FTW 2026 Programme

Day 1 (Monday, 13 April 2026)

Day 1	13 April 2026 | First Floor Hall, King's House Conference Centre, Manchester, M1 7HB	
9:30		Registration and Arrival Tea & Coffee
10:00		**Plenary Session 1 (Textile Innovation)** **Welcome by Conference Chair** *Sadat Sayem, Editor, The Textile Institute Professional Publication Series*
	1	**Opening Address** *Professor Jess Power, Chair of The Textile Institute*
	2	**Keynote 1 - Think to Innovate – Why the Future of Textiles Depends on the Quality of Our Thinking,** *Jason Kent, Chief Executive Officer, British Textile Machinery Association (BTMA)*
10:55		Break
11:00		**Technical Session 1A (Digital Fashion Innovation)** *Chair - Professor Jess Power, Chair of The Textile Institute*
	3	**Sensory and Emotional Perception of Pleated Pants: A Comparative Study of Actual and Virtual Representations Focusing on Reflectance** *Jisoo Ha[1] and Sujin Lim[2], 1) Seoul National University, 2) Hongik University*
	4	**Immersive Storytelling Through AR Textiles, AI and Digital Fashion** Jacqueline Toal, Dundalk Institute of Technology, Ireland
11:55		Break
12:00		**Technical Session 1B (Sustainable Textile & Fashion)** *Chair – Professor Fiona Hackney, Manchester Metropolitan University*
	5	**Labelling structure for textile products considering differentiated eco-design aspects** *Sabrina Mauter[1], Dominique C. Adolphe[2], Markus Muschkiet[1,3]* *1) Hochschule Niederrhein University of Applied Sciences, 2) Université de Haute-Alsace, France* *3) Fraunhofer Institute for Material Flow and Logistics, Germany,*
	6	**Examining The Influences of Ghanaian Consumer Care Practices on Garment Longevity,** *Josephine Opoku, Akosua Mawuse Amankwah and Ebenezer Kofi Howard* *Kwame Nkrumah University of Science and Technology, Ghana*
13:00		Lunch

BTMA BRITISH TEXTILE MACHINERY ASSOCIATION

The Textile Institute

DIGITAL FASHION NETWORK

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Day 1 (Monday, 13 April 2026)

14:00		**Technical Session 1C (Textile Innovation)** *Chair – Jason Kent, Chief Executive Officer, British Textile Machinery Association (BTMA)*
	7	**Keynote 2 - Flexible/elastic ceramic nanofibrous materials** *Professor Bin Ding, Vice President, Shanghai Polytechnic University*
	8	**Nature-Inspired Biodegradable Textile with Integrated Evaporative-Radiative Cooling for Personal Thermal Regulation** *Dong Lyu, Siru Chen, Kaixin Lin and Chi Yan Tso, City University of Hong Kong*
14:55		**Break**

15:00		**Technical Session 1D (Textile Innovation)** *Chair - Dr Mazed Islam, University of Southampton*
	9	**Innovations in Infrared Coating Technologies for Yarns** *Liam O'Neill, Roaches*
	10	**Sustainable Textile Engineering Through Bio-Derived Cellulosic Materials** *Aida Fadakarsarkandi, Omid Doustdar, Mingchao Liu and Karl David Dearn, University of Birmingham*
	11	**Cationic Microencapsulation of Coconut Oil with CHPTAC and Ethyl Cellulose for Eco-Friendly Thermally Stable Textile Coatings** *Zarnab Gul, Daiva Milašienė; Kaunas University of Technology, Lithuania.*
16:25		**Break**

16:30		**Technical Session 1E (Fashion Innovation)** *Chair –Dr. Sadat Sayem, Editor, The Textile Institute Professional Publication Series*
	12	**The Sixth Sense Garment: A State-of-the-Art Framework for Sustainable Neurofashion** *Andrew Burnstine, Lynn University, USA*
	13	**New motifs for making waves: An update on motif design for optimal performance in women's competitive swimwear** *Renee Lamb, Jennie Cook and Jacqueline Mullins, Virginia Commonwealth University, USA*
17:30		**End of Day 1**

FTW 2026 Programme

Day 2 (Tuesday, 14 April 2026)

Day 2		14 April 2026 | First Floor Hall, King's House Conference Centre, Manchester, M1 7HB
9:00		Arrival Tea & Coffee
9:30		**Plenary Session 2 (Digital Fashion)** *Chair - Dr. Sadat Sayem, Editor - The Textile Institute Professional Publication Series*
	1	**Keynote 3 - Wearables in Contemporary Design Practice** *Professor Carolyn Hardekar, De Montfort University*
	2	**The Era of Agentic AI: Redefining the Fashion Value Chain from Concept to Consumer** *Elizabeth Brandwood, Style3D Assyst Europe*
10:25		Break
10:30		**Technical Session 2A (Sustainable Textile & Fashion)** *Chair – Dr Morolake Dairo, Manchester Metropolitan Univeristy*
	3	**What about us? Academics role in cocreating circular ecosystems: Evidence from Circular Textiles and Fashion transitions in the UK** *Alaa Abed and Tulin Dzhengiz, Manchester Metropolitan University, UK*
	4	**Adire Symbols in Textile and Fashion Designs: A Yoruba Cultural Perspective** *Olayinka Olumide BAKARE and Christianah Yetunde KOLAWOLE,* *Modibbo Adama University, Nigeria.*
11:25		Break
11:30		**Technical Session 2B (Textile Innovation)** *Chair – Dr Julfikar Haider, Manchester Metropolitan University*
	5	**Research on the Flame-Retardant Properties of Bio-Based Materials.** *David Zheng, Shandong Aobo Environmental Protection Technology Co., Ltd, China*
	6	**Innovations in Textile Testing** *Simon Dakin, SDL ATLAS USA*
	7	**Fabrication Strategies and Functionality of Superelastic Electrospun Nanofibrous Aerogels** *Fei Wang, Donghua University, China*
13:00		Lunch

FTW 2026 Programme

Day 2 (Tuesday,14 April 2026)

14:00		**Technical Session 2C (Sustainable Textile & Fashion)** *Chair – Professor Carolyn Hardekar, De Montfort University*
	8	**Durability and Desirability in the High Street: A Case Study Analysis of Clothing Donated to the Marks and Spencer Archive** *Kevin Almond and Judith Simpson, University of Leeds*
	9	**Integrating repurposing concepts into textile innovation: Humming the Ghanaian eco cottage innovation stories** *Theophilous Tweneboah Osei-Bonsu, Naa Omai Sawyerr and Kweku Safo-Ankama* *Takoradi Technical University, Ghana*
14:55		**Break**

15:00		**Technical Session 2D (Digital Fashion Innovation)** *Chair – Professor Jisoo Ha, Seoul National University, Korea*
	10	**Understanding User Responses to Virtual Try-On Through Large-Scale and Qualitative Studies,** *Ian Anderson, Glance AI*
	11	**How Virtual Fashion Experiences Realize: Digital Materiality and Tactility** *Se Jin Kim, Hanyang University, Korea*
	12	**Fashion Beyond the Physical: How Has the Framing of Digital Fashion Shaped Its Role in the Fashion Industry?** *Salma Tallaa, De Montfort University*
15:55		**Break**

16:00		**Technical Session 2E (Textile Innovation)** *Chair – Dr. Kevin Almond, University of Leeds*
	13	**Adjustable Textile Recycling Machine: Impact of Machine Settings on Fibre Quality** *Yunhao Wu, Prasad Potluri, Claudia Henninger, The University of Manchester*
	14	**Coupling Radial Conduction with Radiative Emission: The CAMIC Framework for High-Efficiency Passive Radiative Cooling**, *Siru CHEN, Yihao ZHU and Man Ho CHOI; i2Cool Limited, Hong Kong*
	15	**Ultrathin Dual-Network Aerogel Metafabric for Efficient Self Sustainable Heating via Dual Air-Gelation Synthesis** *Yucheng Tian, Yixiao Chen, Sai Wang, Bin Ding; Donghua University*
16:55		**End of Day 2**

FTW 2026 Programme

Day 3 (Wednesday, 15 April 2026)

Day 3		15 April 2026 | First Floor Hall, King's House Conference Centre, Manchester, M1 7HB
9:00		Arrival Tea & Coffee
9:30		**Technical Session 3A (Textile Innovation)** *Chair – Professor Kweku Safo-Ankama Takoradi Technical University, Ghana*
	1	**Design of Thermal-wet comfortable and Cooling Wearable Masks via Engineered 2D Nanofibrous Networks for Enhanced Personal Protection** *Xinxin Zhang, Ming Yang, Jianyong Yu and, Bin Ding; Donghua University, China*
	2	**Design Evaluation of Protective Fabrics for Motorcyclists** *Rashmi Thakur, Naveen Kumar Jha, Nandan Kumar, Sanjay R, National Institute of Fashion Technology, Mumbai, India*
10:30		Break
10:35		**Technical Session 3B (Wearable Technology Innovation)** *Chair – Dr. Raju Ahmed, University of Manchester*
	3	**MXene-Enhanced Nanofiber Yarns for Dual-Mode Sensing in Wearable Electronics** *Jian Tang[1], Han Liu[1], Yuting Wu[2], Fatemeh Mokhtari[3], Jizhen Zhang[4], Ken Aldren S. Usman[5], Shidong Ma[2], Tao Yan[2], Zhijuan Pan[2], Haibo Xie[1], Kaichen Xu[1], Xungai Wang[6], Joselito M. Razal[6]* *1) Zhejiang University, China, 2) Soochow University, China, 3) KU Leuven, Belgium, 4) National Institute for Materials Science (NIMS), Ibaraki, Japan, 5) Deakin University, Australia, 6) The Hong Kong Polytechnic University, China*
	4	**Architectural Strategies for Textile-Integrated Wearable Sensor Systems in Healthcare-Oriented Monitoring,** Shivangi Madhavi Harsha[1,2], Ajay Agarwal[1] and Neeraj Gupta[2] , 1) Indian Institute of Technology, Jodhpur, Rajasthan, India; 2) All India Institute of Medical Sciences, Jodhpur, India.
	5	**Advancing Hallux Valgus Care: A Review of Data-driven Approaches in Orthoses Design Authors and Co-Authors in correct order** *Mei-Ying KWAN[1], Kit-Lun YICK[1], Joanne YIP[1], Chi-Yung TSE[2]; 1) The Hong Kong Polytechnic University, Kowloon, China, 2) Centre for Orthopaedic Surgery, Hong Kong, China.*
11:55		Break
12:00		**Technical Session 3C (Sustainable Textile & Fashion)** *Chair – Dr. Tulin Dzhengiz, Manchester Metropolitan University*
	6	**Development of a basic structure for the recovery of sorted laundry textiles to a closed cycle based on practical transfer** *Lisa Gudehus[1], Sabrina Mauter[1] and Markus Muschkiet[1,2]; 1) Hochschule Niederrhein University of Applied Sciences, Germany, 2) Fraunhofer Institute for Material Flow and Logistics, Germany*
	7	**From Cabin to Circularity: Credible Upcycling of Aviation Textiles for Sustainable Fashion,** *N. Jammoul[1] and G. Soliman[2]*;* *1) The University of Manchester, Dubai, UAE, 2) The University of Manchester, UK*
12:55		Lunch

FTW 2026 Programme

Day 3 (Wednesday, 15 April 2026)

14:00		**Technical Session 3D (Textile Innovation)** *Chair –*
	8	**Mechanically robust ceramic nanofiber materials** *Cheng Liu[1] and Bin Ding[1,2],* *1) Donghua University, 2) Shanghai Polytechnic University*
	9	**Early Engagement with Supply Chain Technology** *Chelsea Sullivan, VeriVide Limited, UK*
14:55		**Break**

15:00		**Technical Session 3E (Textile Innovation)** *Chair - Dr. Sadat Sayem, Editor - The Textile Institute Professional Publication Series*
	9	**Three-dimensional Woven Structural Composites for Advanced Engineering Applications** *Soumya Chowdhury[1,2], Jost Göttert[1], and Bijoya Kumar Behera[1]* *1) Niederrhein University of Applied Sciences, Germany, 2) Indian Institute of Technology Delhi, India*
	10	**Circular Textiles Under Scrutiny: Performance Trade-offs in Mechanically Recycled Yarns from Post Consumer Textile Waste** *Muhammad Sohaib Anas and Daiva Mikucioniene, Kaunas University of Technology, Lithuania.*
16:00		**End of Day 3**

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Technical Session 1A (Digital Fashion Innovation)

Sensory and Emotional Perception of Pleated Pants: A Comparative Study of Actual and Virtual Representations Focusing on Reflectance

Jisoo Ha[1] and Sujin Lim[2],
[1]Seoul National University, [2]Hongik University

This study aims to provide foundational insights into enhancing interpret-ability and user trust in digital fashion simulations. Clarifying how viewers perceive virtual garments compared with their physical counterparts contributes to a more informed understanding of digital material perception. A 100% polyester jersey wide-leg pants were selected to optimize the observation of dynamic pleat behaviour during wearer movement. To examine the visual transformation of pleated structures during movement, a walking simulation was conducted using the CLO 3D software. Detailed examination of semantic differential adjective pairs revealed that perception gaps were particularly pronounced in items like shiny–matte, textured–flat, luxurious–cheap, comfortable–uncomfortable, and dynamic–static. These descriptors, especially among non-expert participants produced lower scores for perceived realism and greater emotional fluctuation, suggesting that virtual rendering techniques tend to amplify certain visual cues that consumers subconsciously associate with quality or desirability. As results while expert participants displayed consistent and analytical evaluations based on prior tactile experiences, non-experts showed increased emotional volatility and greater sensitivity to surface exaggerations in virtual garments particularly in attributes such as glossiness, texture, and elasticity. These distortions resulted in heightened perceptions of luxury, comfort, or dynamism in digital representations, often disconnected from the actual material properties.

Immersive Storytelling Through AR Textiles, AI and Digital Fashion

Jacqueline Toal,
Dundalk Institute of Technology

This practice-led study explores how traditional textile practices, including printed silk, intersect with digital fashion, projection mapping, AI-generated design, photogrammetry, and augmented reality (AR) to reimagine cultural heritage in immersive environments. Focusing on the Irish textile industry, it examines motifs, materials, costumes, processes, and labour histories to highlight women's creative and economic contributions to both craft and symbolic representation. A hybrid exhibition juxtaposes heritage-informed silk textiles with AI-generated designs, AR overlays, and projection mapping to animate narratives of presence, memory, and resistance centred on women's roles. AR costumes act as interactive storytelling surfaces, layered with motion, sound, and symbolism, enabling audiences to engage with speculative identities and reimagined heritage. Immersive technologies enhance multisensory experience and emotional resonance, while AI-generated patterns expose tensions between tradition, automation, and authenticity. Silk textiles serve as tactile anchors for AR storytelling, bridging physical and digital practices. The research employs autoethnography, artefact-based inquiry, installation, and qualitative feedback to examine lived experiences of interaction. Ultimately, the exhibition positions digital fashion as a speculative space where heritage, innovation, and intersectionality converge, offering a feminist lens rooted in equity, empowerment, and inclusive storytelling.

Technical Session 1B (Sustainable Textile & Fashion)

Labelling structure for textile products considering differentiated eco-design aspects

Sabrina Mauter[1], Dominique C. Adolphe[2], Markus Muschkiet[1,3]
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[3]Fraunhofer Institute for Material Flow and Logistics IML, Center Textile Logistics, Germany, Markus.Muschkiet@hs-niederrhein.de

This research project (PhD) focuses on defining performance classes taking into account various eco-design aspects of the product group textiles for a labelling structure. The background to this is the newly adopted Ecodesign for sustainable products regulation (ESPR) of the European Union from 2024. The ESPR expands the potential scope of application. In addition to energy-related and non-energy-related products, the aspects that have an impact on the environmental sustainability of a product are also being expanded. In addition to energy efficiency, this includes, for example, the durability of products, the proportion of recycled material in products, the possibility of recycling and the reparability. In order to provide consumers with a basis for making purchasing decisions regarding product quality, the ESPR intent to establish a mandatory EU label within the aforementioned framework. The research addresses the question of the extent to which weighting the underlying product aspects could also be a way of influencing the ecological assessment of a product. For this purpose, the selected parameters (from the ESPR) and their assessment basis are weighted according to their respective relevance using a matrix system. This requires the prior specification of criteria on the basis of which the parameters can be calculated.

Examining The Influences of Ghanaian Consumer Care Practices on Garment Longevity

Josephine Opoku, Akosua Mawuse Amankwah and Ebenezer Kofi Howard
Kwame Nkrumah University of Science and Technology, Ghana

Ghana has been a major dumpsite for second-hand clothes in Africa, prompting research into recycling and upcycling concepts. Despite the impact of these efforts, little attention has been paid to some promising solutions that could address this issue. Traditional African garments foster attachment due to their cultural uniqueness and timeless design, encouraging the prolonged use of local clothing over cheaper alternatives, which presents an opportunity worth exploring. However, little discussion exists regarding garment care practices for such clothes and how they could enhance consumption. This research highlights the overlooked care practices that have preserved Ghanaian locally made textile print garments over time. It explores the idea of longevity, which can be utilised to extend clothing lifespan, slow consumption, and inform garment design and retail strategies. Using a mixed method, Convergent Parallel Research Design, it involves dialogues with textile manufacturers, fashion designers, retailers, and consumers, conducted through interviews, descriptive surveys, and observations. The study emphasises the importance of understanding culture-specific insights and consumer behaviour to advance knowledge and promote sustainable practices within the fashion industry, provide a valuable framework for future research, inform policymakers and businesses, and highlight the critical role consumers play in extending clothing lifespan and reducing environmental impact.

Technical Session 1C (Textile Innovation)

(Keynote 2)

Flexible/elastic ceramic nanofibrous materials

Bin Ding[1,2]

[1]*Shanghai Polytechnic University, Shanghai 201209, China*

[2]*Innovation Center for Textile Science and Technology, Donghua University, Shanghai 201620, China*

Ceramic fibrous materials not only meet the needs of people's daily life, but also are widely used in aerospace, national defence, military industry, and other fields. Since ancient times, reducing fibre diameter is one of the important development trends of fibrous materials. When the diameter of the fibre is reduced to the nanoscale, the properties of the material can be effectively improved, and its application fields can be broadened. Electrospinning has become the main method for preparing ceramic nanofibrous materials due to its advantages of abundant spinnable raw materials and high tunability of fibre structure. This report reviews the recent research work of our group on the controllable preparation and functional application of electrospun ceramic nanofibrous materials: (1) A variety of flexible ceramic nanofibrous materials were prepared for the first time to solve the problem of the brittleness of traditional ceramic fibers, which realized its application in the field of thermal insulation. (2) Two new construction methods were innovatively proposed to prepare ceramic nanofiber aerogels with ultralight and super-elastic properties, realizing their special applications in high-temperature thermal insulation, fire protection and heat preservation, flame retardancy and noise reduction.

Nature-Inspired Biodegradable Textile with Integrated Evaporative-Radiative Cooling for Personal Thermal Regulation

Dong Lyu, Siru Chen, Kaixin Lin, Chi Yan Tso

City University of Hong Kong

Cooling textiles have garnered significant attention for enhancing thermal comfort. However, existing designs often rely on single cooling mechanisms, suffer from limited sweat management, and pose environmental challenges due to their reliance on non-biodegradable polymers. Inspired by the directional water transport of spider silk, we developed a fully biodegradable, passive radiative cooling textile (Bio-PREC). This textile integrates dual cooling mechanisms—passive radiative cooling and evaporative cooling—through a hierarchical nanostructure. It achieves a high solar reflectance of 0.97 and a mid-infrared emissivity of 0.92, resulting in a 9°C temperature reduction under direct sunlight. Concurrently, bioinspired Janus structure enables rapid, unidirectional sweat transport away from the skin, providing an additional 8°C of evaporative cooling. Constructed entirely from sustainable biomaterials, the textile exhibits excellent environmental sustainability. By synergizing high-performance thermal-moisture management with biodegradability, this work provides a comprehensive and eco-friendly solution to the limitations of conventional cooling fabrics and opens new avenues for sustainable functional material development.

Technical Session 1D (Textile Innovation)

Innovations in Infrared Coating Technologies for Yarns

Liam O'Neill
Roaches, UK

The development of coated, bonded and composite yarns has become a major focus in modern research and technical textiles. Investment and interest in this area continue to grow, leading to the rapid emergence of new chemistries, processes, and materials. Despite this progress, many of these modern materials have been developed only at small scale, often in vitro, and those that have been scaled up frequently rely on outdated approaches to yarn coating/bonding.

Close collaboration with world-leading thread manufacturers has highlighted the need for new methods for the synthesis of engineered yarns on a production scale. The development of a vertical coating system has enabled greater penetration of chemicals into yarns (when desired), improved coating uniformity, and higher product throughput within a smaller overall footprint compared with conventional horizontal systems.

The vertical system enables semi-continuous processing of yarns with precise control of tension at each stage of the coating process, including pre-coating, coating, IR-oven drying and air drying. Additional control of dosing systems, synchronised with the running speed of the machine, allows accurate regulation of chemical deposition while significantly reducing chemical consumption compared with the large bath volumes typically required in conventional horizontal systems. The machine incorporates four applicators, enabling the introduction of up to four different chemicals within a single processing pass, with each yarn passing through the oven a total of 17 times.

Such developments are expected to support the wider adoption of functional and composite yarns within advanced technical textiles, including emerging medical and biomedical applications.

Technical Session 1D (Textile Innovation)

Sustainable Textile Engineering Through Bio-Derived Cellulosic Materials

Aida Fadakarsarkandi, Omid Doustdar, Mingchao Liu, Karl David Dearn
Department of Mechanical Engineering, School of Engineering,
University of Birmingham, Birmingham, B15 2TT, United Kingdom

The textile industry faces challenges to use environmentally friendly materials. Meanwhile, cotton, despite being a natural and renewable fibre, remains one of the most environmentally challenging agricultural and industrial products in the world, especially given its widespread use across industries, notably the textile industry. In recent years, the environmental consequences of cotton production and consumption became increasingly apparent. Cotton requires huge amounts of water, extensive farmland, and significant quantities of pesticides and chemical fertilisers for cultivation and processing, factors that ultimately lead to air, water and soil pollution. In this regard, bacterial cellulose as one of the sustainable alternatives produced through environmentally friendly fermentation processes has gained significant attention. Bacterial cellulose can be generated from a variety of wastes and agricultural residues and therefore does not require agricultural land, irrigation, or toxic chemical inputs. Furthermore, its production in controlled systems results in significant reductions in wastewater and pollutants. This review examines the sustainability challenges associated with cotton production and compares them with the benefits of green technology in bacterial cellulose production. Emphasising reduced resource consumption, compatibility with the circular economy, and a much lower environmental impact, bacterial cellulose is presented as a promising option for the future of sustainable textiles.

Cationic Microencapsulation of Coconut Oil with CHPTAC and Ethyl Cellulose for Eco-Friendly Thermally Stable Textile Coatings

Zarnab Gul and Daiva Milašienė
Faculty of Mechanical Engineering and Design, Kaunas University of Technology, Lithuania.

Eco-friendly coatings that provide multifunctional benefits, such as thermal regulation and enhanced adhesion, are at the forefront of research in smart textiles. This study focuses on a naturally biodegradable shell made of ethyl cellulose, which eliminates negative impacts while promoting green processing. Six different samples were prepared, varying in 3-Chloro-2-Hydroxypropyltrimethylammonium Chloride (CHPTAC) concentration and encapsulation time, to study their thermal and structural properties. Results from Scanning Electron Microscopy (SEM) confirmed that the microcapsules had smooth and uniform shapes, showing successful encapsulation. Zeta potential results showed a positive surface charge in high-CHPTAC samples (+31 to +33 mV), improving attachment to textiles. Differential Scanning Calorimetry (DSC) showed that samples with lower CHPTAC concentrations (e.g., TC2/6 and TC4/6) had higher enthalpy values (51.16 J/g and 49.95 J/g), indicating they could store more heat energy. Results suggest that these capsules have good heat storage capabilities alongside improved attachment to textile surfaces. This development can contribute to reducing environmental impact by replacing harmful synthetic cross-linkers and promoting biodegradable, non-toxic solutions.

Technical Session 1E (Fashion Innovation)

The Sixth Sense Garment: A State-of-the-Art Framework for Sustainable Neurofashion

Andrew P. Burnstine,
Lynn University, USA

Fashion textiles and wearables innovation increasingly operates at the intersection of artificial intelligence embodied interaction and planetary boundaries, yet most computational advances remain focused on upstream activities such as forecasting personalization and inventory management. This leaves the apparel use phase underexplored despite its central role in sustainability outcomes related to wear duration care practices and premature disposal. This paper introduces the Sixth Sense Garment, a conceptual framework for smart and adaptive apparel that integrates biometric and environmental sensing with responsive textile systems to support wearer regulation and sustained engagement during use.
Grounded in affective computing neuroaesthetics and circular economy theory, the framework combines privacy aware edge intelligence modular textile construction and alignment with the European Union Ecodesign for Sustainable Products Regulation including Digital Product Passport requirements. Through comparative analysis of adaptive fashion exemplars by Anouk Wipprecht Iris van Herpen and Hussein Chalayan, the paper traces a shift from performative and reactive garments toward embodied and use oriented design strategies.

This paper outlines a research through design agenda supported by real world evaluation and longitudinal behavioural indicators including wear duration repair frequency and delayed replacement. The contribution lies in demonstrating how smart textile systems can extend garment lifetimes and reposition wearables as active agents in circular fashion practice.

New motifs for making waves: An update on motif design for optimal performance in women’s competitive swimwear

Renee Lamb, Jennie Cook, Jacqueline Mullins
Virginia Commonwealth University

Women gained access to competitive swimming platforms in the early twentieth century, and debates about their swimsuit designs have embroiled us ever since. Originally, women were restricted to competing in cumbersome suits that were constructed from a wool or cotton twill, dark in coloration, and solid in color. Patterns, prints, and other design motifs remained largely absent from women’s competitive swimwear until the 1970's when new fiber technologies and loosening uniform restrictions ushered in a wider range of suit designs. Even with these innovations, silhouette and fabric construction have often been at the center of our cultural debates about women's competitive swimwear. The impacts of motif, color, and pattern are many times overlooked. This creates a gap in the research that begs the question: Could a change in motif usage on women's competitive swimwear impact a competitive swimmer’s performance? Using a mixed methods approach, this study explored this question using document analysis, interviews, and surveys of current swimmers to create a historical and current overview of the competitive swimwear environment. This data has shaped the creation of new competitive swimwear motifs that will be shown in a 2026 exhibition and can be tested in future studies for performance impacts. This presentation provides an update to the 2025 presentation on the study, exploring the 2-year research study designed to create these motifs and its incorporation of female swimmer’s voices into the design process.

Technical Session 2A (Sustainable Textile & Fashion)

What about us? Academics role in cocreating circular ecosystems: Evidence from Circular Textiles and Fashion transitions in the UK

Alaa Abed and Tulin Dzhengiz
Manchester Metropolitan University

As academics, we often direct attention outward examining how businesses, NGOs, policymakers, and communities respond to planetary crises. But rarely do we turn the lens inward. Rarely do we ask: “Mirror, mirror on the wall, what role do we play in it all?” What roles do academics assume in the co-creation of circular solutions? How are they embedded within the very ecosystems they study? This study examines the often-overlooked role of academics in shaping circular economy (CE) transitions, particularly within the UK’s circular fashion ecosystem. Through a scoping review of 78 academic publications, the study identifies four key roles academics play in circular ecosystems: generating and translating knowledge, facilitating cross-sector collaboration, challenging unsustainable practices and raising justice concerns, and mobilising resources and policy to embed circular change. To deepen this understanding, the research includes 31 interviews with UK academics working on circular fashion and textiles, a sector facing major issues such as overproduction, waste colonialism, and limited investment in repair and reuse. Findings show that academics act as transdisciplinary bridge-builders, system thinkers, impact catalysts, and orchestrators. They connect diverse actors, mentor innovators, influence policy, support community repair initiatives, and help shift cultural norms toward just and regenerative futures. Despite their impact, academics face structural and relational challenges including funding constraints, barriers to collaboration, stemming from disciplinary silos, and misaligned institutional priorities. By mapping these dynamics, the study turns the mirror back on us as academics and asks: What about us? How do we (as academics) need to adapt and change in order to enable the circular transitions? Ultimately, it invites reflection on how the academic community must evolve if it is to genuinely support and enact the circular transitions we advocate.

Adire Symbols in Textile and Fashion Designs: A Yoruba Cultural Perspective

Olayinka Olumide BAKARE and Christianah Yetunde KOLAWOLE
Department of Industrial Design, Faculty of Environmental Sciences,
Modibbo Adama University, Yola, Adamawa State. Nigeria.

This study explores the creative works of designer-scholar Olayinka Olumide Bakare, showcased in a solo exhibition. The designs draw inspiration from Yoruba cultural experiences, proverbial expressions, and Adire symbols, utilising Batik techniques. The research highlights the designer's use of Adire motifs and patterns to communicate esoteric and exoteric meanings. Influenced by artistic training and environmental factors, the designer's work reflects the cultural heritage of south-western Nigeria. The findings aim to boost Adire design culture, incorporating modernity and cultural motifs in textile and fashion designs. This innovative approach is expected to inspire a new wave of creative expression in the region. The study demonstrates the designer's expertise in blending traditional and modern elements, resulting in unique and meaningful designs. By exploring the significance of Adire symbols, this research contributes to the preservation and promotion of Yoruba cultural heritage. Key words: Adire Prints, Batik Techniques, Fashion Design, Yoruba Symbols.

Technical Session 2B (Textile Innovation)

Research on the Flame-Retardant Properties of Bio-Based Materials

David Zheng
Shandong Aobo Environmental Protection Technology Co., Ltd, China

This paper systematically explores the integration of flame retardants with both pre-treatment and post-treatment processes in organically combined nonwoven production, which addressing the inherent flammability of bio-based fibre materials, this approach effectively enhances flame resistance while preserving the natural and environmentally friendly properties of bio-based nonwoven material. The innovative customization of flame-retardant bio-based nonwoven products enables their application in various sectors, including personal protective equipment, home textile mattresses, architectural interiors, high-speed rail and automotive industries, as well as filtration and separation technologies, this research aligns with global sustainability trends and advances the development of eco-friendly functional materials.

Fabrication Strategies and Functionality of Super-elastic Electrospun Nanofibrous Aerogels

Fei Wang
Donghua University, Shanghai 200051, China E-mail: feiwang@dhu.edu.cn

Electrospun nanofibrous membranes, as the forefront of advanced fibrous materials, hold extraordinary potential applications ranging from environmental, energy to biology owing to their integrated advantages of fine diameter, extremely high aspect ratio, and high porosity. Despite their outstanding potential, the major problem associated with electrospun nanofibers is their anisotropic lamellar deposition character, which leads to the bottlenecks in further improving the thickness and porosity of current electrospun nanofibrous materials. Alternatively, three-dimensional nanofibrous aerogels with both high porosity and excellent compressive resilience might open up the possibility of solving the above problem and expand the applications of electrospun nanofibers; however, creating such aerogels has proven extremely difficult. Therefore, we create fibrous, isotropically bonded elastic aerogels with a cellular network by two strategies, including fibrous freeze-shaping technique, and direct electrospinning. The successful synthesis of such fascinating aerogels will open broad technological implications in thermal insulation, air filtration, and flexible electrical devices.

Technical Session 2C (Sustainable Textile & Fashion)

Durability and Desirability in the High Street: A Case Study Analysis of Clothing Donated to the Marks and Spencer Archive

Kevin Almond and Judith Simpson
University of Leeds, UK

This research centres on a case study examining clothing donated to the Marks and Spencer Archive held at University of Leeds. The items examined had been kept by their owners for a long period of time. They had been handed on to other people to wear or altered in a bid to sustain their durability and desirability. Pieces spanned from the 1940s to the 2000s and ranged from men's, women's and childrenswear, which included dressing gowns, dresses, suits, a mackintosh, lingerie, knitwear, trousers, pyjamas, vests, swimming trunks and shirts. Each item included a donor story detailing, which Marks and Spencer's stores had been visited and what each garment had signified to the donor as well as documenting how items had been altered or mended. A focus group was convened to discuss key questions related to the garments. The conversations were recorded and analysed to identify key themes with which to inform Marks and Spencer sustainability strategies. The research also discusses the results of this case study in relation to a literature review that explores the wider connections between emotional attachments to remade and reused clothing as well as the garment making skills that need to be acquired to alter them.

Integrating repurposing concepts into textile innovation: Humming the Ghanaian eco cottage innovation stories

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The study used a structural textile design approach to examine the possibility of converting used trashed sachet water bags through material collaboration into repurposed eco innovative plastic fabric, a physical creation as part of contributing to Ghana's zeal towards the achievement of the SDGs and environmental sustainability. The studio-based research paradigm was adopted with repurposing and composite material collaboration methods to express an artistic creation. The trashed sachet water bags were sampled for consistency in weft length. The trashed sachets bag were cut out into strips and joined as long weft thread with a composite of cotton warp thread for a broadloom weaving process. The descriptive analysis presented a result of an eco-innovative plastic fabric. The study brought to bear how the numerous trashed water sachet bag wastes can be converted and transformed into sheet of fabric for different manufacturing possibilities. The results also highlighted the environmental impact of single-use water sachet plastics at market, picnic sites, beaches etc, which threaten life below water (SDG 14), life on land (SDG 15), and responsible consumption and production (SDG 12), however fabric decoration trajectories can help solve these issues. Revealing the material component for the project will effectively raise awareness and promote change in societal consumption and disposes of trashed sachet water bag. Based on the outcomes and the properties of the created fabric sheet large scale production can be explored for technical uses.

Technical Session 2D (Digital Fashion Innovation)

Understanding User Responses to Virtual Try-On Through Large-Scale and Qualitative Studies

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Virtual Try-On (VTON) has advanced rapidly in visual realism, yet less is understood about how users cognitively and emotionally respond to seeing digital representations of themselves wearing suggested fashion items. This paper presents applied research insights from Glance AI (glance.com), a large-scale consumer fashion discovery app, examining the intersection of VTON, fashion concept presentation, and user feedback. Our analysis is grounded in the generation of VTON images across more than 200,000 unique users, spanning diverse body types, skin tones, and garment categories. We study how self-visualisation alters user perception of style, fit, and personal relevance compared to traditional model-based imagery. In addition to large-scale behavioural signals, we incorporate qualitative findings from structured user focus groups conducted across multiple demographics. These sessions provide deeper insight into user trust, emotional resonance, and perception of realism when engaging with personalised VTON imagery. By triangulating quantitative engagement data with qualitative feedback, we identify key design and system-level considerations, including representation fidelity, expectation management, and latency, that influence adoption and sustained use. Together, these findings offer practical guidance for the development of human-centred fashion AI systems that place the user, not the garment, at the core of fashion discovery.

How Virtual Fashion Experiences Realize: Digital Materiality and Tactility

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This study investigates how VR fashion content—a non-material visual medium—elicits material sensations and realism for users. Fashion, traditionally perceived through multiple senses such as texture and weight, is now increasingly experienced within digital platforms like the metaverse and XR, where physical materials are not required. Exploring how the virtual experience of VR fashion films manifests 'digital materiality' is essential for understanding human–technology–environment relations. Drawing on literature, digital materiality is conceptualised as performative–sensory, technical–structural, and sociocultural–meaning materiality. Interviews with fashion professionals who have engaged with VR fashion content were conducted to analyse its expression. Findings reveal three key aspects: disembodied tactility, where users sensorially imagine textures, weight, and movement through immersive spatiotemporal experiences; technical realness of virtual fabric, achieved via physical simulations and graphic structures that realistically render garment qualities; and extended performativity of fashion identity, as users identify with virtual bodies, styles, and brand narratives, constructing fashion identities as real within VR environments. These results suggest that VR fashion content stays not merely a digital image but a medium generating new form of fashion materiality through the interplay of sensation, technology, and culture. This study extends existing materiality-centric fashion theories, offering a theoretical basis for future research on VR interface design, digital fashion aesthetics, and virtual fashion consumer behaviour.

Technical Session 2E (Textile Innovation)

Adjustable Textile Recycling Machine: Impact of Machine Settings on Fibre Quality

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The rapid growth of the textile industry has led to significant environmental challenges, particularly due to textile waste. Mechanical textile recycling, which converts textile waste into recovered fibres, is a promising solution. However, the quality of recovered fibres is often compromised due to fibre shortening during the process. The settings of the recycling machine, which directly control the shredding of textile waste into fibres, are likely to have a significant impact on fibre quality. This study addresses this critical factor by designing a laboratory-scale textile recycling machine with adjustable settings, including the speed of the opening roller, the speed of the feeding system, and the distance between the feeding system and the opening roller. The machine integrates a precision-controlled feeding system and a shredding unit with a customized opening roller, enabling controlled experimentation to investigate the impact of machine settings on fibre quality. The findings aim to provide valuable insights for optimising mechanical recycling processes, advancing more efficient and sustainable textile recycling technologies.

Coupling Radial Conduction with Radiative Emission: The CAMIC Framework for High-Efficiency Passive Radiative Cooling

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Passive radiative cooling represents a promising zero-energy strategy for personal thermal management. However, the efficacy of conventional polymer-based PRC textiles is intrinsically compromised by low thermal conductivity, which imposes a significant thermal impedance between the skin and the radiative interface1. This study establishes the Conduction-Assisted Mid-Infrared Cooling (CAMIC) theoretical framework to elucidate the critical coupling between radial heat conduction and surface spectral emission. We experimentally characterized i2Cool Breeze, a nanomodified textile, against standard matte nylon. A dimensionless metric, the CAMIC Number, was derived to quantify the transition from conduction-limited to radiation-dominated regimes. Results demonstrate that the Breeze fabric exhibits a simultaneous enhancement in thermal conductivity (+34.8%) and mid-IR emissivity. Consequently, the CAMIC Number increases by approximately 40%, validating that minimizing thermal resistance is prerequisite to maximizing radiative potential. Furthermore, dynamic modelling indicates a 16% extension in thermal penetration depth, facilitating effective sub-dermal heat dissipation. These findings propose CAMIC as a superior design paradigm for next-generation thermal regulation textiles.

Technical Session 2E (Textile Innovation)

Ultrathin Dual-Network Aerogel Metafabric for Efficient Self Sustainable Heating via Dual Air-Gelation Synthesis

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Incorporating passive heating structures into personal thermal management technologies offers an effective approach to mitigating the escalating energy crisis. However, existing passive heating materials often face challenges in balancing thickness and insulating capabilities, leading to compromises in comfort, space efficiency, and thermoregulatory performance. In response, we developed a dual air-gelation strategy that directly synthesizes an ultrathin, self-sustainable heating metafabric with a 3D dual-network structure during electrospinning. By precisely controlling the interactions among polymer, solvent, and water, our method facilitates microphase separation of the charged jets. Additionally, the distribution of carbon black nanoparticles within the charged fluids is adjusted to form fibrous networks comprising interlaced aerogel micro/nanofibers capable of heat storage. With a thickness of just 0.18 mm, this integrated metafabric exhibits exceptional thermal insulation (15.8 mW $m^{-1}K^{-1}$), super-hydrophobicity, enhanced mechanical properties, and high breathability, while also maintaining a self-sustainable radiative heating ability, capable of long-lasting warming by 8.8 °C. This dual air-gelation strategy opens up new possibilities for the development of advanced fibrous materials, with promising applications in smart textiles and thermal management systems.

Design of Thermal-wet comfortable and Cooling Wearable Masks via Engineered 2D Nanofibrous Networks for Enhanced Personal Protection

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Wearable protective masks play a vital role in safeguarding human health against airborne particulate matter (PM) in polluted environments. Yet, conventional masks often suffer from high breathing resistance and thermal discomfort due to their dense and thick structures. In this study, we present a novel phase-inversion assembly strategy based on anti–Plateau–Rayleigh instability to fabricate lightweight two-dimensional nanofibrous webs (2D nanowebs) specifically designed for next-generation wearable masks. By precisely tuning the surface tension of polymer solutions, we achieved stable liquid films that transform into continuous interconnected nanofibrous networks through rapid nonsolvent-induced phase separation. The resulting 2D nanowebs exhibit an ultrathin monolayer structure with fine features including nanoscale fibre diameter and uniform pore size. When integrated into a mask prototype, the nanoweb membrane demonstrates outstanding filtration performance against the most penetrating particle size PM0.3 while maintaining low airflow resistance and high moisture permeability. Furthermore, the unique nanoarchitecture provides passive personal cooling, lowering the in-mask temperature by 3.9°C during outdoor wear. This work highlights the potential of structurally engineered nanofibrous materials in advancing the functionality and wearability of protective textiles, offering a promising pathway toward smart, comfortable, and high-performance wearable protection systems.

Design Evaluation of Protective Fabrics for Motorcyclists

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As per EN 17092 the motorcyclists' pants are divided into three zones of performance based on the extent of abrasion they are exposed to in the event of accident. In this study, six fabric variants were engineered by varying the weave structure along with variation in weft yarn type. Cotton/para-Aramid blend (70/30) yarn was used in the warp, whereas two types of weft yarns— polyester/nylon and cotton/nylon 70/30 blend were incorporated. Three weave structures, namely plain, matt, and 2/2 twill, were utilized to produce six fabric samples to evaluate the combined influence of weave structure and weft yarn on mechanical performance of the protective cloth. A set of tensile strength and abrasion resistance tests were conducted. Analysis of variance was carried to determine differences among the samples, with a significance level of 0.05. Fabrics with cotton/nylon weft exhibited the highest warp-way tensile strength in matt weave and the highest weft-way tensile strength was noted in plain weave. Abrasion resistance test inferred that matt weave offered superior performance with the lowest loss in mass among all samples. Based on abrasion resistance and tensile strength developed fabrics can be recommended for usage in Zone 3 of motorcyclists' protective pants. Further comfort property evaluation of the developed fabrics is proposed.

Technical Session 3B (Wearable Technology Innovation)

MXene-Enhanced Nanofiber Yarns for Dual-Mode Sensing in Wearable Electronics

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Flexible strain-sensing yarns are crucial components in smart textiles. However, integrating high-performance tensile and pressure sensing into a single yarn to monitor comprehensive human activities remains a significant challenge. In this work, we present a dual-model strain-sensing nanofiber yarn fabricated by self-shrinking MXene-coated carbon black/thermoplastic polyurethane (MXene@CB/TPU) composite nanofiber films into Janus-structured slim scrolls, followed by double twisting using internal stress. Carbon black doping enables conductive nanofibers to bridge propagated cracks in MXene coating, forming a synergetic conductive network. This structure enhances the yarn's tensile sensing linearity from 0.810 to 0.994, while achieving a broad range of 106% with a gauge factor of 56. The self-shrunk and double-twisted architecture also provides dual-stage pressure sensitivity, endowing the yarn with an ultrahigh pressure-sensing range of up to 10 MPa, a sensitivity of 17.74 MPa-1, and a linearity of 0.997. Furthermore, the yarn exhibits an excellent washability (>30 ultrasonic washing cycles), due to the protection offered by crosslinked nanofiber encapsulation of the MXene layer. We demonstrated the practical applicability of this yarn by stitching it into various smart textiles, which successfully detected both tensile and pressure signals from full-range human activities. As a proof-of-concept, a smart waist support developed using this yarn can monitor both dynamic and static waist status. This work achieves high-performance dual tensile and pressure sensing in smart textiles using a single yarn, opening new pathways for advanced wearable electronics.

Technical Session 3B (Wearable Technology Innovation)

Architectural Strategies for Textile-Integrated Wearable Sensor Systems in Healthcare-Oriented Monitoring

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Research Gap: Textile-integrated wearable sensors offer strong potential for continuous healthcare monitoring, but adoption is limited by challenges in conductive integration, system routing, and signal stability during motion and repeated use. Most existing research focuses on isolated materials or sensors, with insufficient attention to holistic system architecture and long-term wearability.

Aim: This work investigates architectural strategies for integrating textile-based conductive circuitry into wearable systems, with emphasis on interconnect stability, modularity, and user-centric design for healthcare-oriented monitoring.

Methods: A textile-integrated wearable framework was developed by embedding conductive elements within fabric to function as sensing interfaces and flexible interconnects. Electrical behaviour was qualitatively evaluated under temperature and voltage variations as well as repeated mechanical deformation (bending and stretching). System-level design aspects including textile circuit layout, module interfaces, and ergonomic garment construction were analysed to optimise fit, pressure distribution, and wearability.

Findings: Observations indicate material-dependent trade-offs between electrical stability and mechanical compliance, influencing integration strategies and textile circuit architecture. Architectural design choices were found to mitigate motion-related disturbances while preserving essential textile properties and supporting durability.

Implications: By prioritising architectural integration over application-specific implementations, this work provides design guidance for scalable, reusable, and user-centric textile-based wearable sensor systems for healthcare monitoring.

Technical Session 3B (Wearable Technology Innovation)

Advancing Hallux Valgus Care: A Review of Data-driven Approaches in Orthoses Design

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Background: Hallux valgus (HV) is a common orthopaedic condition closely associated with pain, reduced mobility, and diminished quality of life. Conventional orthoses often lack individualized biomechanical and geometrical optimization, limiting their clinical effectiveness and revealing a significant research gap in patient-centred care.

Objective: This review examines the transformative shift towards data-driven design methods in HV orthoses design. This review aims to determine the effectiveness of data-driven methods in HV orthoses design and how to utilize these methods to improve the design.

Methods: Electronic databases are searched up to December 2025. Studies with content focus on HV orthosis design and data-driven methods, such as 3D foot scans, gait analysis, pressure mapping, computational modelling, and machine learning algorithms are included.

Results: A total of 1145 articles are identified. The results show that leveraging patient-specific data enables the development of orthoses that improve fit, corrective force, and comfort. This review provides a comprehensive analysis of how emerging technologies enable personalized design paradigms. By quantifying patient-specific deformity geometry and gait pathology, designers can apply finite element analysis to simulate device-foot interaction and predict outcomes. Machine learning models further optimize this process by identifying optimal design parameters directly from clinical datasets.

Technical Session 3C (Sustainable Textile & Fashion)

Development of a basic structure for the recovery of sorted laundry textiles to a closed cycle based on practical transfer

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The research project “ReCircleTex” deals with the material flow of ‘laundry waste’, which serves as input for fibre-to-fibre recycling. Due to the process flows in laundries, it is possible to feed specific fractions of laundry waste into the appropriate material recycling processes. In this case, these are fractions with a high cotton fibre content from product categories such as hotel and catering linen. With the help of a practical transfer, the concept developed for the recovery of sorted textiles was tested and further specified in a pilot laundry. Furthermore, as part of a specific textile sorting process carried out by the Center Textile Logistics, a tailored sorting catalogue was created, which served as a structured basis for the systematic recording and assessment of the products examined. Sorting was carried out manually with the help of automated sorting technologies, such as NIR technology for determining material compositions. The project highlights that laundry waste has great potential as an input stream for fibre-to-fibre recycling due to the materials used, the product structure and its colour content. In addition, the consistent waste stream and the predictable quantities it generates are another prerequisite for the long-term practical implementation and optimisation of fibre-to-fibre recycling.

Technical Session 3C (Sustainable Textile & Fashion)

From Cabin to Circularity: Credible Upcycling of Aviation Textiles for Sustainable Fashion

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Circular economy initiatives are increasingly incorporated into ESG agendas. In carbon-intensive sectors such as aviation, circular interventions without direct emissions-reduction effects are often framed as peripheral or symbolic, heightening concerns about greenwashing; however, limited research explains how such initiatives are rendered credible within ESG practice. This paper analyses the implementation and substantiation of aviation-textile upcycling as an ESG practice through a qualitative case study of an international airline. Focusing on a cabin retrofit programme, the study traces the recovery, sorting and repurposing of decommissioned interior materials, particularly seating textiles and cabin soft furnishings, and examines downstream pathways such as redistribution and partner-led product making. Empirical material combines semi-structured interviews with executives and operational staff, field observations, and documentary analysis of ESG reporting artefacts, performance indicators, and investment rationales. The findings show that simply recycling materials doesn't automatically make it legitimate; instead, legitimacy comes from the "evidence work" that connects material processes with tracking systems, measurable standards, management practices, and reporting systems that can withstand both internal and external review. Organisational stakeholders articulate criteria for credible impact, disclose limitations and trade-offs (e.g., scale constraints and the bounded relevance of emissions), and translate circular outcomes into ESG accounts. The paper advances scholarship in the circular economy and ESG by theorising how upcycling initiatives in high-emission sectors are implemented, justified, and defended under conditions of contested legitimacy.

Technical Session 3D (Textile Innovation)

Mechanically robust ceramic nanofiber materials

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Silica nanofibers (SNF) and their aerogels suffer from poor mechanical properties due to defects and weak bonding. This study aimed to enhance their mechanical performance. For 1D SNF, a self-templated method was developed via controlled polycondensation of silica sol without polymer, yielding dense, defect-free fibers. For 3D aerogels, SNF films were impregnated in inorganic sol, laminated, and calcined to form lamellar multi-arch structures. The self-templated SNF exhibited superior tensile strength and flexibility, while the aerogels withstood 160 kPa at 60% strain (no stress loss after 500 cycles) and showed excellent compression recovery at ±196–1100 °C. This work provides effective strategies for preparing superstrong SNF and aerogels, expanding their applications in new energy, biomedicine, and environmental fields.

Technical Session 3E (Textile Innovation)

Three-dimensional Woven Structural Composites for Advanced Engineering Applications: Tailored Weave Architectures and Circular Upcycling of Textile Waste into Geosynthetic Composites

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Three-dimensional woven fabric-reinforced composites (3DWFRCs) constitute textile-reinforced structural materials for engineering systems in aerospace, automobiles, defence, and renewable-energy sectors. 3DWFRCs offer advantages, including superior impact resilience, structural integrity, near-net shape capabilities, and enhanced damage tolerance over conventional 2D laminates. Notwithstanding their demonstrated superiority over conventional laminated architectures, woven-preform design rules that correlate 3D weave descriptors—binder-yarn pathway and float length, stuffer-layer configuration, direction-resolved (X–Y–Z) fibre volume fraction, and inter-yarn crossover density, with impact resistance, damage initiation and progression, and post-impact residual load-carrying capacity remain inadequately established, particularly under dynamic low-velocity impact loading. This limitation impedes the rational, application-driven design of 3DWFRCs, because preforms that appear nominally comparable can exhibit different architecture-governed energy-dissipation mechanisms, through-thickness constraint and load-transfer characteristics, and post-impact compressive integrity. Addressing this gap requires architecture-controlled investigations that resolve structure–damage–property relationships across relevant impact loading modes. Accordingly, weave architecture is positioned as a primary design lever for engineering damage-tolerant 3DWFRC structures with predictable, optimizable post-impact performance in practice. In parallel, this work demonstrates a circular manufacturing pathway in which end-of-life textile waste is mechanically reclaimed and re-engineered into reinforcement architectures for geosynthetic composites, including geocells and geogrids, by leveraging 3D weaving and consolidation, while maintaining traceability for reuse and end-of-life recovery.

Circular Textiles Under Scrutiny: Performance Trade-offs in Mechanically Recycled Yarns from Post Consumer Textile Waste

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The growing environmental concerns surrounding cotton production such as excessive water usage, pesticide application, and textile waste accumulation have intensified the need for sustainable textile recycling solutions. Cotton farming, known for its excessive water usage and pesticide application, significantly contributes to environmental degradation. The textile industry, which generates millions of tons of waste annually, exacerbates this issue, particularly with the disposal of post-consumer garments. This study investigates the feasibility of recycling post-consumer cotton denim waste into new yarns by examining the effects of recycled fibres percentage, twist level, and spinning methods (ring vs. rotor) on the yarn and fabric quality. Recycled cotton fibres, blended with chemically recycled polyester in 3 different ratios, and 12 samples were developed which then knitted into single jersey fabrics. Results indicate that increasing recycled content by more than 10% significantly degrades the yarn strength, elongation, and fabric durability due to the fibre shortening from prior use. This research raises important questions about the feasibility of large-scale post-consumer textile recycling in achieving sustainability goals while maintaining the quality of the final product.
Keywords: Post consumer textile, Circular economy, Sustainability, Recycling, Environmental concerns