

Safe Net Zero 2024 - Safety considerations for materials used in hydrogen environments

13 February 2024

EVENT PROGRAMME

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WELCOME TO SAFE NET ZERO 2024

It gives me tremendous pleasure to welcome you here today in Manchester, not only because it's the fifth event in the Safe Net Zero hydrogen series, but it's our first deep-dive looking into a key theme that many in industry, academia and government are keen to explore: the selection, performance and safety of materials used in hydrogen environments.

In response to your valuable feedback from our past events, particularly the insights shared at Safe Net Zero 2023, we've tailored today's programme to focus on the compatibility and durability of materials in hydrogen environments – key factors that influence the reliability, efficiency and safety of hydrogen-based technologies, which are crucial for our transition to clean energy.

From exploring ways to safely repurpose existing infrastructure for hydrogen use and the requalification of existing and in-use materials, to the development of new materials optimised for hydrogen, there is a lot to consider. This focus is key to unlocking the potential for hydrogen to be produced, stored and distributed at scale, supporting the achievement of net zero by 2050.

Materials science and engineering are taking centre stage as essential tools and enablers in our efforts to lower carbon emissions, therefore I am looking forward today to engaging in meaningful discussions, taking onboard the insights from our distinguished speakers and uncovering the progress being made through our collective efforts in various sectors.

I would like to thank our event sponsor, Rolls-Royce, our exhibitors, Element Materials Technology and Triton Hydrogen, as well as you for your participation and support. I hope that today will be filled with insightful discussions and will serve as a catalyst for further research and coordinated collaborative efforts towards our clean energy goals.



David Johnson

Deputy Chief Scientific Adviser, HSE

PROGRAMME

Tuesday 13 February 2024

09:15 - WELCOME AND KEYNOTE	
Welcome	David Johnson - Deputy Chief Scientific Adviser at HSE
Keynote	Professor Paul Monks - Chief Scientific Adviser at the Department for Energy Security and Net Zero
09:40 - SESSION 1 MATERIALS FUNDAMENTALS AND SELECTION - STATE OF THE ART	
Introduction by session chair	David Knowles - CEO at the Henry Royce Institute
Qualification testing of metals in gaseous hydrogen environments	Shengqi Zhou - Senior Research Scientist at the National Physical Laboratory
The other phase: Metals and liquid hydrogen	Tim Illson - Principal Specialist at DNV
Recommended properties of thermoplastics to study after exposure to hydrogen	Bernadette Craster - Technology Fellow at TWI
10:40 - BREAK	
Composites and hydrogen – addressing the challenge of cryogenics	Marcus Walls-Bruck - Head of Hydrogen Technologies at the National Composites Centre
Hydrogen sealing with polymers - overview of current available options	Andrew Douglas - Material Engineering Group Manager at James Walker
Engineering considerations for cryogenic hydrogen applications	Cameron Blackwell - Senior Research Engineer, Materials Technology at the Manufacturing Technology Centre
Current state of the art in testing	Mark Eldridge - Director of Hydrogen at Element Materials Technology
12:00 - PANEL DISCUSSION	
12:25 - LUNCH BREAK	

13:40 - SESSION 2 INDUSTRY APPLICATIONS AND CASE STUDIES	
Introduction by session chair	Stuart Hawksworth - Head of the Centre for Energy and Major Hazards at HSE
Materials challenges in bringing solid-state hydrogen storage to the off-road industry	Marcus Adams - Energy Systems Research Fellow at the University of Nottingham
Decarbonisation roadmap for the UK ceramics industry - hydrogen initiatives	Lee Brownsword - Associate Director of Industrial and Environmental Policy at Ceramics UK
Firing critical ceramic material in hydrogen atmospheres	Noor Ali - Group Business Development Director at Lucideon
Materials challenges for hydrogen in aerospace	Louise Gale - Materials Specialist at Rolls-Royce
14:45 - PANEL DISCUSSION	
15:10 - BREAK	
15:30 - SESSION 3 FUTURE TRENDS AND COLLABORATION	
Introduction by session chair	Chris Scales - Head of the Centre for Asset Integrity at HSE
Materials for end-to-end hydrogen	Robert Sorrell - Independent Technology and Policy Advisor at the Henry Royce Institute
Overview of the UK-HyRES project with focus on materials	Alasdair Campbell - Senior Lecturer at the University of Sheffield and Co-Investigator on the UK-HyRES project
Overview of the HII project with a focus on materials	James Hunt - Future Propulsion Lead at the Advanced Manufacturing Research Centre
Overview of the HCN project with a focus on materials	Timothy Davies - Aerospace Test Infrastructure Lead - Hydrogen Capability Network (HCN) at the Aerospace Technology Institute
16:35 - PANEL DISCUSSION	
17:00 - CLOSING REMARKS DAVID JOHNSON - DEPUTY CHIEF SCIENTIFIC ADVISER AT HSE	

SPEAKER BIOGRAPHIES



David Johnson

David is the Deputy Chief Scientific Adviser at the Health and Safety Executive. With a career spanning 15 years at HSE, he joined as a Materials Scientist in 2008, and has since undertaken a range of scientific and technical leadership positions at its Science Division based at HSE's Science and Research Centre in Buxton, UK. Prior to joining HSE, David worked in private industry, primarily in the defence and aerospace sectors, for organisations such as MBDA and Cobham.



Prof Paul Monks

Professor Paul Monks is the Chief Scientific Adviser (CSA) for the Department for Energy Security and Net Zero (DESNZ). As CSA, he delivers independent and impartial scientific advice to Ministers and policy makers across the DESNZ portfolio. Paul also works closely with the Government Chief Scientific Adviser, other Departmental CSAs, and the department's Chief Economist, to strengthen the links within and across departments, encouraging effective engagement and knowledge sharing and to support delivery of a robust evidence base to underpin DESNZ policy decisions. Prior to joining the department, Paul was Pro-Vice Chancellor and Head of College of Science and Engineering at the University of Leicester, where he remains a Professor in Atmospheric Chemistry and Earth Observation Science.



Prof David Knowles

Professor David Knowles joined the Henry Royce Institute as its CEO in early 2019, bringing with him a wealth of experience from senior roles in both academia and industry in the areas of materials and structural integrity. David is particularly experienced in leading the collaboration between higher education and industry, to accelerate energy sector-related research, knowledge transfer and implementation.

David is a Fellow of the Royal Academy of Engineering, a Professor of Nuclear Engineering at Bristol University and was Co-Director of the South-West Nuclear Hub and an Atkins Fellow. Through his career he has lead materials research at Shell Global Solutions, served as CTO at Quest Integrity (operating throughout Australasia and SE Asia) and lectured at Cambridge University; collaborating with Rolls-Royce as Assistant Director of their Ni-alloy UTC.

In recent years, David has led industrial projects related to design and assessment of renewable energy offshore structures, oil and gas and nuclear plant. He holds and participates in several EPSRC/Innovate grants and is the PI on 'SINDRI Prosperity Partnership' which is developing cutting-edge digital technology for nuclear plant design and assessment. He has a strong interest in sustainable use of materials and the application of advanced materials in tackling the transition to net zero, with a particular focus on the hydrogen economy.



Shengqi Zhou

Shengqi Zhou is a Senior Scientist in the Electrochemistry Group at NPL. He leads research activities in corrosion and environment induced cracking in energy applications, with a particular focus on CCUS and hydrogen. He is a Fellow of ICorr and IOM3 and the author of over 80 publications.

Tim Illson



Tim Illson has worked in industrial corrosion control for more than 35 years and is presently involved in consultancy for a wide range of hydrogen and CCUS activities and renewables infrastructure. Specific areas of technical expertise include pipeline repurposing studies (H₂/CO₂), corrosion control and materials selection for hydrogen and CO₂ pipelines, test programme development for validating hydrogen materials, corrosion of wind turbine structures, cathodic protection of monopile interiors and offshore and onshore coating systems.

Dr Bernadette Craster



Dr Bernadette Craster has worked as an industrial research scientist on topics connected with the transport of fluids and gases through inorganic and organic polymeric materials since 1989.

In 2012 she joined TWI Ltd, near Cambridge, from a position in Canada. Bernadette has championed the development of a permeation facility where transport studies are carried out using complex fluid mixtures at temperature and pressure.

As a published scientist working with a large membership base internationally, she has held the title of Technology Fellow (polymeric materials and ageing through permeation processes) since 2018. The permeation of hydrogen through thermoplastics and thermosets contained in products has been of interest to the Members.

The activity on hydrogen builds on TWI's experience with charging of hydrogen in metals and the associated embrittlement mechanisms. In 1946, the forerunner of TWI, the British Welding Research Association, was established to address industrial challenges in the adoption of welding, which included hydrogen cracking.

SPEAKER BIOGRAPHIES



Marcus Walls-Bruck

Marcus is Head of Hydrogen Technologies at the National Composites Centre, and Chief Engineer for the Hydrogen Innovation SEED Programme. With an initial focus on composites for the hydrogen economy, Marcus has since built a broad knowledge base of the wider hydrogen ecosystem and challenges.



Andrew Douglas

Andrew Douglas is a Fellow of the IOM3 and the Material Engineering Group Manager of James Walker & Co LTD. In this role he is responsible for polymer compound design, material testing, seal failure analysis, authorship of standards and specifications and direct customer support.

He has co-authored and presented multiple papers on the subjects of low temperature sealing, seal lifetime prediction, sealing hydrogen, RGD resistance, elastomers in the nuclear industry and the behaviour of high performance elastomers in sour environments on behalf of both JW and the European Sealing Association. Andrew is a member of several BSI technical committees focussing on polymeric materials.



Mark Eldridge

Mark Eldridge is Director of Hydrogen for Element Materials Technology, a TIC global network of 280 laboratories, supporting customers from early R&D, regulatory approvals to production. Element's Hydrogen services span the value chain addressing modelling, gaseous and liquid forms ensuring applications are safe, compliant, and fit for purpose. www.element.com



Cameron Blackwell

Cameron Blackwell is a Senior Research Engineer at the HVMC Manufacturing Technology Centre, in the Material Technology team. Here he leads the MTC's capability development programme for hydrogen technologies and is supporting activities in the Hydrogen Innovation Initiative, leading the work package on cryogenics and supporting the Foresight team. He is also seconded into the Aerospace Technology Institute's Hydrogen Capability Team, supporting the team in their work to define innovation programmes to drive the development of UK cryogenic hydrogen capability.



Stuart Hawksworth

Stuart leads HSE's Centre for Energy and Major Hazards and has over 25 years' experience in the area of major hazards, many of these focusing on the safety of hydrogen as an energy vector. Stuart is also the Past President and Honorary Member of the International Association for Hydrogen Safety; Task Leader in the European Hydrogen Safety Panel and advisor to the EPSRC Hydrogen and Fuel Cells Supergen Project.

Marcus Adams

Marcus Adams is a Senior Research Fellow at the University of Nottingham. His work focuses on solid-state hydrogen technologies, specifically metal hydrides (MH) for use as hydrogen storage, hydrogen compression and thermo-chemical energy storage. He specialises in system and reactor design for MH vessels and research approaches into bringing solid-state hydrogen technology into industry.



Lee Brownsword

Lee has worked at Ceramics UK (formerly known as the British Ceramic Confederation) for the last 10 years, representing the technical interests of UK ceramic manufacturers. With 20 years' experience working across climate, energy and environmental regulation for industry, unsurprisingly Lee's main focus is currently around decarbonisation and assisting members through a range of support activities.



Noor Ali

Noor is the Group Business Development Director of Lucideon, a material science consultancy based in Staffordshire UK. As well as leading the global commercial activities of Lucideon since 2019, Noor was involved in the industrial and speciality gases business for 24 years in technical and commercial roles, including the production, supply and use of hydrogen. He was involved in the HyDeploy 2 project regarding the firing of industrial and advanced ceramics in a 25% hydrogen in natural gas mix.



SPEAKER BIOGRAPHIES



Louise Gale

Louise works as a Materials Specialist for Rolls-Royce Plc focusing on the development of materials for net zero. In particular, she is the materials lead for Rolls-Royce's hydrogen burning gas turbine engine demonstrator program. Previously she has worked on the development of ceramic matrix composites for civil aerospace applications.

Chris Scales



Chris leads HSE's Centre for Asset Integrity with a focus on delivering a number of major shared research projects between HSE and industry into Corrosion Under Insulation and Engineered Composite Repairs.

Chris has over 30 years of sector and regulatory expertise and experience in metallurgy, welding and corrosion.

He began his career working in a number of materials engineering roles in the private sector, before joining HSE, where he has spent the last 10 years regulating Great Britain's offshore oil and gas industry as a Specialist Inspector in materials and corrosion within HSE's Energy Division.

As well as ensuring Operators complied with Major Accident Hazard regulations, his remit also included helping to develop the government's regulatory framework for net zero-related energy technology.

Having spent a number of years sitting on the MoD's Defence Standards Corrosion Committee, Chris is currently involved in the HOIS (Inspection) JIP and the Energy Institute's Corrosion Management and Asset Integrity Committee, as well as being Chair of The Welding Institute's Process and Pressure Systems Technical Group.



Robert Sorrell

Bob is chair of the NPL Science and Technology Advisory Committee (STAC) as well as a non-executive Director. He chairs the Campaign for Science and Engineering (CaSE) and the UK Research Partnership Investment Fund. Bob is the Royce Hydrogen Challenge Lead and CEO of the Royce Hydrogen Accelerator. He is a Strategic Advisor to the National Centre for Universities and Business. Prior to that he held various senior technology roles at bp.



Dr Alasdair Campbell

Dr Alasdair Campbell is a Senior Lecturer in Chemical and Biological Engineering at the University of Sheffield, with an interest in the modelling of reactive flows. He is a Co-I in the UK-HyRES Hub associated with the cross cutting theme on safety.

James Hunt

As Future Propulsion Lead, James is working with the AMRC's industrial partners to address the manufacturing challenges around the implementation of technologies to deliver zero carbon emission transport. With over 20 years' experience of cross sectoral applied research in the field of materials and manufacturing, James has delivered several IUK and ATI funded programmes, providing technical support and programme management. He was the author of a manufacturing capability review of LH2 storage tanks for the ATI's FlyZero programme.



Timothy Davies

Timothy Davies is currently a test infrastructure specialist in the Hydrogen Capability Network team at the Aerospace Technology Institute. This role is seconded from Rolls-Royce and is driving the case and requirements to invest in cryogenic hydrogen test capability in the UK.

He is a chartered mechanical engineer and has 20 years' experience in Rolls-Royce, as an aerospace test specialist, leading engineering product development on the Trent 1000 jet engine and leading the fan and compressor research portfolio.



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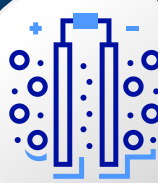


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HSE's Safe Net Zero solutions integrate health and safety into the development and deployment of the new and novel technologies underpinning the UK's decarbonisation activities. We combine our regulatory insight, our world class science and engineering capabilities and our experience, learned from over a century of accident analysis, process safety development and major accident hazard and risk management, and apply it to the deployment of new technology, or novel use of existing technology, with the aim of making the transition to net zero as safe as possible, as fast as possible.

Contact us for help with new energy technologies

If your business is based in the energy sector and you'd like to benefit from HSE's expertise to design in health and safety for new and innovative energy technologies, please visit:

<https://solutions.hse.gov.uk/safe-net-zero>



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