Advanced Materials and Manufacturing Research for Energy, HealthCare and Nuclear Technologies

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iHRS
Innovation in Hydrogen Research and Sustainability

Advancing sustainable materials and manufacturing innovation through applied research, education, and global collaboration, empowering communities to transform industries and society.

IHRS Research Portfolio

- Unsustainable, Expensive and Energy-Intensive Materials and Manufacturing technology.
- Material Degradation (Embrittlement and permeation) and Safety Risks.
- Poor Circular Economy Integration into the fabrication of H2 Storage and Pipelines system.

Background and Challenges to meet UK's 10 GW and EU's 20 million tonnes H2 by 2030

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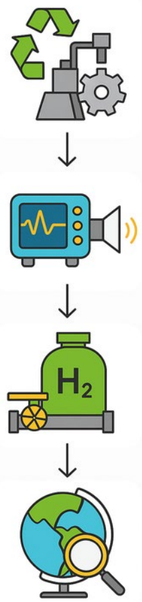
Strategic Goal

To develop Sustainable Advanced Materials and Manufacturing Technology that enable safe, durable, and affordable hydrogen storage and transfer engineering solutions for accelerating hydrogen economy.

Current Research Themes

- Hydrogen storage/Transfer materials .
- Fully Recyclable Graphene -reinforced metal matrix composites (MMCs).
- Net -Zero Advanced manufacturing (Energy Efficient processing and additive manufacturing) .
- Life cycle assessment (LCA), Improving sustainability practice and Circularity .
- Multiscale and Multiphysics Modelling of Advanced Materials and Manufacturing .
- Data -Driven Modelling, Gen AI and Machine Learning for Eco-friendly Composites Design and Monitoring .
- Hydrogen Materials Compatibility and Failure Modelling . (Embrittlement, Permeation and Durability) .



Advancing the Economy and Society

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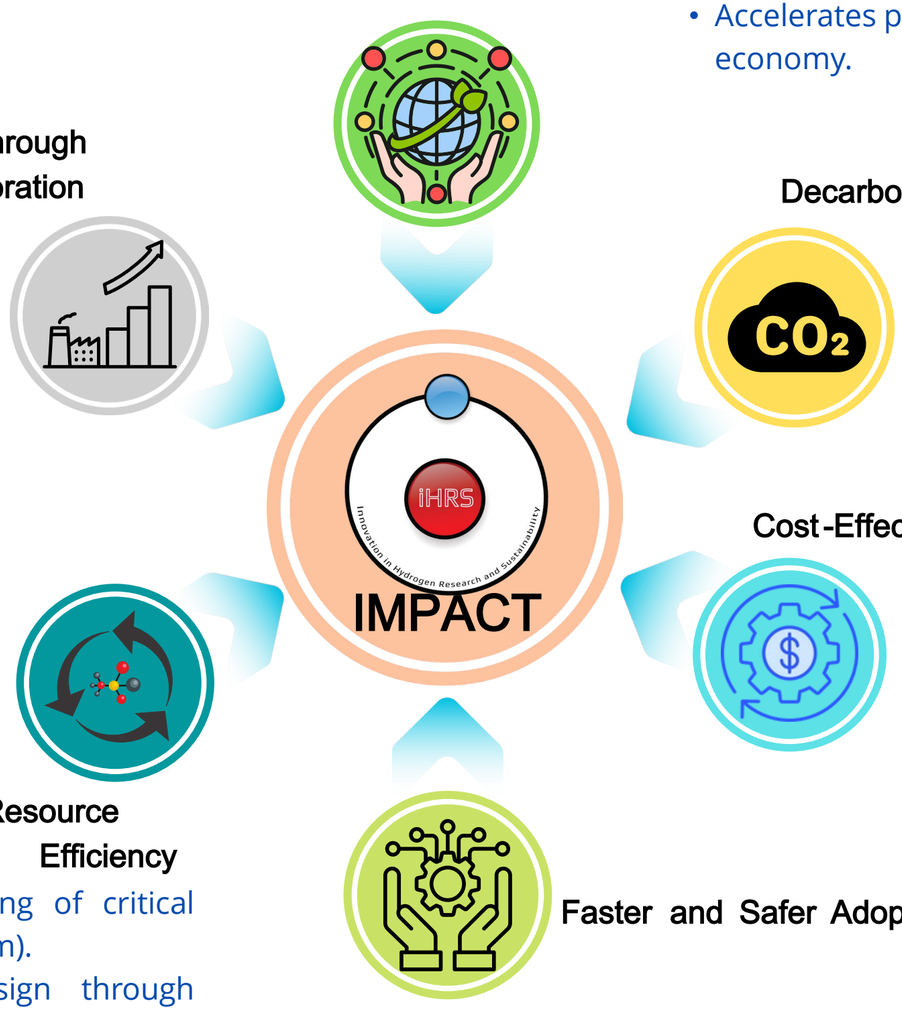
Alignment with National and Global Climate Goals

- Directly contributes and Supports the Uk's Hydrogen Targets of GW low-carbon hydrogen capacity (10 GW by 2030; 25 GW by 2045).
- Accelerates progress towards Net Zero 2050 and the global hydrogen economy.

Socio-economic Growth through Industrial Collaboration

- Builds partnerships with industry leaders (BOC, Wefco, GKN H2) to inform practical innovation.
- Drives policy reforms and standardization to support hydrogen deployment.
- Enhances skills development and workforce training for the hydrogen sector.



Decarbonization of Industrial Systems

- Reduces energy consumption by 30% in hydrogen storage and transfer.
- Improves material performance under hydrogen exposure, increasing safety.
- Achieves a 12% reduction in CO_2 emissions, contributing to cleaner industry.

Cost-Effective and Scalable Hydrogen Technologies

- Develops affordable storage and pipeline solutions with CAPEX and OPEX reductions.
- Scalable delivery with >50 tons capacity per site, enabling commercial readiness.
- Infrastructure planning for deployment in critical locations such as airports by 2030.

Innovation in Circular Economy and Resource Efficiency

- Promotes recycling and repurposing of critical materials (aluminium, copper, lithium).
- Enables sustainable product design through resource recovery.
- Reduces the overall environmental footprint of hydrogen technologies.

Faster and Safer Adoption in Key Sectors

- Supports the integration of green hydrogen in civil aviation, marine, and off-road vehicles by 2040 in Uk and globally.
- Contributes to a safer hydrogen value chain with robust materials and design innovation.

UoC and IHRS Future Research Direction

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Clean Energy

Smart manufacturing/Industry 4.0

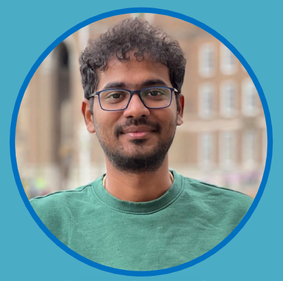
- Battery Technology
- Renewable -Energy Innovation
- SM2 Research for Nuclear
- SM2 Research for Green H2
- Smart Industry & Manufacturing

@Institute of Engineering, Computing and Advanced Manufacturing

UoC iHRS Hydrogen Technology Team

Group for Innovation in Hydrogen Research and Sustainability

Group Lead



Ashwath Pazhani

Assistant Professor (Lecturer) of Mechanical and Materials Engineering

Ali Hassan

Associate Professor (Senior Lecturer) Digital Manufacturing

Jamie East

Assistant Lecturer Electrical and Electronics

Andrew Southam

Assistant Professor (Lecturer) Computer science and AI

IoECAM, UoC Leadership and Mentorship Team

Zulfiqur Ali

Pro Vice Chancellor (Research and Knowledge Exchange)

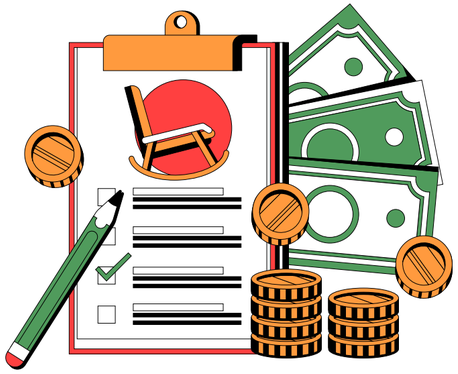
Kate Dixon

Deputy Director of Institute of Engineering, Computing and Advanced Manufacturing

Matt Ryder

Principal Lecturer in Engineering

Funding Plans and Current Proposals



- EPSRC - Responsive mode and Strategic Infrastructure
- ERC – Proof of Concept
- Hydrogen Europe Research (HER) - Storage and Distribution themes
- Innovate UK, UKIERI and HyRES/HI-ACT
- USA Funding

- **EPSRC- Strategic Infrastructure Grant Under Development**

1. **Project BEAM** - Barrow Engineering, Advanced Materials and Manufacturing facility based at Barrow Campus **(£ 2-3 Million) (2026-2027)**

- **Hydrogen Europe Research (HER) - Storage and Distribution themes (€ 4 Million) (2026)**

1. TC2-01 - Development of mined, lined rock cavern for hydrogen storage
2. TC2-01 - Affordable, Safe and Sustainable aboveground medium to large GH_2 storage)

- **Innovate UK, UKIERI and HyRES/HyACT (£ 1 Million) (2027)**

1. Innovation in Eco-friendly Composite Research for Sustainable Energy -Hydrogen production and Storage **(Innovate -HPS)**
2. Development of an Innovative Technology for Accelerated Additive Manufacturing Processes with Sustainable energy efficiency – **(DITAC-AM)**

Project -BEAM (Structure and Purpose)

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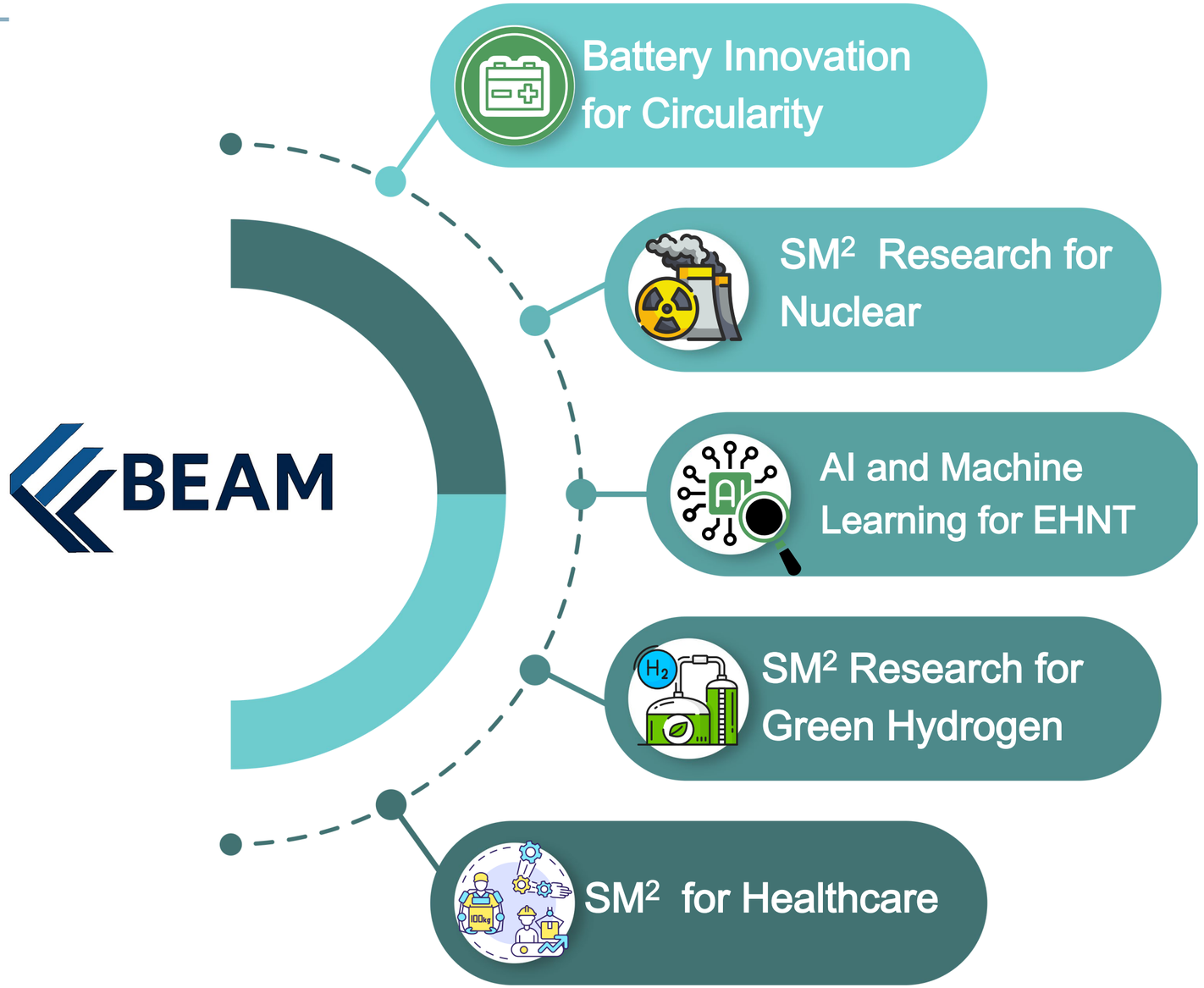
UKRI Science and Technology Facilities Council

LIVERPOOL JOHN MOORES UNIVERSITY

NHS North Cumbria Integrated Care NHS Foundation Trust

HERIOT WATT UNIVERSITY

Aston University BIRMINGHAM UK



SM² - Sustainable Materials and Manufacturing

EHNT - Energy, HealthCare and Nuclear Technologies

Current Academic and Industry partners

UNIVERSITY OF LEEDS

Science and
Technology
Facilities Council

Hydrogen is Future

Questions?

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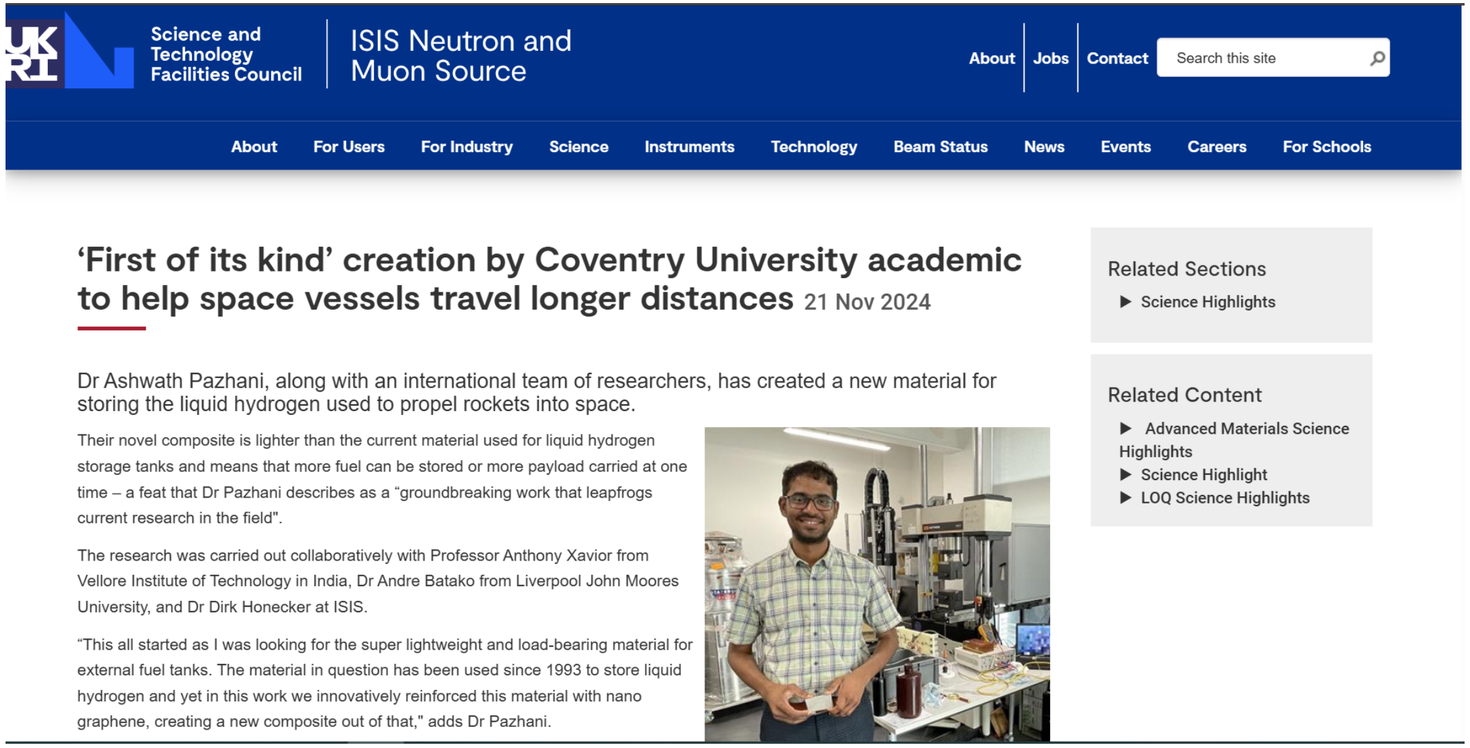

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‘First of its kind’ creation by Coventry University academic to help space vessels travel longer distances 21 Nov 2024

Dr Ashwath Pazhani, along with an international team of researchers, has created a new material for storing the liquid hydrogen used to propel rockets into space.

Their novel composite is lighter than the current material used for liquid hydrogen storage tanks and means that more fuel can be stored or more payload carried at one time – a feat that Dr Pazhani describes as a “groundbreaking work that leapfrogs current research in the field".

The research was carried out collaboratively with Professor Anthony Xavior from Vellore Institute of Technology in India, Dr Andre Batako from Liverpool John Moores University, and Dr Dirk Honecker at ISIS.

“This all started as I was looking for the super lightweight and load-bearing material for external fuel tanks. The material in question has been used since 1993 to store liquid hydrogen and yet in this work we innovatively reinforced this material with nano graphene, creating a new composite out of that," adds Dr Pazhani.

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