AMRICC

A YEAR IN REVIEW 2024

Accelerating knowledge and collaboration in advanced ceramics across the UK

The AMRICC Centre is an open-access facility

www.AMRICC.com

Welcome to the 2024 AMRICC Year in Review

2024 has undoubtedly been a milestone year for AMRICC.

Although AMRICC has existed for almost a decade now, 2024 has in many ways been the year that we have put down our roots and established ourselves as a hub for companies to seek technical support on their product development and commercialisation journey.

Of all of our achievements in 2024, the most notable is the official opening and launch of The AMRICC Centre - the UK's Centre of Excellence for Advanced Ceramics.

The cutting-edge equipment suite here at our site in Stone combines capabilities from powder processing, forming, sintering, and testing, all the way through the manufacturing process, and all in one co-located facility.

We also revamped our website at amricc.com, bringing it in line with the our new location and providing a location to host our other largest project of the year: The AMRICC Academy. In line with the UKRI SIPF funded Midlands Industrial Ceramics Group's (MICG) programme "Midlands Advanced Ceramics for Industry 4.0", one of the core goals of AMRICC is to strengthen the materials science talent pipeline.

The AMRICC Academy supports this outcome by developing courses which aim to directly address the skills needs of the sector and providing easy access to a wide array of courses developed both in house and by valued training partners.

By providing open access to technology that would not normally be available to the industry, organisations are able to trial new products at commercial pilot scale, so helping to de-risk the use of new technologies much more quickly.

It's a unique facility in the UK, which has been on an exciting journey over the last 12 months, with the support of our members and the wider community.

Our customers trust us with delivering large-scale collaborative projects that impact the whole ceramics sector and move us into the future.

I hope you enjoy this year's report.

Cathryn Hickey, CEO, AMRICC

2024 KIT INSTALLATION

Cold Isostatic Press

Following its installation at The AMRICC Centre in January, the Cold Isostatic Press (CIP) was immediately put to work on a range of commercial projects and will help clients understand optimal processing route for these parts produced using this equipment in the future.

CMC Sintering Furnace

In February, Midlands Industrial Ceramics Group (MICG) member company CDS Group designed, built, and installed a custom-specified large electric furnace suitable for the production of ceramic matrix composites (CMCs) at The AMRICC Centre.

As part of the design, a novel heating element positioning was developed to enforce uniform temperature over a large volume hot zone, and three separate viewing ports were installed to permit the real-time tracking of material distortion and enable analysis through machine learning.

"The extra-wide ceramic kiln is a showcase of both CDS' expertise in furnace design and The AMRICC Centre's commitment to innovation. The kiln is designed for firing wide CMC products to AMS 2750 Class 4 at 1200 °C and is controlled over a total of 6 heating zones.

As a member of the Midlands Industrial Ceramics Group (MICG), CDS Group has a positive relationship with AMRICC. We are very grateful for their support in allowing us to showcase this R&D project at their facilities."

Jason Dainty, Technical Sales Director, CDS

Autoclave

OLMAR installed our autoclave in February, enabling us to trial the sintering of large parts at high pressure, scaling up to 1.4 megapascals. This enhanced capability allows our clients to trial forming processes for advanced materials such as composites, where other more conventional forming methods may be insufficient. The autoclave enables the controlled consolidation and drying of CMC parts, minimising voids in the structure. It also makes use of internal thermocouples, giving our customers the ability to monitor the temperature of the sample during heating and allowing for greater control over the process.

2024 KIT INSTALLATION

Large Hydraulic Press

Installed by Stenhøj in May, the large-scale hydraulic press adds to the list of ceramics forming equipment accessible to our customers.

With a programmable pressure range of 2 to 200 tonnes and high capacity we are now able to trial new products and produce large samples accurately.

Hot Isostatic Press

Hot Isostatic Pressing is a manufacturing process that uses incredibly high temperatures and pressures to increase the density and reduce the porosity of materials, altering and improving their mechanical properties.

Our press, built by American Isostatic Presses (AIP) and installed in June, is capable of exerting pressures of up to 310 megapascals and reaching temperatures of 1400 °C using a molybdenum liner or 2000 °C using a graphite liner.

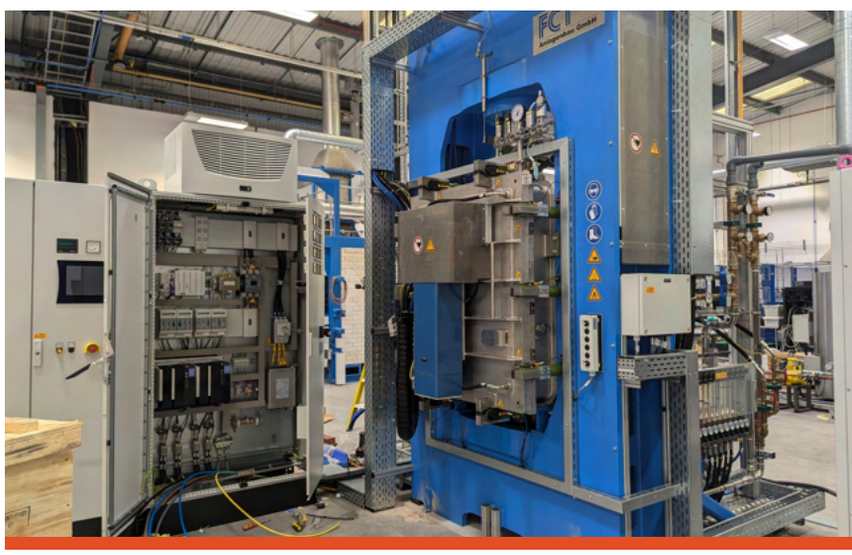
These extreme conditions allow for the full densification of advanced ceramic parts, producing components with high reliability that are suitable for use even in exceptionally harsh environments.

Hot Press

Our hot press was installed in July. Hot pressing is used to densify materials through the application of uniaxial pressure under elevated temperatures, and is particularly suitable for the fabrication of advanced ceramics.

The heat and pressure causes the material to fit a mold, resulting in a dense and uniform product.

The process allows for the manufacture of complex shapes that would be challenging to replicate through other methods.



LAUNCH OF THE AMRICC CENTRE

Since the founding of AMRICC as a company in 2016, our top priority has been to establish a suitable home from which we can help our customers to translate materials, processes, and technologies into real-world products and solutions through the commercialisation of innovative ideas. One of the highlights of 2024, therefore, following years of hard work by AMRICC staff and MICG members, was the official launch of The AMRICC Centre and the full opening of its facilities which we marked at an event in February.

The day began with a reception in our atrium, with speeches by our CEO Cathryn Hickey as well as the cutting of the ribbon by then-MP for Stoke-on-Trent Central and Chair of the All-Party Parliamentary Group for Ceramics, Jo Gideon.

The AMRICC Centre launch was attended by some of the most significant figures in UK ceramics, as well as the people who've helped to bring us to where we are today.

Among them were Graham Hillier, Chair of the FISC (Foundation Industries Sustainability Consortium), members of whom are using The AMRICC Centre to pursue projects in three key workstreams: geopolymer scale-up, hydrogen kiln conversion for sustainable ceramics production, and process optimisation within the ceramics industry through the application of sensors, collection of time-series data, and machine learning data processing.

The expertise at The AMRICC Centre was on show during our launch event, with presentations from Gilda Gasparini, Robert Crookes, Mark Dudson and more demonstrating the fantastic work that was already underway at the site on behalf of our customers.

Jo Gideon and Cathryn Hickey

Cathryn Hickey and Graham Hillier

Guests at the launch of The AMRICC Centre

The AMRICC Centre not only fosters research and development but also serves as an educational hub.

A key aspect of AMRICC's mission involves collaborating with universities such as University of Staffordshire to establish an educational facility aimed at training and nurturing the next generation of materials scientists.

This initiative seeks to cultivate a continuous stream of talent, ranging from degree apprentices to post-doctoral graduates, to bolster the ranks of skilled professionals in the UK ceramics industry.

The day concluded with a full tour of the advanced ceramic processing facilities, featuring a tailored range of state-of-the-art equipment built out in an industrial setting.

Our tour guides introduced each piece of kit, giving a flavour of how they are used to serve our customers and improve concepts, products, processes, and technologies.

Jo Gideon and degree apprentice Connor Ayre

NATIONAL COMPOSITES CENTRE EVENT HOSTED AT THE AMRICC CENTRE

In July, The AMRICC Centre hosted a meeting of the National Composites Centre's Ceramic-Matrix Composites (CMC) Working Group at our facility in Stone, Staffordshire. Co-ordinated with Enya Collier of Lucideon and Dr David King of the NCC, the hybrid event was a huge success, with the session followed by lunch and a tour of The AMRICC Centre's co-located Centre of Excellence for Advanced Ceramics.

The event followed the signing of a Memorandum of Understanding between Lucideon and the NCC in 2023, leading to opportunities for collaborations that offer end-to-end capability for developing and exploiting supply chain organisations' technologies and addressing CMC adoption challenges from fundamental materials development through to full system design and validation.

Access to the wide selection of next-generation, high-value equipment at The AMRICC Centre forms a critical component of the end-to-end Ceramic Matrix Composite (CMC) capabilities that constitute the backbone of the two organisations' agreed areas of cooperation.

Enya Collier and Dr David King at the NCC event in July

Equipment such as our autoclave, hot press, and CMC furnace, all co-located at our site in Stone, brings together cutting-edge technology and offers the partners unrivalled opportunities to solve specific materials challenges in an ultra-modern environment.

Our pilot-scale equipment allows for the design and undertaking of end-to-end trial processes including milling, mixing, and slurry characterisation, allowing for the entire production process to be carried out in-house in one location.

"As a world-leading UK research and development facility, and the UK's centre of excellence for composites, the NCC offers a full range of services across the engineering lifecycle. Collaborating with Lucideon and AMRICC means that the NCC can combine its expertise in composite product innovation with cutting-edge high temperature processing knowledge to benefit the UK's extreme temperature engineering challenges including achieving Net Zero flight, hypersonics, and nuclear fusion.

"The facilities at The AMRICC Centre complement our in-house capabilities through their specialist array of high temperature furnaces to process the most demanding material systems. Their advanced ceramics capabilities mean that, between our facilities, we can work with truly end-to-end processes that address the current challenges with CMCs, from fundamental materials development through to full system design and validation."

David King, Capability Lead – Advanced Materials, National Composites Centre

SIPF QUARTERLY MEETINGS HELD AT THE AMRICC CENTRE

The AMRICC Centre had the privilege of hosting several Strength In Places Fund (SIPF) quarterly review meetings through 2024, welcoming Midlands Industrial Ceramics Group (MICG) members to our fantastic new facilities in Stone.

As a UKRI programme, SIPF is intended to reinforce clusters of local strengths in research and innovation by promoting and facilitating collaboration between research organisations and businesses.

The AMRICC Centre, as the legacy of the successful SIPF programme "Midlands Advanced Ceramics for Industry 4.0", fulfils this mission by undertaking work on behalf of SIPF through collaboration between universities and industry. The vision of the SIPF programme is 'Advancing Ceramics', with a mission of bringing economic and social growth for the Advanced Ceramics sector in the Midlands through the acceleration of new product development and of innovation commercialisation.

The quarterly review meetings bring together all of the partners to demonstrate the ongoing commitment to advancing the industrial ceramics sector.

THE AMRICC CENTRE HOSTS FISC'S ECONOMISER QUARTERLY REVIEW

FISC

The AMRICC Centre is a significant facilitator for collaboration, working across organisations and industries to progress technologies quickly from the laboratory, through pilot process and scale-up, to commercialisation. As part of this role, we were delighted to host a quarterly project review meeting for the Foundation Industries Sustainability Consortium (FISC) on the 30th July.

FISC brings together global leaders in innovation, research, and technology from across the cement, metal, glass, ceramic, paper, polymer, and chemical industries. Its purpose is to deliver global innovation in low-carbon resource-efficient sustainable solutions that will help to transform these essential industries that contribute over £50bn each year to the UK economy.

FISC's first project is known as Economic Materials Innovation for the Sustainable and Efficient Use of Resources (EconoMISER) and is funded by Innovate UK as part of the Transforming Foundation Industries (TFI) Challenge.

The programme seeks to support industry and academic engagement in innovation in carbon reduction, process improvement, and product development.

The AMRICC Centre plays a key part in the EconoMISER activities by providing resources and capability for several key project workstreams, including geopolymer scale-up, hydrogen kiln conversion for sustainable ceramics production, and process optimisation within the ceramics industry through the application of sensors, collection of time-series data, and machine learning data processing.

The FISC Partners

cpi · Glass Futures · Henry Royce Institute · Lucideon · Materials Processing Institute

SIR GAVIN WILLIAMSON VISIT

In November, Sir Gavin Williamson, Member of Parliament for Stone, Great Wyrley and Penkridge, met with the AMRICC team to tour the facility and explore the value they bring to both the community of Stone, Staffordshire and the UK as a whole. During the visit, Sir Gavin had the opportunity to see the Centre's latest technology, discuss the future of ceramics, and understand its significance for Stone.

Sir Gavin stated: "I was rather impressed to see the cutting-edge technology and innovation happening at AMRICC. The team's dedication to advancing material science and supporting local businesses is a tremendous asset to Stone, the wider Staffordshire community, and the UK as a whole.

"It is truly inspiring to see how their work is not only driving the future of ceramics but also creating real economic value and opportunities internationally, with benefits for the region in both supply chain and reputation.

"It is clear that AMRICC plays a vital role in the community of Stone, fostering collaboration and turning ground-breaking ideas into tangible impact."

Dr Gilda Gasparini shows Sir Gavin a range of additive manufacturing ceramic components in the SLA Printer room. This room must be kept in controlled lighting conditions due to the photosensitive resin used in the printing process.

MICG MEMBER WORKSHOPS

Advanced ceramics are vital to the UK to unlock the performance of a wide range of innovative technologies including energy-efficient jet engines for aerospace, as well as clean energy systems such as fuel cells and batteries and electronic components for 5G telecommunication.

Throughout 2024, a series of workshops hosted by MICG members provided valuable insight into the role of ceramics in the modern Midlands economy. We were delighted to attend several this year, including one held at the University of Nottingham to celebrate their new MICG membership and organised by Anthony Everitt of ADE Regeneration, who put on a brilliant showcase of how the Midlands is driving forward advancements in the advanced ceramics sector.

Jonathan Phillips, chair of the MICG, said:
"The dissemination event at the University of Nottingham was an opportunity to talk about all the great work that's been happening through our SIPF funding programme, and to share that more widely with the industrial and academic partners that have joined us.

"There's been a fantastic turnout, we've had a lot of interest in using our facilities at The AMRICC Centre, and we've had lots of great discussions and networking.

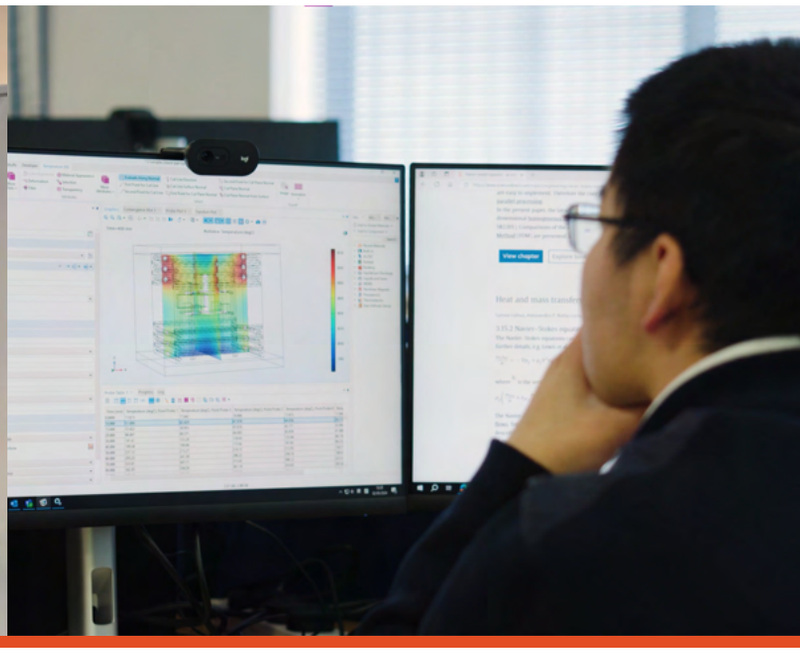
"If you're interested in using our AMRICC facility, or if you've got research that you want to do with us as industrial or academic partners, then reach out to us and we'll be happy to work and have discussions with you."

If you're a manufacturer interested in how advanced ceramics could solve critical technology challenges, or a researcher interested in learning more about the great work being carried out by the MICG, we wholeheartedly recommend keeping an eye out for similar events happening in 2025!

Visit the MICG on LinkedIn through the QR code to stay up to date with the latest announcements

DATA SCIENCE AND MODELLING

by Dominic Wadkin-Snaith, Data Science Business Development Manager, AMRICC



Dominic Wadkin-Snaith - Data Science - BDM

Qihong Jiang, Specialist – Materials and Process Modelling

2024 – A big year for the data science and modelling team, which has seen the team grow in numbers with graduate Paul Zhan joining as a trainee data scientist under the mentorship of senior data scientist Mohamed Boosiri. Alongside this expansion of the data science team, Qihong Jiang has joined our physics-based modelling competency, as well computational materials scientist Dominic Wadkin-Snaith, who leads the group.

Both team members bring with them strong backgrounds in computational modelling in materials science. With these additions, the team now comprises two data scientists and two computational materials scientists.

FISC
Foundation Industries Sustainability Consortium

There has been much progress in the EconoMISER project, created by the Foundation Industries Sustainability Consortium (FISC) following a grant from Innovate UK in 2022. Key clients in the ceramics industry from the surrounding Midlands area are actively working alongside the thriving partnership between the AMRICC data science team and Reliable Insights to begin the transition to Industry 4.0.

At each client manufacturing site, we have installed sensors for the optimisation of process or for the future adoption of Industry 4.0. advanced ceramics.

Another exciting development is the development of Digital Twin technology as pioneered by the University of Leicester team led by Jingzhe Pan. This really has the potential to bring industrial processes such as sintering into the world of Industry 4.0.

Infrared sensors have been positioned to detect air trapped in ceramic green bodies, giving the ability for industry to remove the defective parts before firing. Techniques such as this are vital to reduce wastage and energy usage, where it is not always possible to detect these defects with the naked eye.

Further sensors are placed to measure slurry tank depth, measuring data that is both accessible and in real-time for the team to analyse.
Additionally, sensors for humidity, temperature, load cells and current have been set up in strategic positions within manufacturing sites to collect necessary data for our team's machine learning expertise to work through uncovering vital insights.

Another big development for the data science team at AMRICC is the Computer Vision work. C

omputer Vision is the name of a technology system that offers the ability to observe and distinguish an object from its surroundings - even when that object is in a kiln at a temperature above 1100 °C.

This is made possible through intelligent application of state-of-the-art image processing, enabling the team to differentiate hot objects from their hot environments. Once an image of a part that is sintering is established, AI techniques are used to track a key distance metric that allows for real-time distortion tracking.

This is game changing for the ceramics world, allowing the tracking of part distortion during sintering for the first time.

As well as the data science developments, the modelling team has been busy modelling kilns. This consists of using computational fluid dynamics to predict how temperature would vary inside, for example, a gas-fuelled kiln. This modelling enables the team to predict how sample temperatures evolve during firing processes covering both traditional and advanced ceramics.
Another exciting development is the development of Digital Twin technology as pioneered by the University of Leicester team led by Jingzhe Pan. This really has the potential to bring industrial processes such as sintering into the world of Industry 4.0.

THE AMRICC ACADEMY

Across the ceramics sector, it has long been established that there is a challenge with skills development and training, leading to companies of all sizes struggling to fill their vacancies and retain their talent. In 2021, the Midlands Advanced Ceramics for Industry 4.0, Strength In Places Funding programme (SIPF Wave 2 82148) was launched which aimed, in part, to help address the challenges faced with skills development with a view to address this at multiple levels, from schools and colleges to universities and businesses.

It was quickly discovered, through consulting with the sector within the Midlands region, that there was a requirement to strengthen the training offering for the sector through the development of new and innovative training. This development would allow for training to become more enticing to new generations as well as enhancing the learning experience and ensuring this is accessible for all audiences and learning needs.

From this, the idea of The AMRICC Academy was born. Utilising the many years of expertise within the sector, The AMRICC Academy has developed courses which aim to directly address the skills needs of the sector and provide easy access to a wide array of courses developed both in house and by valued training partners.

These courses and The AMRICC Academy will be launching publicly within 2025 so that the sector can benefit from the expert training on offer.

"The AMRICC Academy has the potential to make a real difference to the current and future workforce which I find to be an exciting prospect.

"Training and education are often considered low priorities within businesses, as the focus is usually on delivering commercial projects. However, investing in your workforce to upskill them is something I am very passionate about as it helps to ensure you have a workforce that is thriving.

"Being able to play a part in this journey to support the current workforce through The AMRICC Academy is something I am incredibly grateful for, and I can't wait to see the impacts this has on the overall skills gaps and challenges being experienced within the sector. "

Sophie Hartless, Business Manager – The AMRICC Academy

"In today's rapidly changing business landscape, partnerships cannot be overstated. Building meaningful connections has become a cornerstone for sustainable growth and innovation.

"Partnerships are not merely about collaboration. They represent opportunities to share knowledge, align strengths, and co-create value. I think this is really important in the training field. Because of cross-knowledge, our partnership can offer our clients the best possible training - through direct collaboration with others - in various domains.

"As the one in charge of CTA Ceramic Technology Academy, I think that the collaboration with the Academy AMRICC is an important step to unlock potential and lead to remarkable achievements. When companies connect with multiple topics and entities they expose themselves to new concepts methodologies and markets.

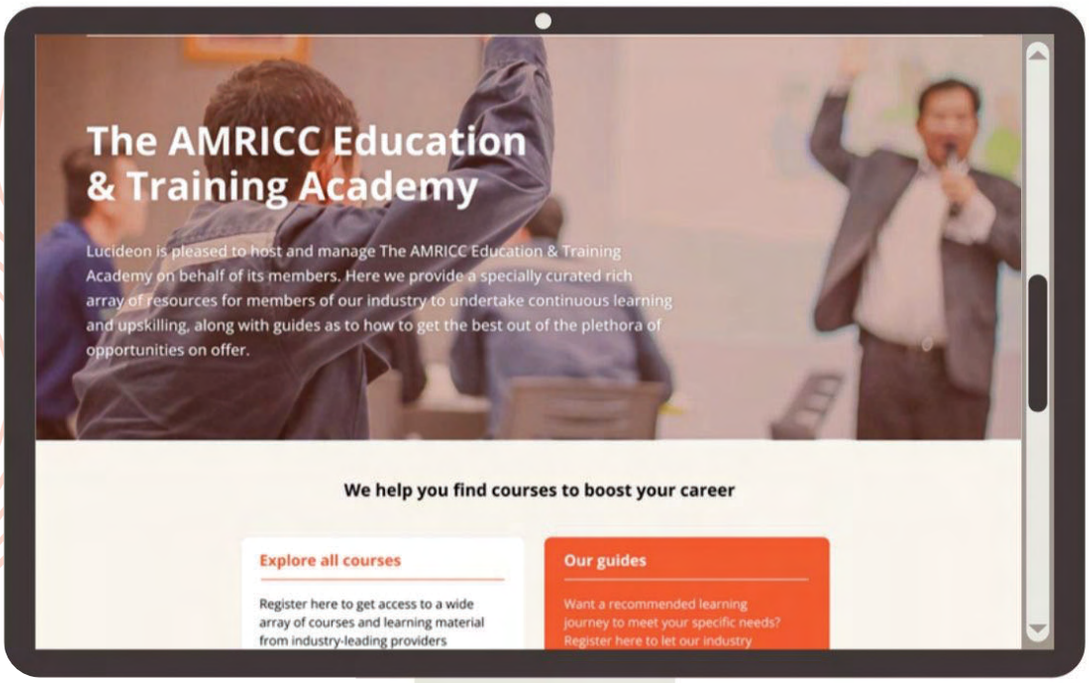
"By working together and building bridges we position ourselves—and our partners—for a brighter, innovative and more successful future."

M.Luisa Savigni,
Project Manager,
CTA, Ceramic Technology Academy

CERAMIC TECHNOLOGY ACADEMY

WHAT'S NEXT?

Further courses being developed through The AMRICC Academy currently are focused upon topics that have been identified as being needed by industry.



Preview of The AMRICC Academy website, due for launch in Spring 2025

Due to the current workforce often being recruited from a non-ceramics background, it has been highlighted that there is a pressing need for training which provides an overview of ceramics and advanced ceramics to ease the recruits into this field of work.

One of the main courses in development is therefore an Introduction to Ceramics and Advanced Ceramics course which aims to provide the user with a guided journey through the background of the techniques used in traditional ceramics and how these are used as the foundation for advanced ceramics. This course is aimed at those with little to no ceramics knowledge so this could be for new recruits from a different background, customers who want to learn more about how ceramics could help their business, or apprentices who are just starting out and want a leg up on this knowledge.

Another pressing need of the industry is the need for an understanding of data science, machine learning, and computational modelling. As elements of Industry 4.0 are being adopted, there is an increasing need for data driven solutions within processes to help drive optimisation.

To help address the skills gap in this area, The AMRICC Academy is developing a range of courses focused on understanding these topics in relation to ceramics and materials science to aid in the adoption of these techniques through understanding how they can be applied to the sector.

In addition to the courses being offered through The AMRICC Academy directly, we also have training partners who are able to provide further courses in these areas to provide a wider understanding of the techniques themselves, not just how these apply to our sector.

The list of topics we aim to cover is ever-growing, so if there is an area of interest that is not represented here, get in touch using the QR code below and we would be happy to discuss how we can include this within our offering.

www.amricc.com/education/training-expression-of-interest

NEXT GENERATION

Degree Apprenticeships Introduction

AMRICC has led the development of a degree-level apprenticeship programme in material science to plug the vocational skills gap identified by manufacturers in need of a skilled workforce going forward, annually recruiting candidates to fill the position of Apprentice Materials Technician for the newly-launched AMRICC Centre.

The apprentices gain foundation science and engineering skills through time spent with specialist materials and testing teams and personnel across the business, working with experienced instructors to complete both theoretical and practical activities.

2024 has been an excellent year for our apprentice cohort, and it's been a pleasure to see such a talented group receive recognition for their outstanding achievements.

Degree Apprenticeships offer an exceptional pathway for students to gain both academic knowledge and hands-on industry experience. This integrated approach ensures that apprentices develop practical skills directly aligned with industry needs, making them highly employable upon graduation. By combining rigorous academic study with real-world application, Degree Apprenticeships prepare students to make meaningful contributions to their chosen fields from day one.

"The University of Derby has proudly partnered with AMRICC since 2022 to deliver the Materials Science Technologist Degree Apprenticeship programme. This collaboration has enabled students to engage with cutting-edge materials science and industry innovations, ensuring they receive a comprehensive education grounded in practical experience.

"AMRICC is an outstanding partner due to its commitment to research excellence and industry relevance. Their state-of-the-art facilities and expert mentorship provide our apprentices with unparalleled opportunities to apply theoretical concepts to real-world challenges, fostering innovation and professional growth.

"It is truly inspiring to see our apprentices excelling in their fields. Katie Hadley's recognition as the Rising Star at the Apprenticeships and Skills Awards, Connor Ayre and Ethan Ellis sharing their insights at the Future of Work conference, and Ethan and Amin Damena presenting at the prestigious FORGE conference hosted by the Royal Society of Chemistry are remarkable achievements. These successes highlight the strength of the programme and the positive impact of our partnership with AMRICC."

College of Science & Engineering,
University of Derby

> "We look forward to continuing this valuable collaboration and celebrating the future successes of our apprentices."

College of Science & Engineering,
University of Derby

AMRICC APPRENTICE KATIE HADLEY WINS WEST MIDLANDS 'RISING STAR' AWARD

We were absolutely over the moon in November as our very first apprentice, Katie Hadley, won the Rising Star award for the West Midlands at the Apprenticeships and Skills Awards.

Katie was the very first level 6 apprentice taken on at The AMRICC Centre in 2022, and since then has become an incredibly valued member of our team. Katie's role involves exploring various facets of materials science for our clients, conducting experiments, 3D printing, powder processing, and sintering. She operates advanced equipment unique in the UK and is essential in both running experiments and contributing to technical reports.

"I am incredibly grateful to my place of work and to my colleagues for their belief in my abilities and potential. The experience was truly unforgettable, and it shows the invaluable support and opportunities provided by my apprenticeship journey with AMRICC."

Katie accepts the award at the ceremony in Birmingham

INTERNSHIP TESTIMONIAL

HENRY: GENERAL ENGINEERING, DURHAM UNIVERSITY

I wanted to take on a summer placement because within Engineering you need a large and broad range of knowledge. A place like AMRICC that has so many different fields happening at the same time really helps to train you and give you that knowledge.

In this role, it was my responsibility to calibrate a WASP robocaster using a new paste. This paste was formulated in-house, and was using more sustainable materials than conventional formulations. The reason we wanted to calibrate this WASP was that this paste has a different rheology and material properties from any paste that we have used before, so the same setting will not produce the same results; we therefore needed to work out which settings would work best.

I've learned a lot about rheology and the science behind ceramics – from an Engineering perspective I was never quite as interested in the materials science, I was more focused on the machines and how they were doing what they were doing, but as I said, General Engineering requires a broad knowledge that gives you a strong basis across many different areas.

I was quite surprised at how much AMRICC trusts the apprentices and how much machine time I got. It's been great to have this trust, to use the machines, and to build a confidence that wasn't there before.

Henry at work on the robocaster

In terms of professional development, it's certainly clarified that I want to work within the scientific field; it's nice to be able to work in the labs and it doesn't feel like you're working a lot of the time – it quite often feels like you're doing what you want to do. It's definitely given me experience and knowledge towards which path I want to choose.

It's definitely given me an insight into how projects are managed; there is a lot of design work at my university, they try to make half of our learning focus on design projects, and it's really helped me understand how to be a better project planner and how to ensure that these projects hit their goals on time. That's probably been the best experience I've had from this placement – even if the exact field isn't related to what I'm doing at uni, how they do it and the processes they follow really are, and it's given me invaluable experience.

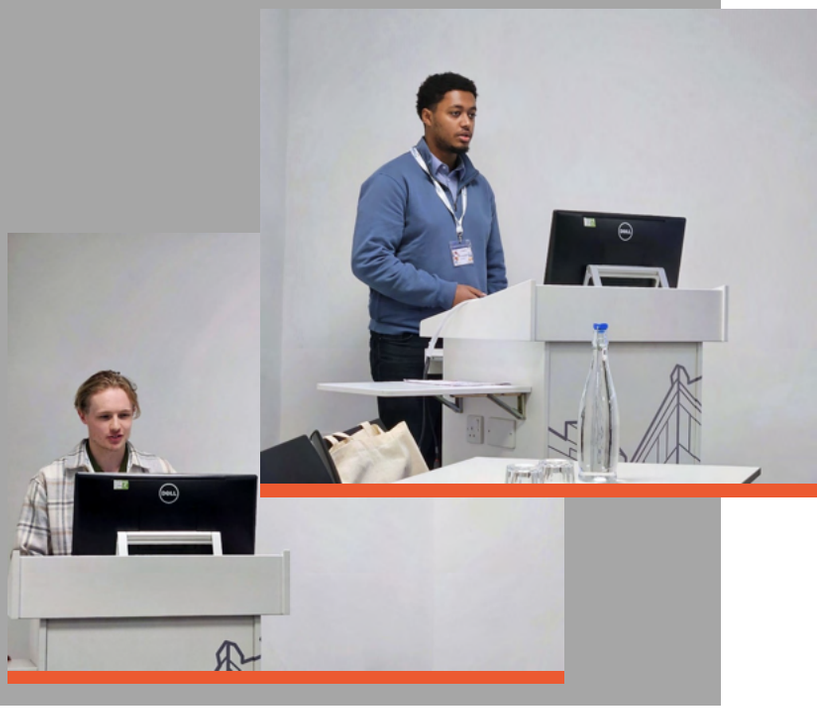
AMIN AND ETHAN AT THE FORGE CONFERENCE

Degree Apprentices Amin Damena and Ethan Ellis both delivered excellent presentations at The Forge 2024 conference, held in November by The Royal Society of Chemistry's Particle Characterisation Interest Group (PCIG).

The Forge 2024 was a two-day event dedicated to knowledge sharing and network building within the particle characterisation sphere, featuring talks by expert scientists with decades of experience.

In such accomplished company, Ethan and Amin excelled, with PCIG member Phil Jackson noting the quality of their presentations and remarking on how well the content showed how strategic use of key particle analysis techniques could be used to support different industrial challenges.

Both apprentices not only delivered their prepared notes, but also fielded questions from PCIG members expertly and confidently.



ETHAN AND CONNOR AT FUTURE OF WORK CONFERENCE

In October, Degree Apprentices Ethan Ellis and Connor Ayre put on a show at the Staffordshire & Derbyshire Future of Work conference, held at the JCB Academy in Rocester. They spoke about how their apprenticeship journeys have progressed in a fireside chat-style interview conducted by Lucideon's Victoria Warren.

Ethan:
"I really enjoy explaining to younger people what materials science is – when I applied for my apprenticeship I didn't really fully understand what materials science entailed, but I took an interest in product design and innovation.

"I deal with a lot of thermal processing. It's a very heavy machinery-based type of work – we can take materials up to three thousand degrees, five times at hot as molten lava, and recently we've used 100% hydrogen to fire ceramics – it's all in my lab, and I'm working on it on a day-to-day basis."

Connor:
"Materials Science is a great route for a career because, fundamentally, everything comes down to materials in one way or another."

"I'm proud of the growth in my career – some of the things I do day-to-day, I don't think I would have thought I'd be able to do them two years ago. Learning new skills, adapting and applying them, giving advice to technical leads and seniors who have years and years of experience who are using my knowledge that I've gained over the past couple of years."

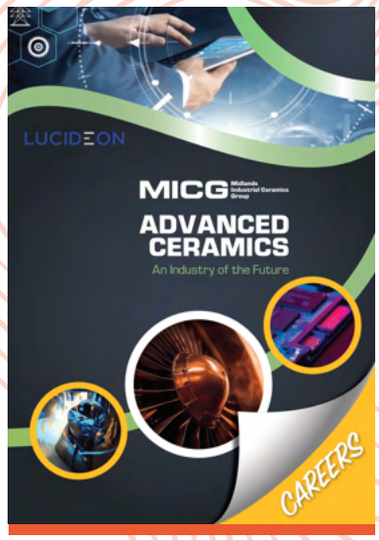
Ethan and Connor are fantastic ambassadors for apprenticeship careers, speaking eloquently and engagingly about the possibilities offered through apprenticeship and playing a huge role in a well-organised and successful event.

A video of the event can be viewed via the QR code.
www.youtube.com/watch?v=DOBwhIXbNdQ

MICG CAREERS BROCHURE

Our partners at the Midlands Industrial Ceramics Group produced a fantastic careers brochure, viewable here:

www.lucideon.com/careers/brochure



What career path links braking systems for Formula 1, replacement hip joints, turbine blades for aircraft, toothpaste, key components for mobile phones, and coatings for spacecraft? Advanced ceramics are used in all of these applications and more!

For young people thinking of a career in science, or anyone looking to move their career laterally or wanting to upskill, materials science education and training is a route to a highly valuable, exciting, and highly rewarding career.

INTAKE 2024

ASFARINA JAMALUDDIN – 1ST YEAR APPRENTICE

Since embarking on my journey here, I have had many opportunities to step out of my comfort zone. I have been involved in multiple projects and work with an exceptional team of apprentices and technicians. It has been an exciting journey so far.
I had the opportunity to work on a European Space Agency project regarding regolith (moon soil) and I have also been involved in research on novel sodium-ion batteries with the Flash Sintering Team. Recently, I have been investigating ultra-high temperature ceramics obtained through sol-gels as well as taking part in scale-up activities within the Flash team. My degree apprenticeship provides me an incredible opportunity for hands on learning with the support of senior scientists.

JACK PYE, AMRICC DEGREE APPRENTICE

I chose this apprenticeship after discovering my interest in materials at college. After seeing the new and exciting things that happen here at the AMRICC Centre I knew it would be a great opportunity to develop myself and my skills. The AMRICC Centre has a wide range of great equipment to use, and I do a lot of work on Flash sintering which I find very interesting. My experience so far has been great, and I have learnt lots of different skills. I have many responsibilities and exciting things to do day to day.

WILLIAM EDGELY – AMRICC DEGREE APPRENTICE

My time here so far has been incredibly interesting. I have spent a lot of time learning new processes, how to use new pieces of equipment, as well as completing my start to my apprenticeship.

Since starting I've worked on a variety of different projects such as Slip Casting and Gel Casting alumina kiln furniture and kiln linings and have been working on a project for alumina-based ceramics for armour applications.

These projects involve learning how to use a lot of new equipment and processes which are very engaging.

NETWORKING EVENT

As well as hosting major industry events at our new home in Stone, Cathryn, Ed, and other colleagues also took AMRICC on the road throughout 2024! One of the premier materials science events in the UK is the annual Advanced Ceramics Show, held at the National Exhibition Centre in Birmingham. For the past few years, the Midlands Industrial Ceramics Group (MICG) has run both a pavilion area and a poster competition, featuring exhibitions from many group members, including AMRICC.

Within the exhibition hall, both The Advanced Materials Show and The Advanced Ceramics Show ran their own dedicated conference sessions tackling the key topics of the day. The programme featured some of the most prominent and engaging leaders and innovators within these industries, enabling attendees to learn how to create better performing products and how to optimise manufacturing processes.

Ed and team at The Advanced Ceramics Show

AMRICC CEO Cathryn Hickey delivered a Chair's Address, highlighting innovations in materials science and collaboration models that could position the UK as a leader in advanced ceramics.

BSBF

AMRICC Business Manager Ed Maynard represented us at Big Science Business Forum (BSBF) 2024 in Trieste, Italy, promoting The AMRICC Centre's open-access international facility and cutting-edge range of equipment.

BSBF is a unique opportunity for businesses and organisations to be fully informed of and get involved in calls and competitions for billions of euros per year managed directly by international Big Science Organisations (BSOs).

BSBF advocates for greater cooperation and coordination between organisations to carry out what they call 'Big Science' - the large-scale collaborative scientific efforts needed to tackle some of the most complex issues facing the world today.

As an international, open-access, one-stop scale-up and technology development facility that's all under one roof, The AMRICC Centre represents a valuable resource for this type of work, and as such we were thrilled to be invited to exhibit there in front of a business-oriented audience focused on high technology and innovation.

BSBF 2024

NATIONAL COMPOSITES CENTRE

EXTREME COMPOSITES

Ed made sure that The AMRICC offering was on full display in November at an event hosted by the National Composites Centre in Bristol, demonstrating how our pilot-scale process development facilities can be used to aid in the development of some of the highest-performance materials around.

The AMRICC Centre is a significant facilitator for the type of collaboration that makes end-to-end process development on high-value, cutting-edge technologies such as composites viable, working across organisations and industries to progress technologies quickly from the laboratory, through pilot process and scale-up, to commercialisation.

Titled 'Extreme Composites 2024: Developing a sovereign supply chain', the event showcased how the supply chain is evolving, and how technological advancements are bringing high-value ceramic matrix composite materials to market. It was great to have an opportunity to visit the NCC itself after hosting their UK Ceramic Matrix Composites Working Group in July – they were as gracious as hosts as they were as guests.

AMRICC OPEN DAYS

Following the array of successful events hosted at The AMRICC Centre throughout 2024, we began hosting a series of regular Open Days at our facility in Stone. Throughout 2025 these will continue, offering guided tours of our brand-new facilities for people and organisations who would like to view in them in person, as well as giving an opportunity to discuss material and process development requirements in more detail.

With the range of options available to you through our centralised facility, you'll be guaranteed to find a solution that works for your product, built out in industrial conditions, in one location.

Visit the link through the QR code and enquire to find out when our next Open Day is scheduled and sign up.

AMRICC WINS CERAMICS UK 'DECARBONISATION TRAILBLAZER' AWARD

In September, we were delighted to win a 'Decarbonisation Trailblazer' award at Delivering Net Zero, hosted by Ceramics UK at the University of Staffordshire. As new members for 2024, it was a privilege to be nominated for this award – one that is of particular relevance for the ceramics sector.

Ceramics manufacturing is a foundation role in various key sectors, such as steel and glass manufacturing, where business incentives and a groundswell of public support are now aligning to reward organisations that take the challenge of tackling climate change seriously.

The experts and equipment at The AMRICC Centre stand ready to help address some of the technological challenges that will inevitably be encountered on the path to decarbonisation. Our colleagues at Ceramics UK, the UK trade association for the ceramics sector, are dedicated to supporting UK manufacturers and suppliers in their pursuit of a more sustainable future.

"[Ceramics UK's] annual Industry Decarbonisation Awards recognise UK ceramic manufacturers / industry suppliers undertaking a range of projects and initiatives in delivering decarbonisation for their company, or supporting the broader ceramic sector.

"In 2024 we were delighted to recognise the Applied Materials Research, Innovation, & Commercialisation Company (AMRICC) as a 'Decarbonisation Trailblazer' highlighting its noteworthy support of innovative product and process research and development, as well as prominent role in cross-sector collaborative programmes and consortia groups.

"Congratulations to all involved and we look forward to seeing what the future holds for AMRICC's innovation-led activities!"

Rob Flello, Chief Executive, Ceramics UK

"Batri have been working using AMRICC facilities to develop an innovative battery material manufacturing technology that lowers the energy consumption of production and therefore make a more cost effective and sustainable product.

"The combination of AMRICC and Lucideon as partner choices came about due to their expertise in ceramics that have very similar properties to our battery materials.

"The team in Stone have access to world-leading facilities that SMEs such as Batri simply wouldn't be able to procure themselves, and the team's knowledge of production-scale processes has really helped take our lab scale idea through to something more applicable to industrial scaling."

Stephen Hughes,
Chief Technology Officer, Batri

NET ZERO – HYDROGEN FIRING KILN

The ethos that saw us win a Ceramics UK Decarbonisation Trailblazer award is evident through our kit selection at The AMRICC Centre, with a particular highlight being our static kiln capable of hydrogen firing at concentrations of up to 100% H2.

The collaboration between Lucideon and AMRICC marked another major milestone in 2024 as part of the mission to support the worldwide ceramics industry on the journey to Net Zero.

"After leading the way on blended natural gas & hydrogen in 2022 and an intensive project to redesign the kiln and fuel supply system supported by the Foundations Industry Sustainability Consortium (FISC) through the EconoMISER programme, in October we ran the burners on 100% hydrogen.

"Following this, we successfully completed our first 100% hydrogen firing – 13 hours at 1,200 degrees centigrade – and then our first client for 100% hydrogen firing, supporting Creavit Türkiye on their alternative energy R&D project for sanitaryware.

"The team is now gearing up to continue delivering client project work throughout 2025 and into the future.

Hydrogen Kiln at The AMRICC Centre

It's great to see the strong international interest in the use of hydrogen as part of the ceramics industry's decarbonisation journey."
Mark Dudson, Lucideon

LOCAL CLUSTER, GLOBAL SUPPORT - MIDLANDS INDUSTRIAL CERAMICS GROUP'S YEAR THREE TIMELINE VIDEO

To mark the completion of its third year of activity, the Midlands Industrial Ceramics Group (MICG) put together a video detailing a timeline of the progress of its work, from its official establishment by its founding partners in 2019, through to the securing of £18.27m of funding from the UK Research and Innovation Strength in Places Fund (SIPF), all the way through to the present day - including the founding of The AMRICC Centre.

The MICG's core aims are to:

- Make the Midlands the go-to location for the global R&D and production of advanced ceramics
- Increase the competitiveness of the Midlands industrial base
- Enhance industrial ability to develop innovative ceramic technologies with speedy marketplace adoption
- Deliver a multi-sectoral approach with rapid translation of new technologies for the advantage of a whole range of industrial sectors
- Strengthen the UK advanced ceramics supply chain for the benefit of the Midlands advanced manufacturing sector.

The numbers are quite astonishing. The MICG has so far engaged with 11 government bodies, 25 catapults and networks, 26 universities and schools, and 44 individual companies - and progress continues to roll on through 2025.

Its work continues to develop and grow the advanced ceramics cluster and supply chain, both locally in the Midlands and nationally across the UK, as well as forging stronger links with organisations and similar networks around the world.

As part of the physical legacy of the MICG, The AMRICC Centre aims to play a crucial role in building the local cluster and supporting the advanced ceramics sector globally.

INTERNATIONAL ENGAGEMENT FOR AMRICC

In 2024, AMRICC engaged beyond the borders of the UK. From client visits to tradeshows, some of the key capabilities of the Centre have generated interest from Europe to Japan in helping manufacturers and researchers realise their ambitions in materials science.

From the end of October to mid-November AMRICC business development manager Ed Maynard spent 3 weeks in Japan representing AMRICC for a number of activities, engaging with the ceramics market there, which is one of the largest in the world.

Ed represented AMRICC at Lucideon's stand at the Tokyo Ceramics Expo, part of the Highly Functional Materials Week and then went on to spend two weeks on secondment with the Japanese Fine Ceramics Association (JFCA – where "fine" means the same as "technical" or "advanced") in the first exchange of its kind for the organisation.

As Japan deals with an aging population and so less availability of researchers, many expect deeper international cooperation in research and innovation with friendly countries like the UK to become more commonplace as a means to tackle these deficits.

Now with the opening of The AMRICC Centre, the UK can demonstrate not just the know-how but also the capability to operate at the level needed to continue to innovate new products in areas like Nuclear Fusion, Ceramic Composites, Geopolymers, and Semiconductors.

Closer to home, in 2024, AMRICC also joined the Pôle Européen de la Céramique or European Ceramics Cluster to help promote

further collaboration between AMRICC and European ceramics manufacturers.

This includes manufacturers from across the industry, all with relevant ambitions in everything from green production of ceramics to new materials development.

WORKING WITH START-UPS

A key objective of AMRICC is to accelerate materials development by providing access to key processing equipment that is expensive or time consuming to invest in. This objective is perhaps most important to start-ups where they may not yet have any equipment available to make prototypes.

Hydrophis, a UK start-up with pilot manufacturing in Australia, has developed a low-energy chemical precipitation process that can make ultra-white carbonates and hydroxides from waste desalination brine and CO2. This technology provides a high-quality sustainable material source for applications ranging from glass and technical ceramics to water treatment and pharmaceuticals.

Using AMRICC's pilot furnaces, Hydrophis has been able to further calcinate their materials into oxides and characterise them using Lucideon's nearby analysis capabilities which has allowed them to understand and explore further applications for their materials.

> "We needed a dedicated calcination service with very exacting requirements; AMRICC were by far our best option"

Glenn Leighton, CEO, Hydrophis

Hydrophis

AMRICC SUPPORTS COLLABORATION BETWEEN LUCIDEON AND US NAVAL NUCLEAR LABORATORY

The AMRICC Centre is trusted to support significant work for some of the most powerful organisations in the world. Throughout 2024 and into 2025, access to the equipment here was a crucial aspect of the collaboration between Lucideon and the Naval Nuclear Laboratory, a partnership which is helping to develop mission-critical technology supporting component supply for the U.S. Navy nuclear-powered fleet.

Working with NNL in support of the Naval Nuclear Propulsion Program, Lucideon used the equipment available at The AMRICC Centre to contribute to research into the Powder Metallurgical - Hot Isostatic Pressing (PM-HIP) process, which uses high pressure and elevated temperatures to densify materials.

As part of the programme of work, Lucideon is evaluating the thermal, physical, mechanical, and microstructural properties of a Nickel-based superalloy, which has undergone the PM-HIP process over a wide range of processing conditions.

Complex evaluation of the material's thermal diffusivity and expansion will be overseen from Lucideon's base in the UK Midlands, working from the new high-technology AMRICC Centre, while the project will be led by NNL's Reactor Equipment Development unit, which is currently working to develop innovative manufacturing methods to enable new designs in support of the next generation of US Navy reactors.

Tony Kinsella, CEO of Lucideon said: "NNL is driving forward the development of this technology in an effort to supplement conventional forging for large, high-value, metallic components required within nuclear propulsion systems.

"Under the 12-month program, we will be drawing on our world-leading materials science testing and assurance capabilities and the equipment available at The AMRICC Centre to enable and accelerate the R&D activity.

"Ultimately this will provide the robust data NNL needs to fully characterise the PM-HIP process. This is a highly complex project, which has the potential to deliver significant benefits to the U.S. Navy nuclear-powered fleet."

Dilatometer

EVENTS IN 2025

Going into 2025, AMRICC will continue to increase its presence on the global ceramics stage through appearances at prestigious events.

If you're planning on attending industry events this year, keep an eye out for us on exhibitor lists and speaking schedules!

We're starting strong in February as AMRICC CEO Cathryn Hickey plans to speak at the Innovate UK Materials and Maufacturing Showcase, where she will showcase the capability of The AMRICC Centre as an open-access facility for the advanced materials sector.

Additionally, Dominic Wadkin-Snaith plans to talk at the Pôle Européen de la Céramique in Limoges, France, for their event titled "The latest advances in additive manufacturing: from software to post-process".

Also known as the European Cluster of Ceramics (ECC), AMRICC is proud to be a member of their organisation, which aims to boost the activity of the ceramics sector through innovation.

Scheduled to take place on 1st-3rd July, Dominic will discuss AMRICC's ability to assist our customers in ceramic additive manufacturing process optimisation via computational modelling, industry 4.0 & AI enhanced data science.

We'll also be exhibiting at the Advanced Materials Show 2025, taking place on the 9th and 10th of July at the NEC in Birmingham. Come and see Ed and others at stand 1348 to discuss anything from this review in person!

In addition to our exhibition, we're sponsoring the Advanced Ceramics Stage, upon which Cathryn will be participating in a panel discussion on training and skills, as moderator. We'll be announcing the topic and guest speakers soon, so check our LinkedIn page for further details closer to the event, with the draft agenda due to be published in February.

Innovate UK Materials and Maufacturing Showcase

February 19th

Pôle Européen de la Céramique in Limoges, France

July 1st - 3rd

Advanced Materials Show 2025
NEC, Birmingham, UK

July 9th - 10th