The AMRICC Centre

A YEAR IN REVIEW 2023

Accelerating knowledge and collaboration in advanced ceramics across the UK

The AMRICC Centre is an open-access facility

www.amricc.com

WELCOME TO THIS YEAR IN REVIEW OF THE AMRICC CENTRE

The advanced ceramics sector is projected to be worth £143 billion this year globally, and The AMRICC Centre places Staffordshire and the Midlands firmly at the forefront of the industry to maximise this opportunity.

2023 has been a landmark year for us, as we brought this state-of-the-art facility to life, to help the region secure a global position in this multi-billion-pound marketplace.

The Centre has been taking delivery of a wide range of next-generation, high-value equipment, to bring together a unique collection of cutting-edge technology under one roof.

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.

The Centre also provides a superbly equipped environment to train the next generation of material scientists, enabling them to develop new skills in an industrial setting, in conjunction with key university partners.

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 story is one of collaboration and partnership, and this report shares some of the highlights along the journey of developing this unique facility.

Dr Cathryn Hickey, CEO
The AMRICC Centre

THE AMRICC DIFFERENCE

"The AMRICC Centre is a really exciting development.

Having close-to-hand a facility that will enable us to work with some of the best materials scientists, both in the UK and worldwide, and to have a research and development centre that's on our doorstep that we've got easy access to, means that for the first time ever we will be in a position to develop and move forward with new material ideas with some of the biggest brains and some of the best facilities.

I can't understate how exciting an opportunity that is and what opportunity it gives us as a UK, Stoke-on-Trent-based manufacturer to move to the forefront of development."

Stephen Dixon, Managing Director, Johnson Tiles

CLICK TO WATCH STEPHEN'S INTERVIEW

"PSR envisage The AMRICC Centre as a go-to for ceramic materials, technology and development that can provide small businesses like ours access to specialist expertise needed to bring innovation into fruition. The AMRICC Centre will help us draw invaluable insights into our processes over the long term and become increasingly useful over time"

Dr. Jafar Daji, Technical Manager, Parkinson-Spencer Refractories Ltd

CLICK TO WATCH JAFAR'S INTERVIEW

"It's really great to be able to tap into the knowledge and resources here at The AMRICC Centre, both with the technicians who are clearly incredibly experienced and knowledgeable, alongside the equipment, which is new and accessible and meets all of the requirements within ceramics research."

Dr. Erin Valenzuela-Heeger, Research Fellow, University of Birmingham

CLICK TO WATCH ERIN'S INTERVIEW

THE AMRICC CENTRE IS:

- **The only facility in the world capable of Flash/Field Enhanced Sintering technology development at pilot scale**
- **Delivering outstanding education opportunities for highly-skilled materials scientists of the future**

THE AMRICC CENTRE CAN UNDERTAKE...

Sintering trials at up to 3000°C. In a range of environments - vacuum, argon, etc.

Cryogenics down to **-196°C**

Spray drying and a range of other critical material preparation techniques

Microscopy at **2,000,000x** magnification

Mechanical testing at **1,650°C**

INNOVATION AND COMMERCIALISATION FOR THE CERAMICS SECTOR

The AMRICC Centre is a unique open-access international facility that translates materials, processes, and technologies into real-world products and solutions through the commercialisation of innovative ideas.

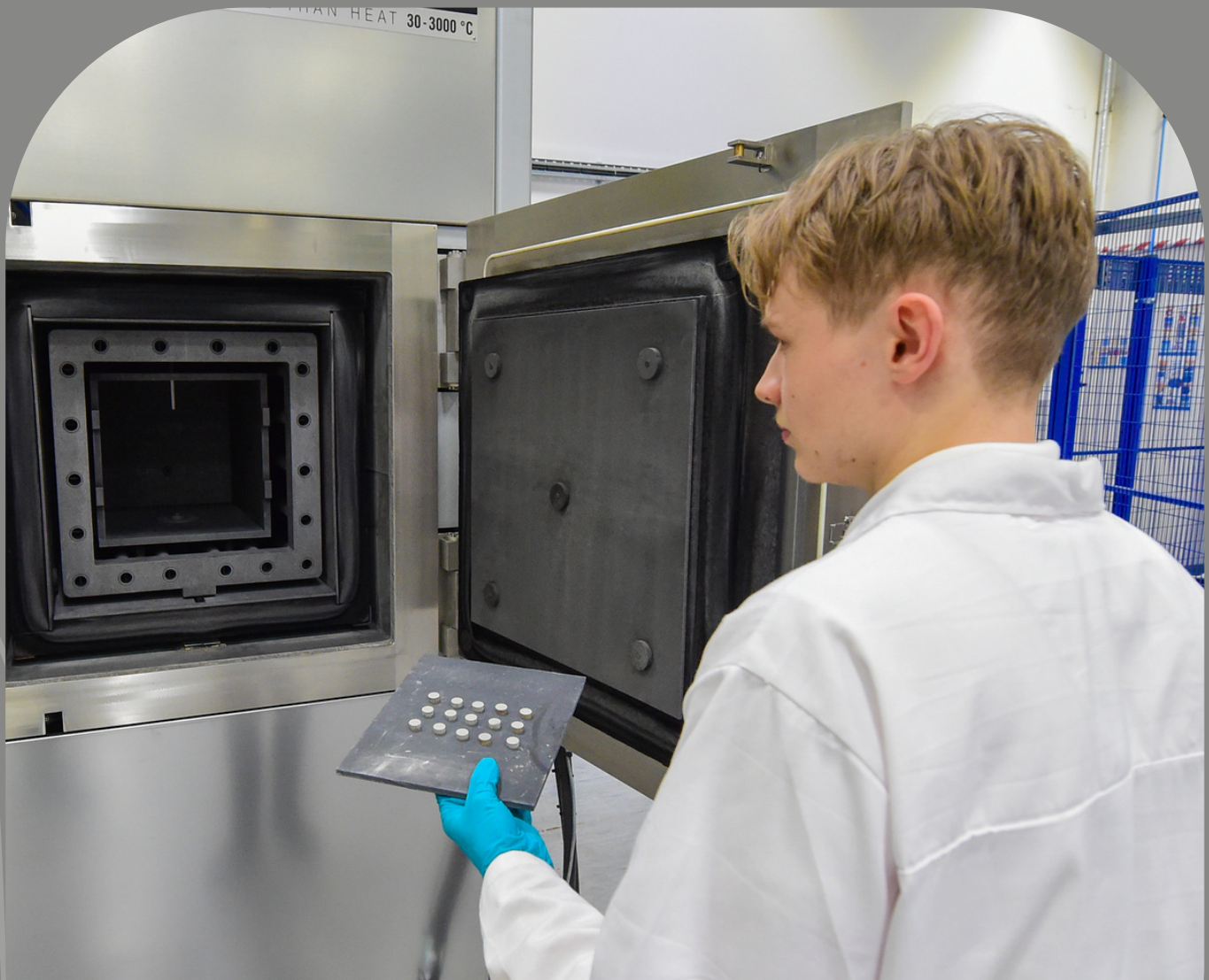
The cutting-edge equipment suite provides capabilities that are rarely available elsewhere, and certainly not collectively.

It covers a range of extreme conditions, from densification with hot or cold isostatic pressure, to sintering up to 3000 degrees, sintering in a vacuum, or in atmospheres such as argon.

It uses the expertise of scientists, engineers, data scientists, and computational modellers to turn innovative ideas into market-ready technologies.

As well as research and scale-up opportunities, AMRICC also provides an unparalleled educational facility that, in partnership with some of the world's leading universities, develops the 'commercial technocrats' of the future – materials scientists with business acumen and industrial experience.

This will build a pipeline of talented people who are able to lead and commercialise scientific breakthroughs in businesses for the future.



THE AMRICC CENTRE **CAPABILITIES**

The AMRICC Centre is able to assist companies with virtually any stage of product development relating to ceramic materials, including:

- **Early prototyping and development trials**
- **New manufacturing processes**
- **Manufacturing process improvement**
- **Small scale trials of 'standard processes'**
- **Production of trial batches**

The AMRICC Centre's current areas of development activity are many and varied:

- Manufacturing process optimisation
- Additive manufacturing of ceramics
- Lower-energy manufacturing technologies
- Use of alternative fuels on the pathway to Net Zero

SUSTAINABILITY

Advanced Ceramics pioneered in the Midlands have a key role to play in the shift towards a Net Zero carbon future.

Cutting-edge technologies developed at The AMRICC Centre have the potential to be world-leading, both in terms of revolutionising advanced manufacturing and championing sustainability by driving down emissions and improving efficiency.

Examples include the use of computational modelling, which cuts wastage by making accurate assessments digitally, without the use of material.

Pilot-scale manufacturing approaches can also expedite technology exploitation, again cutting down on energy and waste and working towards a more sustainable outcome.

CLICK TO WATCH JAFAR'S INTERVIEW

"The AMRICC's Centre's use of sensors to deploy solutions can help us to improve energy efficiency, minimise machine downtime and increase production yield, for example, by putting sensors in our humidifying dryers. Sensors can tell us exactly when our refractories are ready for the next stage of the manufacturing process."

Dr. Jafar Daji, Technical Manager, Parkinson-Spencer Refractories Ltd

CLICK TO WATCH STEVE'S INTERVIEW

"With The AMRICC Centre we're looking at condition-based monitoring. We're trying to target the product before it goes into production and also looking at the product after production, with the main aim being to get it right first time, each time, which obviously will indent on our profitability, but it will also reduce product waste, which will help the environment and we are looking at saving energy and cost savings and the use of electricity and fossil fuels."

Steve Burns, Head of Engineering, Churchill China

INVESTMENT AND DEVELOPMENT

The AMRICC Centre is the physical outcome from the Midlands Industrial Ceramics Group's (MICG) £18.27 million four-year research programme - funded by Government under UK Research and Innovation's flagship Strength in Places Fund.

Overall financial sponsor Lucideon has championed the development, investing significant resources and seven figure sums to support the development and taking the initial step forward to put the wider regional economy at centre stage in this important global market.

The idea for The AMRICC Centre was conceived by the Midlands Industrial Ceramics Group (MICG), and developed with regional support from the Midlands Engine and Stoke-on-Trent and Staffordshire Local Enterprise Partnership.

The MICG Consortium, chaired by Rolls-Royce, was awarded the £18.27m Strength in Places Fund (SIPF) grant in October 2021. This funding was to part-finance a five-year commercialisation programme for advanced ceramics as well as establish The AMRICC Centre as a hub for ceramics capabilities and expertise.

Lucideon manages the SIPF programme on behalf of the MICG Consortium and hosts and manages The AMRICC Centre on behalf of the sector, realising its primary purpose: to enable companies to take innovative ideas and place them on the fast-track into commercial product.

UK Research and Innovation

MIDLANDS ENGINE

MICG Midlands Industrial Ceramics Group

THE INVESTMENT FORMULA

THE BUILDING

- **£6 million** of funds provided by Lucideon
- **£4 million** to support the part funding from UKRI
- **£2 million** to set up the AMRICC Centre building, plus associated costs including rates, insurance, rent and utilities support the centre
- The balancing **£4 million** has been delivered by SIPF

THE TECHNOLOGY

- **87** units purchased with part funding from UKRI
- **269** items added by Lucideon to ensure AMRICC operates as a functioning centre

THE EXPERIENCE

People with many years of experience in Ceramics, employed by Lucideon, are supporting the Centre – offering a critical stream of best practice and knowledge to drive AMRICC's success.

The programme has also had a wider impact across Staffordshire, with Lucideon investing a further £3.475 million in the county's economy in areas including equipment, centre engineering, rent and business rates.

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"What's happened in the last year in the development of The AMRICC Centre has actually been quite astounding. From an empty building, which we started in in January 2023, and the help of the Strength in Places Fund (SIPF) and the support of Lucideon, we've been able to purchase state-of-the-art equipment.

We now have over 350 new pieces of technology and the Centre is up and running. We're looking forward to engaging with new client customers from across the industry to help them in their scale up journey for ceramics and advanced ceramics."
- Dr Cathryn Hickey, CEO, AMRICC

"Developing The AMRICC Centre has been a four-year journey. It has included investing £800,000 over four years to even get to the bid and then, since that time, Lucideon is investing £6 million to create a world-leading Centre of Excellence.

The equipment in the Centre allows a unique capability for the ceramics industry for the UK, to allow it to come back to its global-leading position that it once used to have."
- Tony Kinsella, CEO, Lucideon

LUCIDEON

CLICK TO WATCH TONY'S INTERVIEW

OUR MEMBERS & SUPPORTERS

Here are The AMRICC Centre members, all of which were the founding members of the MICG SIPF programme:

- AEON Engineering
- Birmingham University
- CDS group
- Foseco
- Leicester University
- Loughborough University
- Lucideon
- Mantec Technical Ceramics
- Morgan Advanced Materials
- PCL Ceramics
- Precision Ceramics
- Rolls-Royce
- Trelleborg

Being stronger together, these businesses and universities in the region's advanced materials sector can have the support they need to help develop, prove, and deploy concepts from an initial idea into commercialisation much faster and more effectively to meet changing market needs.

Access to The AMRICC Centre and its entire range of cutting-edge kit capabilities is open to all on a pay-as-you-go basis, with those looking for more frequent collaboration able to access closer engagement and ability from research and development activities through different levels of membership.

These investments bring a real competitive advantage for the Midlands and UK economy overall and put the Midlands, and indeed the UK, centre stage of the critical advanced ceramics sector.

THE TECHNOLOGY IN ACTION

Commercialisation of products and processes is what The AMRICC Centre is all about - our prototyping, testing, and pilot-scale facilities form the backbone of this.

As a one-stop scale-up and technology development facility for the ceramic sector that's all under one roof, The AMRICC Centre offers the tools to obtain accurate and precise results, as well as a full understanding of why they occurred.

Prototyping and development expertise, complementing the ability to carry out small-scale trials, helps companies to bring innovation and new ideas to market faster.

The range of supporting analytical capabilities includes:

- Sample preparation techniques including cutting, grinding, polishing, and hardness testing
- Detailed particle analysis capability: dynamic particle shape, zeta potential, and contact angle
- Dimension scanning capability and microscopy
- Numerous mechanical testing and analytical techniques

INDUSTRY 4.0 AND THE CERAMICS INDUSTRY

The AMRICC Centre is a cutting-edge facility that is spearheading the adoption of Industry 4.0 for the ceramics sector and beyond.

By harnessing the power of data science and modelling, the Centre can uncover patterns and insights that inform process optimisation. The Centre also leverages material informatics as a powerful tool that can cut development costs and time. By performing analysis with computational modelling, cost and time demands can be dramatically reduced, and project savings can be made without a single gram of material being consumed.

This also enables the simulation of various aspects of physical systems and the prediction of their interactions, which can accelerate the development and optimisation of products and processes during the early phases of technology scale-up.

The AMRICC Centre is not only advancing the state of the art in the ceramics sector, but also transforming it with Industry 4.0 by aiming to support the process optimisation of manufacturing sites across all segments of the ceramics industry.

For example, optimising the 3D printing of advanced ceramics or developing real-time monitoring of ceramics shrinkage during sintering.

The AMRICC Centre employs time-series data machine learning on the real-time data collected using a range of standard and novel sensors.

It also conducts computational materials development and finite element modelling of key manufacturing processes, including digital twinning.

These activities enable The AMRICC Centre to create innovative solutions and products that can help our collaborators secure a global position in the advanced ceramics market.

TECHNICAL TESTING

The AMRICC Centre's scale-up pilot work is underpinned by a range of cutting-edge analytical, evaluation and test facilities, supported by an experienced team of scientists and engineers using these facilities to nurture and improve concepts, products, processes, and technologies, as well as verify results.

Analytical and evaluation capabilities include:

- **Physical testing**
- **High temperature performance testing**
- **Chemical analysis**
- **Microstructural analysis**
- **Mechanical and fatigue testing**
- **Metallurgical evaluation**
- **A full suite of advanced surface analysis techniques**

EXTREME CONDITION TESTING

As the UK's only Centre of Excellence for Advanced Ceramics, The AMRICC Centre's range of equipment has been designed to encompass the needs of the ceramics sector as it adopts the techniques required for the evaluation and manufacture of advanced materials.

This cutting-edge equipment suite provides capabilities that are rarely available elsewhere, and covers a range of extreme conditions, from densification with hot or cold isostatic pressure, to sintering at up to 3000°C, sintering in a vacuum, or in atmospheres such as argon.

EDUCATION & SKILLS

Developing highly-skilled materials scientists who have detailed business and commercial knowledge and hands-on practical experience, in addition to fundamental technical expertise, is at the heart of how AMRICC helps companies to reach new heights of commercial development and growth.

Strengthening the talent pipeline of the local area in this way begins from early stages of education, which is why The AMRICC Centre invests in school outreach activities starting from Key Stage 2 and upwards.

The AMRICC Centre also offers placement opportunities from high school through to postdoctoral level, while our Materials Science Technologist degree (BEng) apprenticeship course, developed and delivered in partnership with the University of Derby and approved by the Institute for Apprenticeships & Technical Education, delivers top-class education in combination with invaluable working experience.

This degree apprenticeship ensures that apprentices gain a wide range of knowledge, skills, and behaviours that have been identified by materials employers as future-proof for a career in materials science.

Finally, The AMRICC Centre offers postgraduate students opportunities for level six candidates and above to solidify their education into a world-class set of skills. Mentoring and industrial support is available to develop candidates beyond technical learning and into commercial understanding and exposure to industrially relevant research.

CLICK TO WATCH KATIE'S INTERVIEW

"The AMRICC Centre has a fantastic range of equipment from Keyence microscopes, to laser flash analysis, where I do Thermo Analysis. I really enjoy the opportunities here."

Katie Hadley, Degree Apprenticeship in Material Science and Technology at the University of Derby with AMRICC

"The degree apprenticeship is a great opportunity to develop myself and my own skills and learn from people with more experience than me. I have lots of different tasks and different responsibilities that I can do, which make my work varied and not the same every day.

Connor Ayre, Degree Apprenticeship in Material Science and Technology at the University of Derby with AMRICC

CLICK TO WATCH CONNOR'S INTERVIEW

"I've chosen to do this degree apprenticeship because I'm interested in the new materials in the engineering world. Materials science is really important, because it will be used in a lot of different sectors in the future and I'm in one of the best places to grow and develop myself at The AMRICC Centre."

Ethan Ellis, Degree Apprenticeship in Material Science and Technology at the University of Derby with AMRICC

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"It's really interesting to see the processes used to produce new materials, as well as investigate and testing."

James Mallord, studying Physics at the University of Bristol, visiting The AMRICC Centre

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"Material science is really important because materials make up everything that we do in day-to-day life. When you get into work, when you're booking a holiday, maybe on your laptop, the screen that you're using, the pieces that make up the computer, the things that you use in everyday life."

Amin Damena, Degree Apprenticeship in Material Science and Technology at the University of Derby with AMRICC

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"There's lots of interesting equipment for advanced ceramics at The AMRICC Centre. I really enjoyed meeting all sorts of people and seeing what kind of career path I might be able to have in this amazing field."

Isobel Sargeant, studying Physics at the University of Bristol, visiting The AMRICC Centre

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THE AMRICC DIFFERENCE

"As the UK's only advanced ceramics pilot-scale facility, the AMRICC Centre symbolizes the incredible potential of collaborative innovation. It stands as a game-changer, its state-of-the-art resources and industry access are instrumental in tackling complex material and production challenges"

Professor Jingzhe Pan, University of Leicester

CLICK TO WATCH ALAN'S INTERVIEW

"I want to say how delighted I am that The AMRICC Centre has come to life, and it now has the facilities, the equipment, and the people. This whole area has a huge relevance to manufacturing. We have the opportunity to explore at a scale which is industrially relevant, with novel areas for both materials and manufacturing processes."

Dr Alan McLelland, VP of Technology, Morgan Advanced Materials

CLICK TO WATCH JON'S INTERVIEW

"Both industry and academia constantly need to innovate to 'stay ahead of the game' – however, as with everything else, the cost of equipment, development and training is constantly increasing and so it can be difficult to find the money required to purchase new, or upgrade existing, facilities, develop new products and train staff.

The AMRICC Centre is designed to overcome these issues by providing access to state-of-the-art scale-up facilities and experts in their fields that can help companies with their training requirements.

It is designed to deliver access to facilities, development and training in an affordable – and non-bureaucratic – manner.

To achieve this, it is both agile and has access to real expertise in its field of advanced ceramics processing and characterisation. By staying abreast of the field and having the required foresight it will be able to continue providing the essential means for industry and academia to benefit from its undoubted assets."

Professor Jon Binner, Professor of Ceramic Science and Engineering, University of Birmingham


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