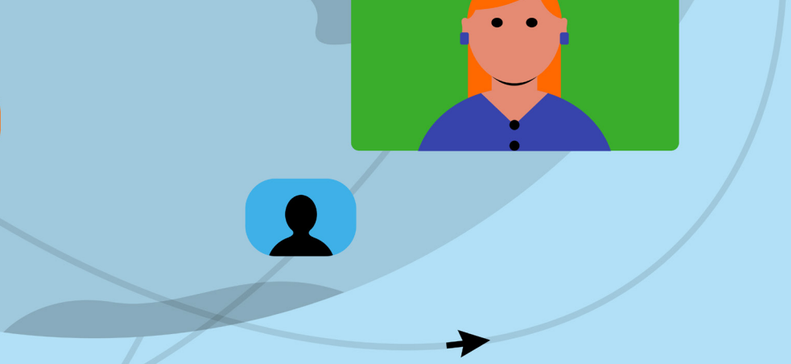
Young Persons' World Lecture Competition

ONLINE FINAL 2022

10 NOVEMBER
12.00 GMT

#YPWLC2022



ORGANISING COMMITTEE

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Nor Akmal Fadil
Malaysia

WELCOME

Welcome to the 2022 final of the Institute of Materials, Minerals & Mining (IOM3) Young Persons' World Lecture Competition.

This flagship event is once again a major highlight of the IOM3 annual calendar bringing together the finest young speakers from 6 countries around the world to showcase their skills. Just to be here today each of our competitors has already won through local, regional and national stage competitions. As such I would like to congratulate them all on behalf of IOM3 for their success so far and wish them the best of luck in this final stage of the competition. Though there can ultimately be only one winner, each of them should be proud of their impressive achievement in reaching this final and the skills they have honed and demonstrated along the way. I am confident we will all enjoy a series of high quality and entertaining presentations and leave the event both better informed in a range of fascinating topics and confident in the capability of the next generation of materials, minerals and mining professionals.

Although the content of the talks will no doubt be of the highest technical quality, we should not forget that the competition is predominantly conceived as a way of encouraging young materials scientists and engineers to develop their communication and presentation abilities. In a highly dynamic world of complex technology and a sometimes bewildering array of communication channels, the ability to convey accurate, balanced technical information in a succinct and accessible way to decision makers and the public is an imperative if we are to be successful in finding solutions to our daunting global challenges. This competition aims to help the next generation of scientists and engineers to develop and showcase these skills.

Today's competition is the sixteenth international event and the third to take place virtually, with previous finals having taken place in the UK, Singapore, USA, South Africa, Malaysia, Brazil, Hong Kong, Ireland and Australia. Although it lacks the human touch of being able to meet in person, the challenge of presenting to a 'digital' audience adds another dimension to the competition and one which is highly pertinent to today's engineers and scientists.

I'd like to thank everyone who has been involved in making this competition so successful. All those who voluntarily gave their time to organise heats and national finals, the IOM3 team who have co-ordinated the competition and brought us together for this final, and our generous supporters.

Finally, I would like to thank our competitors, our judges and of course our audience. If you wish to have a go at scoring yourself, to compare with the decisions of the judges, then a simplified marking sheet has been included for you within this programme.

Good luck to all our competitors, I hope you are each able to perform to the very best of your abilities.

Mr Neil Glover FREng CEng FIMMM
IOM3 President

ORGANISED BY

I·M3 Institute of Materials, Minerals & Mining

THE INSTITUTE OF MATERIALS, MINERALS & 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 SEC

STUDENT & EARLY CAREER GROUP

The Student & Early Career Group (SEC Group) represents the views of student and early career members of IOM3.

Representatives of the Student & Early Career Committee (SEC Committee), the leadership group, sit on the IOM3 Executive Board and Advisory Council ensuring that we are raising with the major issues affecting student and early career members.

Since our creation 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, Art Lecture, Road to Chartership and Professional Development events, Future Materials Conference and Materially Challenged. 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.

We also want to ensure that we are raising with Executive Board the major issues affecting younger members. To do this successfully, we need to communicate more with members and obtain feedback from events.

SEC Group

JUDGING PANEL

Mr Neil Glover
FREng CEng FIMMM, IOM3 President

Chair, Judging Panel

Neil is Head of Materials Research in the Central Technology and Strategy group at Rolls-Royce plc where he has worked for more than 25 years in materials for the aerospace and marine sectors. He studied Natural Sciences (Materials Science) at the University of Cambridge, UK. Neil has worked on the development, application and through life management of a wide range of materials from light alloys and composites to high temperature superalloys within the organisation.

He first became involved in IOM3 as a student as an opportunity to network with others and learn. He has been involved in local society committees including the East Midlands Metallurgical Society; Secretary of the High Temperature Materials Committee.

Dr Kate Thornton
CEng CSci FIMMM

IOM3 Senior Vice-President

Kate works as a Lead Research Scientist at Croda in Widnes and her work is focused on sustainable biopolymers.

Kate studied Biomedical Material Science for her undergraduate degree at the University of Manchester. She then went on to complete her PhD in self-assembled peptide hydrogels for the three-dimensional culture of embryonic stem cells at the same university.

Kate first became involved with IOM3 as a student in the Younger Members' Committee (now the Student & Early Career Group) in 2008 and will succeed Neil Glover as President in January 2023.

Dr Aimee Goodall
CSci MIMMM

Chair, IOM3 Student & Early Career Committee

Aimee is currently the Through Chain Value Manager for Tata Steel UK. Previous work experience includes working for four years as a Process Technology Specialist on the galvanising line in Llanwern, South Wales.

Aimee studied for a Forensic Science undergraduate degree at De Montfort University, Leicester. During the degree she realised her interest for material science. Aimee then carried out a 3-month summer placement at the Corby, Tata Steel site. She gained a PhD in the Phase Transformation and Microstructural Modelling Group at the University of Birmingham looking at the heat treatment of high strength low alloyed steel.

In her spare time, Aimee is a keen reader, swimmer and is part of a musical show choir.

Event Co-ordinator
Mr Martyn Jones
CEng MIMMM

Chair, IOM3 Members' Board

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 this time, 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.

PROGRAMME

12:00	**Login**
12:10	**Welcome & introductions**
12:15	**Lauren Eggleton, UK** *A sticky situation: The contradictory material properties of snail mucus*
12:35	**Shane de Beer, South Africa** *Overcoming limitations on computational adsorption modelling for flexible materials*
12:55	**Kate Fraser, Canada** *Plastics for renewable energy devices*
13:15	**Break**
13:25	**Tianyi Li, China** *MXene/rGO@PI aerogel with excellent EMI shielding performance*
13:45	**Danning Li, Hong Kong** *Investigation on the aging mechanism of asphalt rubber binder prepared with waste tire rubber*
14:05	**Rathosivan Gopal, Malaysia** *Immobilisation of factor VII through polydopamine grafting of polycaprolactone membrane for cardiac bleeding*
14:25	**Networking, Q&A with the finalists**
15:00	**Results**
15:15	**End**

LAUREN EGGLETON
UNITED KINGDOM

Lauren is a second year PhD student in the Materials Science and Engineering Department at The University of Sheffield. She developed a passion for research during her Master's in Materials Science and Engineering, which specialised in biomaterials. During this time, she undertook a year in industry at Philips Research UK, working in oral healthcare on whitening and hypersensitivity. Upon returning, she channelled her love for research and nature into her Master's project on snail and slug locomotion in the Natural Materials Group, and has never looked back. Her EPSRC funded PhD focuses on understanding and bridging the gap between structure and function in snail and slug mucus.

Within the department and faculty, she is an active member of the postgraduate research community: supporting fellow students as part of the postgraduate research committee, helping teach undergraduates, and sharing research stories over arts and crafts lunches. Outside of the lab, she is a keen communicator and advocate for inclusion and diversity in STEM subjects, volunteering for outreach programmes and school events at both the local and national level. Through her work with the Bioladies Network and Natural Materials Association, she hopes to inspire people across all ages and backgrounds to discover the scientific wonders found in nature.

In her free time, Lauren enjoys exploring the Peak District, medieval re-enactment and has recently taken up ice skating, though she can often be found at home curled up with a good book and her two cats.

A STICKY SITUATION: THE CONTRADICTORY MATERIAL PROPERTIES OF SNAIL MUCUS

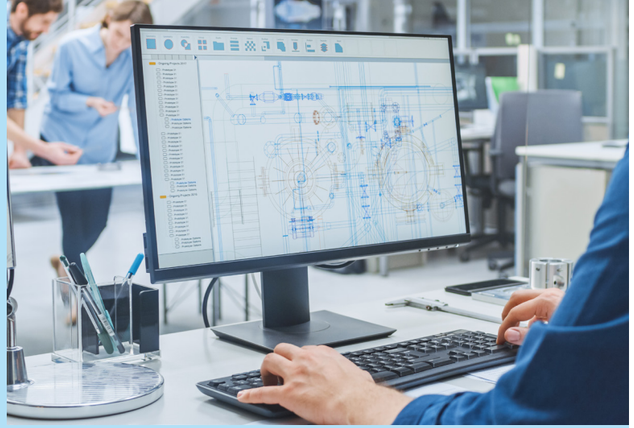
Nature has evolved a vast range of 'smart' materials and is currently an untapped resource for novel biomedical and engineering applications. A surprising example is snail mucus. Embodying two contradictory properties, adhesion and lubrication, this material can switch seamlessly between them whenever the functional need arises. But how does it do this and can we replicate it?

In the search to understand these unusual flow properties, our creation of a snail locomotion translation device demonstrates how a more holistic approach to analysing natural materials can reveal more about their true nature. Discovering that like many industrial materials, snail mucus crystallises, but controlling this is via an elegant means of changing its salt concentration. Showing that we can find inspiration for tomorrow's advanced materials everywhere, even at the bottom of our garden.

SHANE DE BEER
SOUTH AFRICA

Shane is an aspiring academic in the field of theoretical and computational chemistry. He is currently in his second year of PhD at Stellenbosch University after completing his BSc and MSc studies at the University of Pretoria. His research interests include investigating the quantum mechanical nature of materials and using this insight as a basis for developing novel materials, especially catalysts. During his previous studies, he explored chemical bonding in molecules using atomistic theoretical techniques and is now seeking to understand bonding in solid-state materials on a similar basis, as well as supplementing theoretical insights with experimental results from spectroscopy and x-ray diffraction. During his PhD, he is developing theoretical models on adsorption and photocatalysis in the solid-state to capture and convert unwanted products into more useful reagents. Shane has presented his work at ISXB4, ePCCr, AfPS-2021 and the 15th CHPC National Conference. He also published the first step in his journey in the Journal of Computational Chemistry. In future, he aspires to develop theories and techniques to further investigate the quantum behaviours of materials.

When Shane is not working, he can be found in the world of a thriller novel or enjoying the company of his two dachshunds. Otherwise, he is trying his hand at a new recipe or a new language.



OVERCOMING LIMITATIONS ON COMPUTATIONAL ADSORPTION MODELLING FOR FLEXIBLE MATERIALS

Experiments to determine sorption isotherms can take up to weeks to complete whereas computational modelling of sorption isotherms only takes a few hours. The software available limits the adsorbing materials to rigid structures, whereas modern research has shown that many materials of interest undergo structural changes upon guest adsorption.

There are many applications in gas separation, gas storage and catalysis that can utilize this flexibility. However, modelling the isotherm of a flexible material as a rigid structure can lead to inaccurate isotherm models. Here a stepped method is developed to model the isotherms of flexible materials accurately, utilizing the Materials Studio sorption module as well as the CASTEP software. The predicted isotherm for CO_2 adsorption onto the MOF-508 material is then tested against the experimental isotherm to validate the proposed method. This, furthermore, gave fundamental insights into the mechanism for the adsorption of CO_2 onto MOF-508.

KATE FRASER
CANADA

Kate is a PhD candidate in the Department of Chemistry at Simon Fraser University, supervised by Dr Steven Holdcroft. After completing her Bachelor's and Master's in Chemistry at Lancaster University in the UK, she moved to Vancouver, Canada to pursue her PhD. Her research field works to develop and improve devices to make hydrogen a viable replacement for fossil fuels. Kate's research interest within this field lies in the design, synthesis, and characterisation of novel polymer electrolytes and binders for integration into alkaline electrolyzers and fuel cells. The main focus of Kate's PhD is to develop a highly conductive polymer that can withstand the highly caustic, high temperature environments of the alkaline devices.

Within the Department Kate is an active member of the Chemistry Graduate Student Caucus and works to support and connect the students through weekly social events. Outside of the department Kate is part of the Electrochemical Society Student Chapter and has organised virtual and in-person symposiums which included speakers and attendees from various places in North America.

In her personal life, Kate is often found road biking around the Vancouver Lower Mainland and the various islands. And when the winter comes, Kate likes to ski at the nearby mountains.

PLASTICS FOR RENEWABLE ENERGY DEVICES

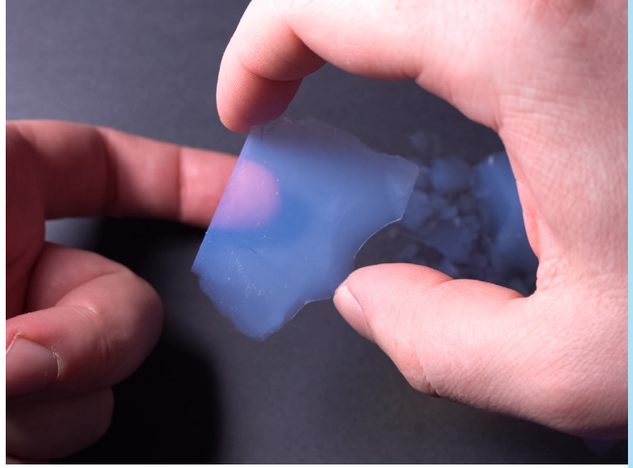
Plastics, also known as polymers, are long molecular chains that interweave with themselves to form complex structures like that of felted wool. These materials have proved to be essential in achieving a net-zero carbon economy through their usage in energy storage and conversion devices.

Hydrogen has the ability to store a large amount of energy, much like gasoline. However, unlike fossil fuels which release greenhouse gases, hydrogen only produces water when combusted. An Electrolyser uses excess renewable energy to create hydrogen fuel which stores energy. Fuel cells then use hydrogen to generate energy and power transportation devices. Specific polymers have been developed to replace caustic liquids within the devices, creating systems that are safer, more compact, and more efficient. However, strongly basic solutions destroy the polymer structure resulting in material degradation and device failure. Here, polymers have been developed to withstand such conditions whilst maintaining high device efficiencies.

TIANYI LI
CHINA

Tianyi is now a Master's student in the state key laboratory of polymer material engineering in Sichuan University, supervised by Prof Zhongming Li. His research is focused on advanced polymer processing technology by machine learning. Prior to this, he obtained his Bachelor's degree in Engineering in polymer material science and engineering with first class from Queen Mary University of London and Northwestern Polytechnical University under the supervision of Dr Han Zhang and Prof Yanhui Chen. His dissertation investigated the aerogel which can be used as EMI shielding material.

Tianyi is also an active member in the field of swimming. He has been taking professional training from 10 years old and became champion in the provincial college students' competition in 2019. He now works as the referee in swimming competitions.



MXENE/RGO@PI AEROGEL WITH EXCELLENT EMI SHIELDING PERFORMANCE

With the requirement to fabricate polymer aerogel that can be able to use in high EMI shielding, lightweight and heat resistance application, MXene/rGO@PI aerogel composite has been fabricated in a facile method combining dip-coating and direct foaming process to ensure the structural integrity and MXene adsorption. An average shielding effectiveness of 25.37 dB and absorption coefficient (A) of 75% is successfully achieved by 6.14 wt% rGO filling and 12.33 wt% MXene filling. The structure was strengthened by chemical and physical interaction between filler and matrix, and inner conductive network improved the thermal conductivity to enable better heat resistance. The fabricated aerogel offers potential uses in next-generation communication technology, miniaturised portable electronic devices, and aeronautics and astronautics.

DANNING LI
HONG KONG

Danning is a PhD candidate in the Department of Civil and Environmental Engineering at the Hong Kong Polytechnic University, supervised by Dr Leng Zhen. His research interests focus on sustainable pavement materials and technologies, especially the rubberized asphalt material. His PhD dissertation topic is 'Multiscale Investigation on the Aging and Recycling Mechanisms of Asphalt Rubber Pavement'. With a good command of rheological, mechanical, and chemical analysis methods, he aims to interpret the intricate aging mechanism of asphalt rubber binder and develop customized rejuvenation methods for reclaimed asphalt rubber pavement to further promote the application of asphalt rubber pavement and disposal of waste tire rubber. His works have been published in journals including the Journal of Cleaner Production, Materials & Design, and Resources, Conservation & Recycling.

In daily life, Danning has always been praised as versatile thanks to his proficient skills at playing the piano and basketball. His passion for these two hobbies is the power source of his life and always fuels his pursuit of research.

INVESTIGATION ON THE AGING MECHANISM OF ASPHALT RUBBER BINDER PREPARED WITH WASTE TIRE RUBBER

Asphalt Rubber (AR) is a sustainable paving material composed of bitumen and crumb waste tire rubber. AR presents enhanced pavement rutting and cracking resistance, and considerable environmental benefits including reduced tire-road noise and waste tire disposal. However, the aging mechanism of AR binder remains unclear due to the intricate rubber-bitumen interaction, which complicates the recyclability of reclaimed AR pavement (RARP).

Aiming at a deeper understanding on the aging mechanism, this presentation investigates the compositional and mechanical evolution of AR binder through experimental methods and micromechanical modelling. As a multiphase material, AR binders at different aging conditions were phase-separated to reveal the structural change during aging. Chemical tests were conducted to observe the rubber absorption behaviours during aging. Rheological tests and micromechanical evolution of AR binder and its components. The findings can provide theoretical support for the recycling and rejuvenation design of RARP.

RATHOSIVAN GOPAL
MALAYSIA

Rathosivan graduated with a first class distinction BEng (Bio-Medical) from Universiti Teknologi Malaysia (UTM) in 2019. He was then offered to pursue the fast-track doctorate programme in the School of Biomedical Engineering and Health Sciences and secured financial aid from the student excellence programme by the Malaysia public service department (PPC-JPA) to further his studies. His research focuses on utilisation of biomaterials especially polymers and hydrogels as an implant material, and has excelled in operating high-end analysis instruments as well as performing in-vitro analyses. He is currently completing his training attachment at Laval University, Canada funded by the Canadian government. Ratho has presented his preliminary research work in biomaterials, polymers and mechanics at conferences in Quebec, Canada in 2022 and in Japan in 2021. Recently, he won the 3-minute Thesis competition in UTM and represented the university on a national level. He also has been on the organising committee for 8th and 9th IGCESH (2020, 2022) conferences. Apart from academic relations, Ratho has led several student associations during his doctorate studies such as postgraduate student societies (PGSS 2019/2020) and residential college student committees (JKM 2020/2021), and organised a series of programs to engage students in activities outside their academic field and cope with the pandemic while excelling in their studies and research.

He is keen in giving back to the community to raise awareness and help young students and kids to engage in STEM programmes. He enjoys participating in charity programs and always willing to lend a helping hand.

IMMOBILISATION OF FACTOR VII THROUGH POLYDOPAMINE GRAFTING OF POLYCAPROLACTONE MEMBRANE FOR CARDIAC BLEEDING

The repair of cardiac bleeding is one of the processes in the treatment of cardiovascular diseases. Nevertheless, postoperative bleeding is still an issue following the implementation, which derange the resources and cost. Oral administration of blood coagulation protein called Factor VII (FVII) has been effective to stop the bleeding. However, the short half-life may lose its effectiveness and frequent intake may distress the patient. Alternatively, synthetic polymers such as polycaprolactone (PCL) are used in drug delivery and wound dressing applications due to their favorable properties. This study immobilises FVII on PCL membrane through polydopamine grafting using dropcasting technique to seal the bleeding at its maximum region and accelerate blood coagulation. The PCL membrane was used to graft a thin polydopamine film as the intermediate layer to enhance the surface compatibility and provide a platform for immobilisation of Factor VII afterwards.

The physio-chemical properties of the thin PCL membranes were characterized using several analyses. While the cytocompatibility of the membranes was evaluated with fibroblast and blood cells. Initial characterisation studies showed the success of FVII immobilisation through polydopamine grafting and the presence of FVII molecules on the PCL membrane with enhanced surface roughness and hydrophilicity. Biocompatibility tests showed increased cell viability and coagulation and the lowest haemolysis ratio on FVII immobilised PCL membrane. This validates the biocompatibility of the membrane and its ability to accelerate blood coagulation and potential application as cardiac bleeding sealant. Future works will focus on the mechanical strength and incorporation of an adhesive component to the membrane.

Young Persons' Lecture Competition

NATIONAL FINAL 2023

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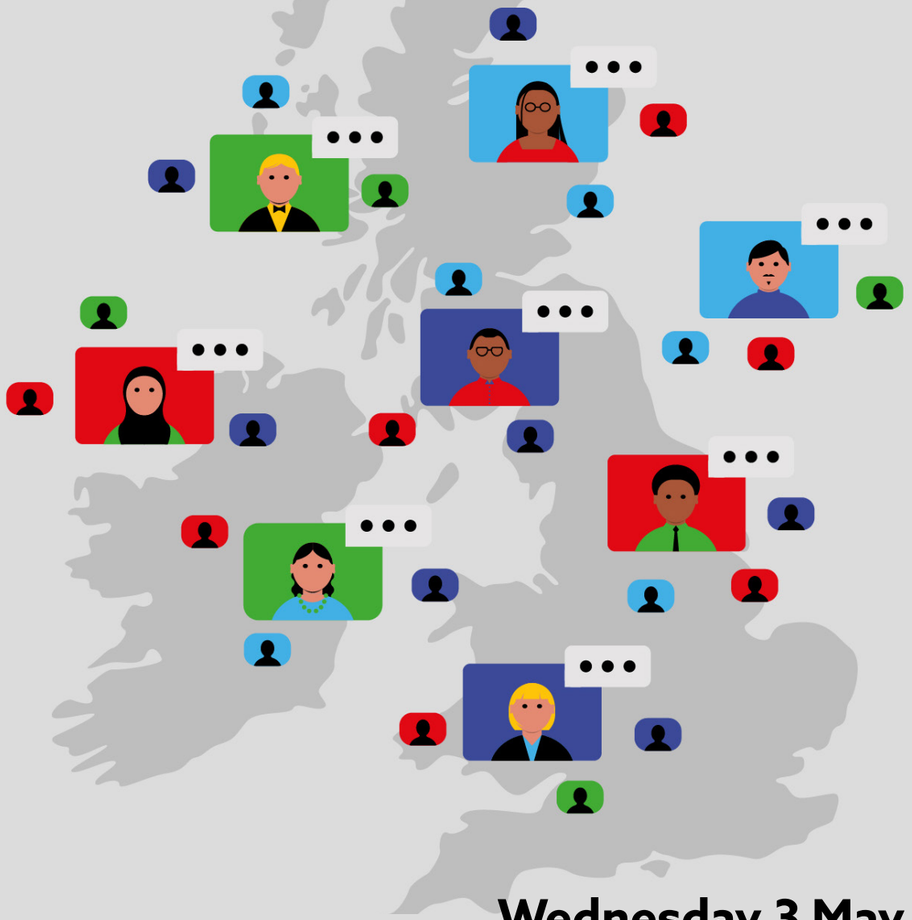

Wednesday 3 May 2023

Win up to £1,000 and a place in the YPWLC final

#YPLC2023

YPWLC WINNERS

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

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

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

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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

London 2020
Morgan Lowther
(UK)

Head, shoulders, knees and microbes: 3D printing better implants

London 2021
Hannah Ramsay
(Canada)

Silver clusters: Small material, big potential

SCORECARD

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

Judging criteria	Max mark	UK	South Africa	Canada	China	Hong Kong	Malaysia
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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