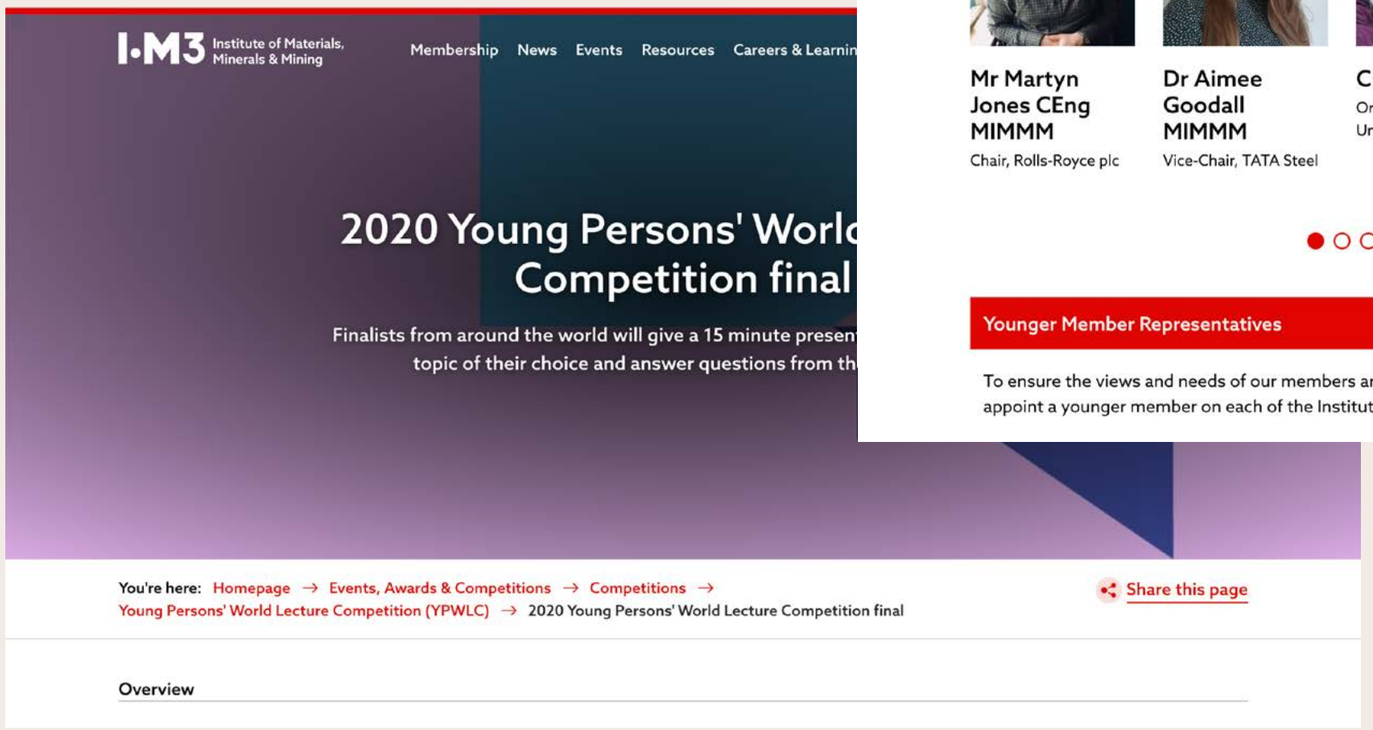

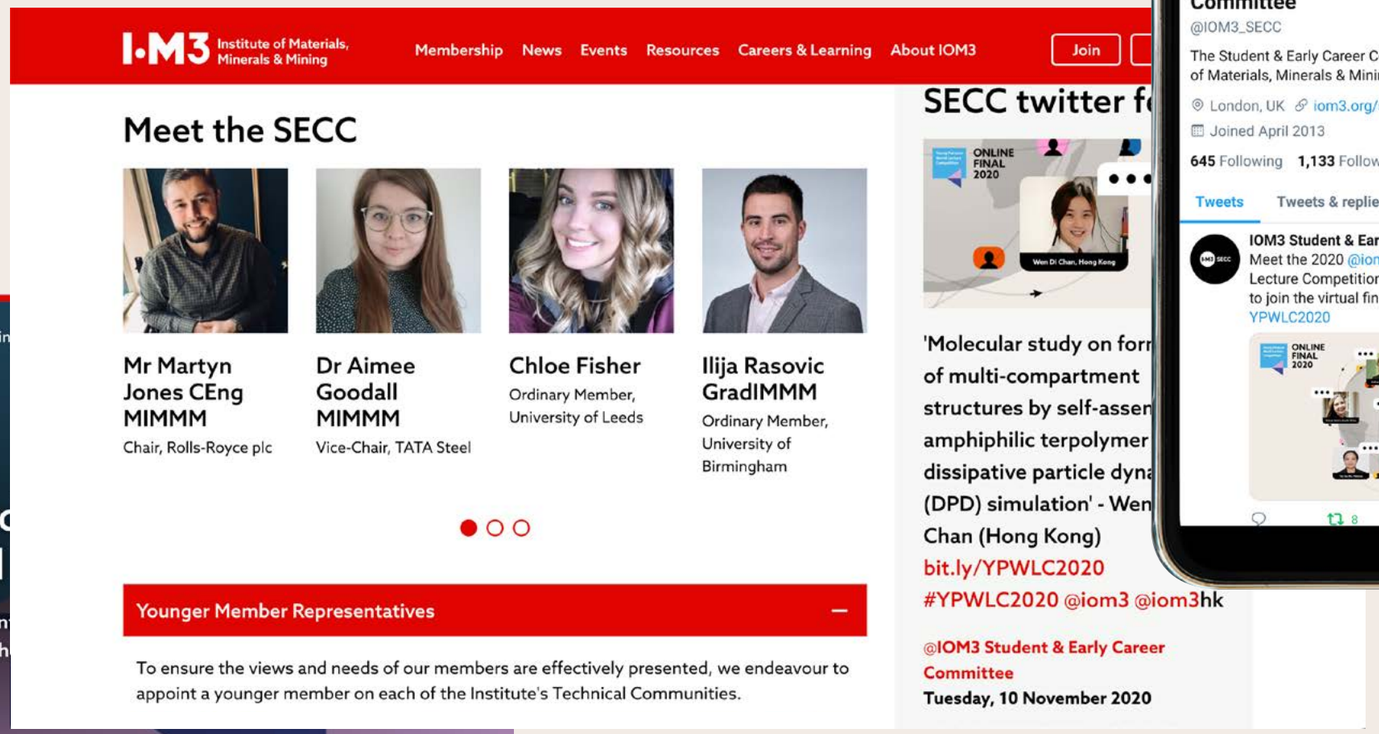

I·M3 SECC

15 YEARS OF YPWLC WINNERS

London 2005
Libby Sharman-Harris
(South Africa)

The use of sulphur-isotope analysis towards the understanding of the formation of sulphide minerals in the Platreef, Northern Limb, Bushveld Complex, South Africa

London 2006
Andrew Tarpey
(UK)

Structural adhesive use in lightweight vehicle architecture

Singapore 2007
Mary Donnabelle L Balela
(Malaysia)

Cobalt nanoparticles: Synthesis, properties and applications

Florida 2008
Sinan Al Bermani
(UK)

Digital manufacture for medicine

South Africa 2009
Rochelle O'Hara
(UK)

Development of an injectable medical material for spinal repair

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Malaysia 2010
Jason Mayers
(Florida)

Enhanced organic photovoltaic cell performance using transparent microlens arrays

Brazil 2011
Mitali Kakran
(Singapore)

Graphene: The new wonder material!

London 2012
Brian Weden
(California)

High performance impact-tolerant and abrasion-resistant materials: Lessons from nature

Hong Kong 2013
Cornelis van Niekerk
(South Africa)

Novel techniques for in-situ laser alloying of AISI 410L stainless steel with nitrogen during laser cladding

US 2014
Raphael Smith
(South Africa)

The design, construction and testing of a hermetically sealed breast platform for dual-modality mammography

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Ireland 2015
Kevin Doherty
(Ireland)

New thermal control material systems for interplanetary and geosynchronous spaceflight

Brazil 2016
Li (Alan) Zhong
(Singapore)

Artificial corneal implants: A brighter future with advanced bioceramics

Australia 2017
Vidya Chamundeswari
Narasimhan (Singapore)

Biodegradable scaffold systems for musculoskeletal tissue regeneration with sustained release of multiple bio-molecules

South Africa 2018
Kyle Saltmarsh
(Australia)

Acoustic based condition monitoring in the resource industry

London 2019
Tamlyn Naidu
(South Africa)

Acid Mine Drainage remediation system using waste products from the steel manufacturing and sugar industries

SCORECARD

Please feel free to use the score sheet to compare your assessment with that of the judges

Judging criteria	Max mark	Malaysia	Australia	UK	South Africa	Hong Kong	Russia	Brazil
Abstract	10							
Structure of lecture	25							
Standard of presentation	25							
Visual aids and physical examples	10							
Technical content	15							
Handling questions	15							
Total								
Lecture time (mins/sec)								
Penalty > 17/19 mins Penalty < 12/13 mins	-5/-10							
Final Score								

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