



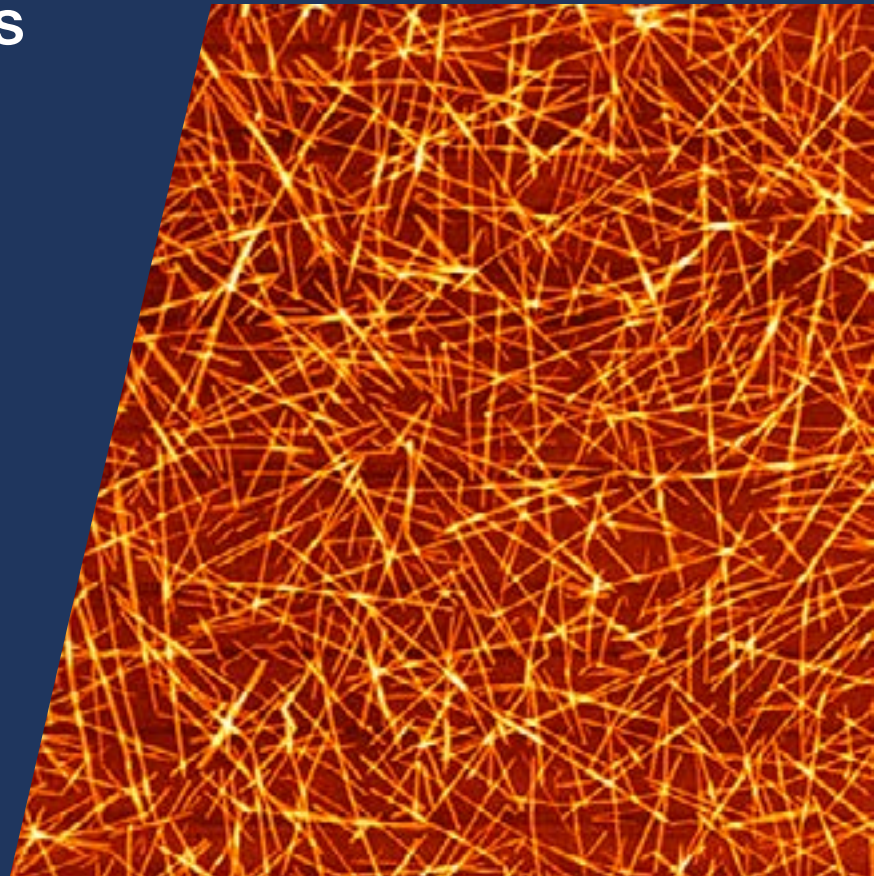
Bristol Composites
Institute (ACCIS)



ADVANCED COMPOSITES COLLABORATION FOR INNOVATION & SCIENCE

SPOTLIGHT

on Bristol Composites
Institute (ACCIS)





Bristol Composites Institute (ACCIS) was established in 2017, building on the expertise and 10-year track record of the Advanced Composites Collaboration for Innovation and Science. We aspire to be a world-leading institute for composites research and education, combining cutting-edge fundamental science with strong industrial links for exploitation and technology transfer.

The Institute continues to grow, with four new academic appointments in the last year: Dr Terence Macquart, Lecturer in Aeroelastics associated with the Wind Blade Research Hub in partnership with the Offshore Renewable Energy Catapult; Dr Giuliano Allegri, who has returned to Bristol as Reader in Composite Structures associated with the Composites University Technology Centre supported by Rolls-Royce; Professor Richard Trask, returning to Bristol as Professor of Advanced Materials; and Dr Sonya Rusnakova who has joined us as Senior Lecturer in Composites Manufacturing.

Dr James Kratz has been awarded a High Value Manufacturing Researcher in Residence Fellowship at the National Composites Centre, and interaction is also being strengthened by a number of technology pull-through projects funded by NCC to further develop and demonstrate research from ACCIS with high potential for industrial application.

Professor Michael Wisnom

Director of Bristol Composites Institute (ACCIS)

Contents

- 1 Introduction
- 2 UTC success story
- 5-6 Materials
- 7-8 Structures
- 9-10 Working with us
- 11-12 Manufacturing and Design
- 13-14 Research partnerships and collaborations
- 15-16 Publications

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UTC success story

Every thriving organisation will have many success stories. We asked Professor Stephen Hallett, director of the Composites University Technology Centre (UTC), to answer a few questions related to the UTC's success story at the Bristol Composites Institute.



Q: Professor, what are you most proud of at Bristol Composites Institute?

A: What we are really proud of here in Bristol are our people. We work closely with our industrial partners to learn about their current and future needs, and then build these into our research and teaching to prepare the next generation of engineers for their work-related challenges. We also invest in soft skills that will help them build a successful and balanced career.

Q: Could you highlight one particular example?

A: Matthew Thomas' case is a fantastic example of collaboration with industry, personal development and knowledge transfer. Matt was a PhD student in the ACCIS Centre for Doctoral Training, supported by Rolls-Royce who did his project on Variable Angled Tow Laminates for Fan Blade Elastic Tailoring. This focused on advanced numerical optimisation techniques for novel curved fibre path composite plies, to take advantage of the mechanical performance benefits that this could bring. After finishing his PhD, Matt continued developing his numerical optimisation techniques as a Research Associate in ACCIS, funded by an EPSRC Impact Acceleration Award. The software tools that Matt's IAA project developed aimed to close the gap between fan blade design and manufacturing constraints. This work was done in close collaboration with Rolls-Royce where his talent was recognised, helping Matt land a job in Rolls-Royce.

Q: What are the industrial partners gaining from such a collaboration?

A: Supporting a PhD student within ACCIS means that they can be closely involved in setting up a project and have access to both cutting edge research and the brightest minds. The University

liaises with the company's legal teams to set up the right framework for the collaboration and the PhD student focuses on that particular project. A PhD project such as Matt's can bring new ideas and technology to a product or process, or help scale up early stage technology to show how it can be applied in new areas.

Q: This all sounds great for the industry and Matt but how does ACCIS benefit from this knowledge transfer?

A: Our goal is generation of new knowledge and impact for the academic, industrial and wider communities. We are also preparing our talented graduates for starting their own career and we have to let them go. So by these measures of success, there has already been great benefit to ACCIS from Matt's project. Also, the work that Matt started has many aspects that need further exploration, this will feed into new projects that other researchers will carry forward. Another benefit is that we have closer contacts with the companies we work with, both through the project work and now in Matt's case, as a new, but familiar face at Rolls-Royce. Having our alumni out in our partner companies means they can act as ambassadors and points of contact, knowing what our strengths and capabilities are, thus facilitating even stronger collaborations in the future.

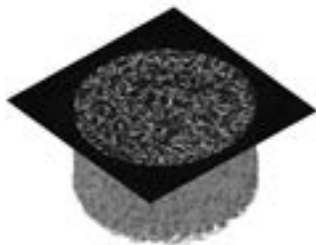


Materials

The Materials team brings together academics with interdisciplinary backgrounds enabling us to approach challenges from different angles and come up with extraordinary solutions. We research advanced composites for extreme engineering environments and various multifunctional smart materials.



Porous metal-organic framework nanocomposites used for energy storage on-board hydrogen fuel cell vehicles



Micro-CT scan of 'metal rubber'

Our research areas

- **High performance polymers**
- **Multifunctional smart materials**
- **Nanoporous materials**
- **Energy materials**
- **Innovative multi-materials manufacturing**
- **Materials variability in processing**
- **Lignocellulosic materials and natural fibres**
- **Cellulose nanomaterials**
- **Auxetics**
- **Self-healing materials**



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Professor Fabrizio Scarpa

*Professor of Smart Materials and Structures,
Head of Materials*

Auxetics, smart materials, honeycombs, vibration damping,
vibroacoustics, foams and multifunctional applications



Professor Ian Bond

*Professor of Aerospace Materials and
Head of CAME School of Engineering*

Self-healing, multifunctional materials,
surface chemistry, particle dispersion,
particle-polymer interfaces



Professor Steve Eichhorn

Professor in Materials Science and Engineering

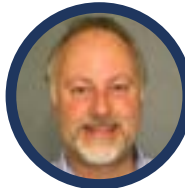
Interfacial properties of natural fibre composites,
mechanical and physical properties of nanofibres,
nanocomposites, biomimetic materials



Professor Ian Hamerton

Professor in Polymers and Composite Materials

Preparation and characterisation of monomers, engineering
thermoplastics, multifunctional nanocomposites,
high performance polymers (resin chemistry)



Professor Richard Trask

*Professor of Advanced Materials,
EPSRC Research Fellow*

Multifunctional materials, innovative composite manufacturing,
3D and 4D polymer composite additive manufacturing,
bioinspired adaptive, morphing and self-healing materials



Dr Valeska Ting

*Reader in Smart Nanomaterials,
EPSRC Research Fellow*

Functional nanoporous materials,
alternative energy generation and storage,
lightweight and smart composites



Dr James Kratz

Lecturer in Materials Engineering

In-process sensing, curing,
voids, out-of-autoclave processing

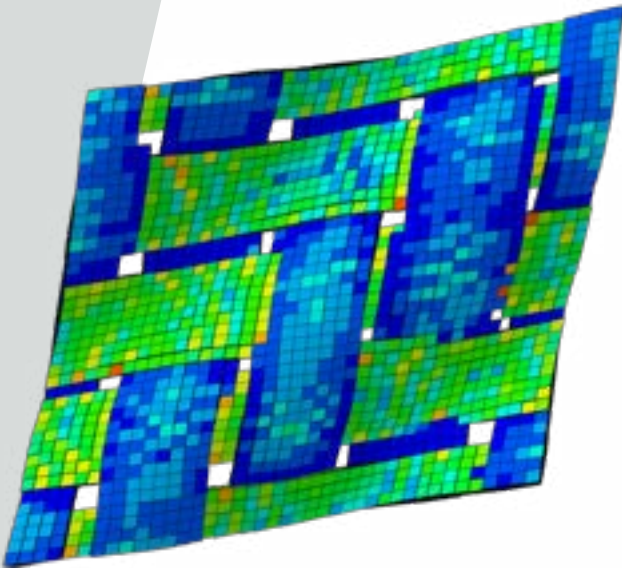


Our Team

We develop novel generations of composites with a broad range of multiscale reinforcements, from nanostructures to carbon and natural fibres, involving design, modelling, manufacturing and testing.

Structures

The ACCIS Structures team combines data-rich experimentation with novel numerical methods development and application to study the mechanical performance of composite structures. An understanding of the driving physical phenomena helps us build and validate models to predict the characteristics of composite structures. This research is deployed in a range of activities from blue sky projects to industrial applications.



Stress analysis of a sheared textile composite

Our research areas

- **Numerical and multi-scale modelling**
- **Textile composites**
- **Structural optimisation**
- **Elastic tailoring**
- **Effects of defects and features**
- **Through-thickness reinforcement**
- **Fatigue**
- **Ductility in composites**
- **Morphing and nonlinear structures**

Professor Stephen Hallett

Professor in Composite Structures, Head of Structures

Failure mechanisms, advanced numerical modelling, through-thickness reinforcement, textile composites, manufacturing and process simulation, impact and high rate effects, fatigue, effects of defects and features



Professor Michael Wisnom

*Professor of Aerospace Structures,
Director of Bristol Composites Institute (ACCIS)*

Failure mechanisms and prediction, residual stresses, finite element analysis, high performance ductile composites



Professor Paul Weaver

Professor in Lightweight Structures, ACCIS CDT Director

Lightweight structures, bicycle frame design, morphing and adaptive structures, anisotropic materials, buckling, aircraft wing design, wind turbine structural design



Dr Giuliano Allegri

Reader in Composite Structures

Multi-functional through-thickness reinforcement, fatigue, failure mechanisms, uncertainty quantification



Dr Alberto Pirra

Senior Lecturer in Composite Structures, EPSRC Research Fellow

Well-behaved nonlinear structures, morphing and adaptive structures, buckling and post-buckling, wind turbine structural design, mechanics of lightweight structures, stiffness tailoring



Dr Luiz Kawashita

Lecturer in Composite Mechanics

Bonded and structural joints, advanced numerical modelling, fatigue, effects of defects and features



Dr Terence Macquart

Lecturer in Aeroelastics

Optimisation, lightweight structures, wind turbine structural design, advanced numerical modelling



Dr Matthew O'Donnell

Lecturer in Composite Structures

Optimisation and design of composite structures



Dr Mark Schenk

Lecturer in Aerospace Engineering

Engineering origami, deployable structures, experimental methods for nonlinear structures



Dr Ben Woods

Lecturer in Aerospace Structures

Novel structural solutions, morphing and adaptive structures, low cost ultra-efficient wound composite truss structures, novel energy storage and actuation methods



Our Team

Our research into the mechanical performance of composites encompasses novel numerical methods, novel structural configurations, advanced analysis techniques, multi-functionality and data rich experimentation.



**Patenting/
licensing**



Spin-outs



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**Tap into the
academic
expertise**

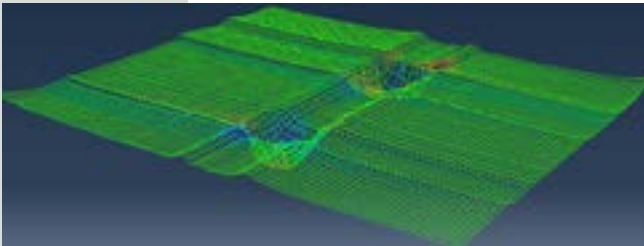


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centres**

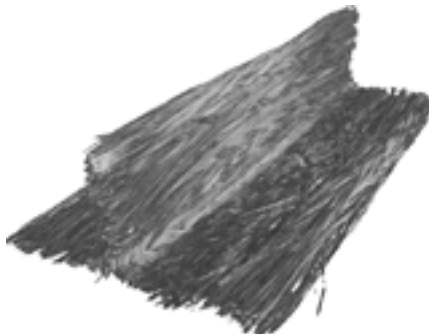


Manufacturing & Design

The Manufacturing and Design team focusses on developing the means to turn ideas into hardware through efficient design and manufacturing practices. We build an in-depth understanding of current processes and develop novel and innovative manufacturing approaches, to deliver improvements in cost, quality and functionality across a range of industries.



Forming simulation of a modified preform



Stabilisation of net-shaped preforms

Our research areas

- **Process automation – automated fibre placement**
- **Robotics and cobotics**
- **Continuous tow shearing**
- **Graded multi-matrix composites**
- **Defects in composites manufacturing**
- **Understanding lay-up processes**
- **Design for manufacture**
- **Supporting manufacturing via Virtual and Augmented Reality tools**
- **Composites recycling**
- **Numerical modelling of manufacturing processes**
- **Manufacturing of functional composites**
- **Closed-loop process control**

Professor Kevin Potter

*Professor in Composites Manufacturing,
Head of Manufacturing & Design*

Automated processes, origins and effects of defects, design for manufacture, novel fibres, reinforcement deformation and drape



Professor Ivana Partridge

*Professor of Composites Processing,
Director of Industrial Doctorate Centre in Composite Manufacture*

Polymer composites, processing for high performance



Dr Ian Farrow

Senior Lecturer in Composites Structural Design

Acoustic emission monitoring, damage thresholds, fatigue damage accumulation process



Dr Dmitry Ivanov

Senior Lecturer in Composites Manufacturing

Multi-scale analysis, damage mechanics, textile composites, mechanics of preregs, liquid moulding, additive manufacturing, innovative manufacturing



Dr Sonya Rusnakova

Senior Lecturer in Composites Manufacturing

Manufacturing technology, sandwich structures, thick-walled composites, fire smoke and toxicity (FST) composites, automotive



Dr Paul Harper

Teaching Fellow

Design and analysis of composite structures, renewable energy systems



Dr B.C. Eric Kim

Lecturer in Composites Design, Processing & Manufacture

Design & manufacturing, automated processes, axiomatic design, computer aided design, bonded joints, tribology



Dr Carwyn Ward

Lecturer in Composites Design, Processing & Manufacture

Manufacturing technology, automated processes, factory processes/operations, process optimisation, costs, recycling, assembly and repair



Our Team

Our research centres around Design for Manufacture, from novel material forms that facilitate forming, through detailed process understanding and novel machines to factory operations.

Composites University Technology Centre

The Composites University Technology Centre (UTC) at the University of Bristol was established in 2007, supported by Rolls-Royce to advance composite materials technology and to support their insertion into components, structures and systems. The centre conducts research in a wide range of composites related areas such as through-thickness reinforcement, defects and features, vibration and fatigue, novel structures and materials, woven textiles and composites manufacturing.

www.bristol.ac.uk/composites/collaboration/utc



Wind Blade Research Hub

The Wind Blade Research Hub is a five-year research partnership between the Offshore Renewable Energy Catapult and the University of Bristol looking into developing larger and more powerful wind turbines than ever before. The Hub is investigating blade materials and manufacturing technology, blade integrity, blade design and performance.

www.ore.catapult.org.uk/work-with-us/our-collaborations/wind-blade-research-hub





National Composites Centre

The National Composites Centre opened in 2011 and is hosted by the University of Bristol. It is an independent, open-access national centre translating world-renowned innovation into manufacturing excellence. The centre brings together dynamic companies and world-class academics to develop new technologies for the design and rapid manufacture of high-quality composite products.

www.nccuk.com



Future Composites Manufacturing Hub

The Future Composites Manufacturing Hub is an EPSRC-funded collaboration led by the Universities of Nottingham and Bristol and also involves a number of other universities as spokes. The Hub aims to increase the potential of composite materials manufacturing within the UK by revolutionising performance and expanding applications into new markets. The Hub also provides training for the next generation of engineers in composites manufacturing.

www.cimcomp.ac.uk

Materials

Professor Fabrizio Scarpa

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Professor Ian Bond

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Professor Steve Eichhorn

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Professor Ian Hamerton

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Professor Richard Trask

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Dr Valeska Ting

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Dr James Kratz

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Professor Stephen Hallett

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Professor Paul Weaver

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Dr Giuliano Allegri

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Dr Alberto Pirrera

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Dr Luiz Kawashita

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Dr Terence Macquart

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Dr Matthew O'Donnell

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Dr Mark Schenk

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Dr Ben Woods

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Professor Kevin Potter

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Professor Ivana Partridge

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Dr Dmitry Ivanov

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Dr Sonya Rusnakova

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Dr Byung Chul Kim

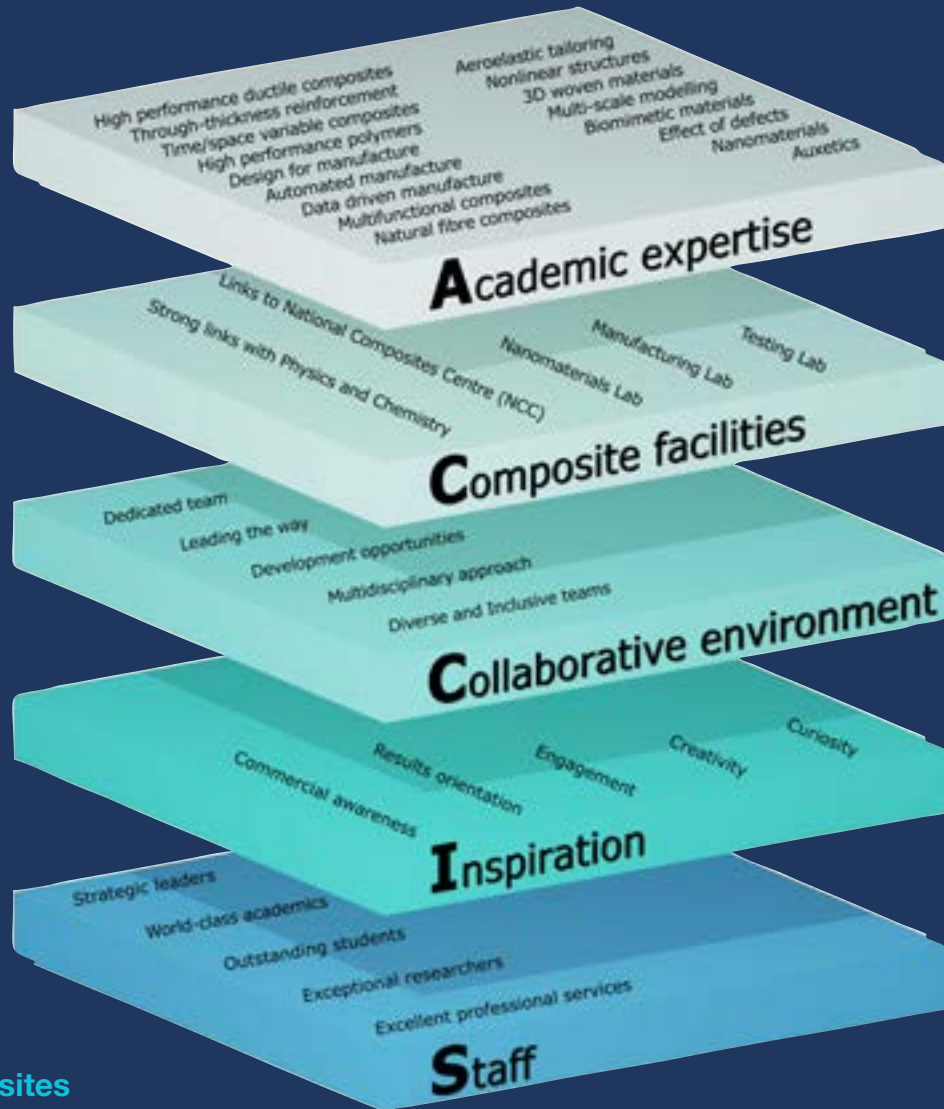
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Dr Carwyn Ward

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