TRAVEL REPORT

Summary Details

CRDC Project Number: RMIT 11998

Project Title: International travel attend and present: Materials Innovation towards Fashion Sustainability

Project Commencement Date: 25/10/2025 **Project Completion Date:** 05/11/2025

Researcher: Xin Wang

Organisation: Royal Melbourne Institute of Technology

Recognition of support: Royal Melbourne Institute of Technology acknowledges the financial assistance of the Cotton Research and Development Corporation in order to undertake this project.

Final Report

Project Summary:

This project supported A/Prof. Xin Wang to attend the 3rd International Conference of Fashion and Sustainability (ICFS 2025) and deliver an invited talk entitled “Materials Innovation towards Fashion Sustainability”. The planned travel offered an opportunity for A/Prof. Wang to exchange his research results and outcomes within a broad international community in the context of fashion and sustainability, and A/Prof. Wang updated his knowledge and skills from a broader international community by attending the conference presentations and events. This travel also consolidated A/Prof. Wang's research network, especially the cotton-related research collaboration with the School of Textile Science and Engineering at Wuhan Textile University (WTU).

Outcomes & Impact for Industry:

A/Prof. Xin Wang attended the 3rd International Conference of Fashion and Sustainability (ICFS 2025) between 26 October 2025 and 29 October 2025. A keynote speech entitled "Materials Innovation towards Fashion Sustainability" was done by A/Prof. Wang as part of the conference proceedings. Apart from presenting his work, A/Prof. Wang attended presentations by other fellow researchers in the field of fashion sustainability. A/Prof. Wang also participated in other activities and events during the progression of the conference. This has greatly enhanced his connection to fashion industry and research community.
A/Prof. Wang also co-chaired the Fashion Sustainability Workshop in which educators/academics from UK, India, Bangladesh, Hong Kong and China shared their

practices in Fashion Sustainability education and research opportunities. This has greatly benefited A/Prof. Wang's professional development both as an educator and researcher. A/Prof. Wang used this travel to consolidate his ongoing research collaboration with the School of Textile Science and Engineering of Wuhan Textile University, through which important research outputs in cotton nanocomposites and functional applications were contributed.

M&E Outcomes: Number of outcomes achieved - 1

People Connections:

Attended the 3rd International Conference of Fashion and Sustainability (ICFS 2025) between 26 October 2025 and 29 October 2025. Presentation slides are attached.
Co-chaired the "Sustainable Fashion Workshop" to discuss challenge and opportunity in the education and research in Fashion sustainability.

M&E People: Number of connections achieved - 2

Learnings:

The key learning from this project is that fashion sustainability is not just a discussion point but an action that is happening worldwide, both in education and research. The community and academia are aware of the importance of circularity and sustainable development in fashion and textiles sector.
RMIT's School of Fashion and Textiles has the research environment and education capabilities to make enormous contribution in this area, and ongoing research activities together with education will continue to make further success in this.

M&E Learnings: Number of learnings and planned actions from the project – 1

Materials Innovation towards Fashion Sustainability

A/Prof. Xin Wang

School of Fashion and Textiles, RMIT University

Melbourne, Australia

Email: xin.wang@rmit.edu.au

School of Fashion and Textiles

QS rankings: 125 globally, 10th in Australia

THE rankings: 251-300 globally, 14th in Australia

RMIT is a global leader in fashion and textiles education. Our programs are internationally recognised, with graduates making an impact across the world.

We offer certificates, diplomas, associate and bachelor degrees, and postgraduate programs in state-of-the-art facilities at RMIT's Melbourne campuses. Our students gain real-world experience working with global companies on projects that explore the connections between **design**, **technology** and **business**.

- QS subjects rankings: 26th Art & Design
- Shanghai rankings: 45th Textile Sci. & Eng.

Research at the School of Fashion and Textiles

The School of Fashion and Textiles engages in research and scholarship to address critical questions of our time and to speculate on future conditions for a sustainable urban orientated world.

The School's research community innovates through design, technology and enterprise within three research themes and in the Research Centre **WEFT**

- **Products & Materials**
- **Circular Systems**
- **Ways of Being**

The Flash-Fire Laboratory for Advanced Manikin & Material Evaluation (FLAMME), funded by the Australian Research Council

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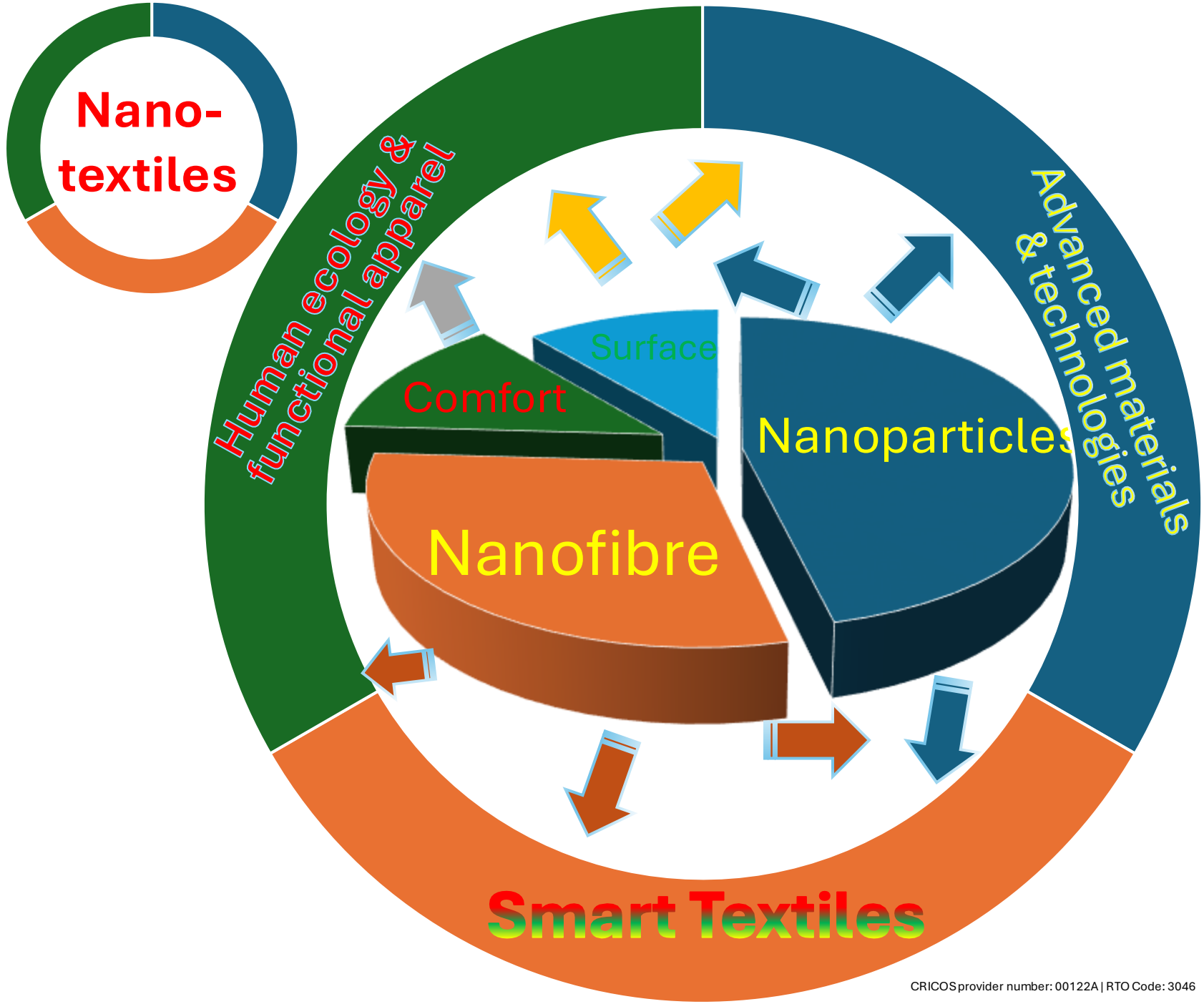
The Nanotextiles group brings together the expertise in applying emerging nanotechnology to develop next generation smart textiles that have a wider application potential to fulfil the growing needs from consumers in terms of functions and protections. The group focuses on developing new nanofibrous materials and advancing textile finish technology in a multidisciplinary way that involves textile technology, nanotechnology, surface science and manufacturing engineering.



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Outline

- Background – Materials Innovation
- Sustainability & circularity
- Examples on cotton textiles
  - Performance
  - Materials actuator
  - Environmental responses
  - Sustainable coloration

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Future textiles

- To help address the challenges we are facing in a transforming world, e.g., virus, global warming, geographical tension (military/defence), energy crisis, environmental/sustainability
- To serve our growing needs in health, safety, wellbeing and aesthetics
- To adapt to industry 4.0/5.0 in interconnection and automation, e.g., IoT, artificial intelligence, quantum communication, big data, etc.

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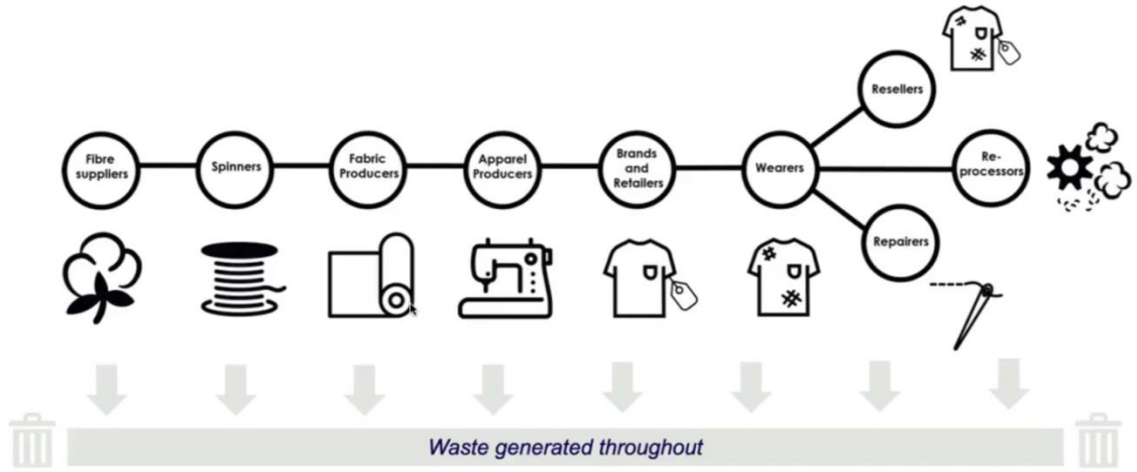
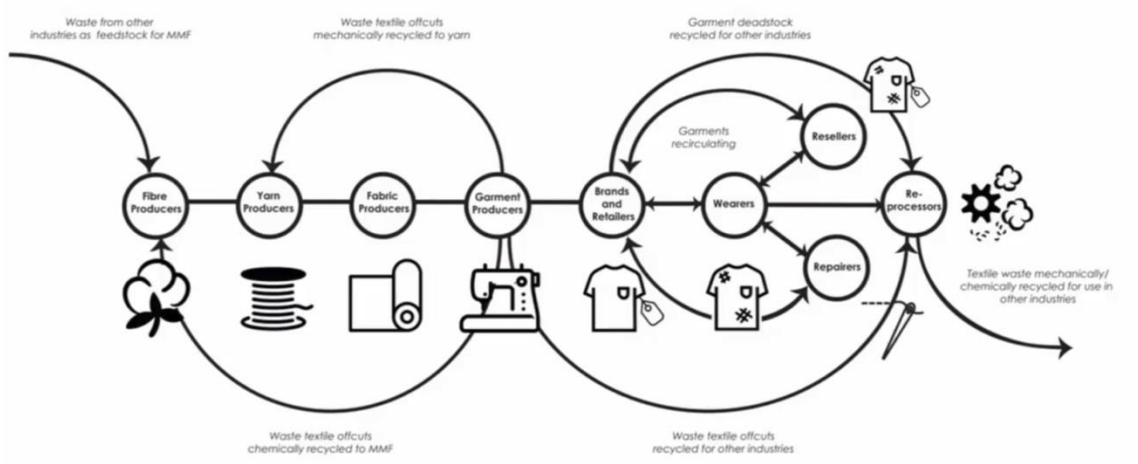
Sustainability/Circularity

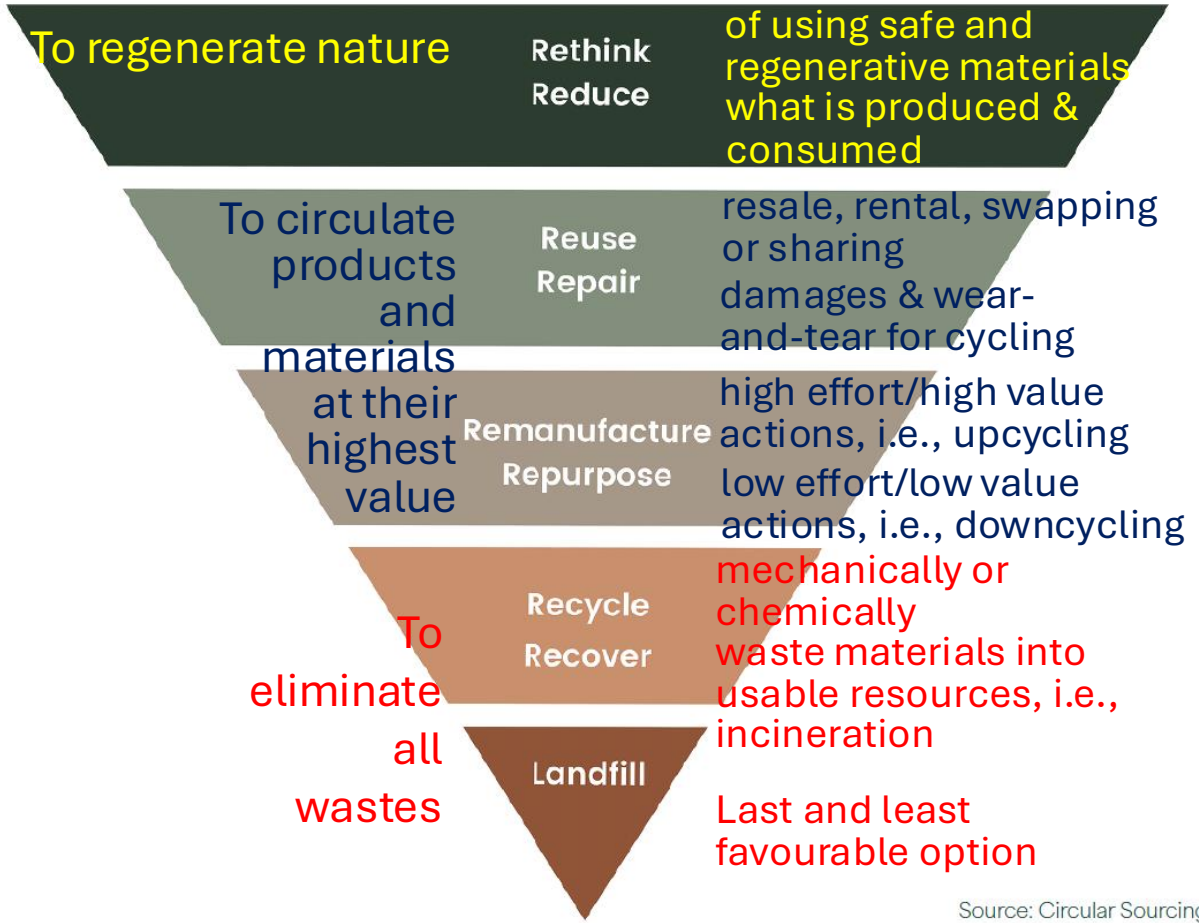


Linear materials flow (cradle to grave) generated waste along the chain



Circular materials flow (cradle to cradle) keeps materials in use as long as possible, eliminates waste as much as possible, and regenerates and restores nature

Strategies and actions to pursue "slow the flow" and "close the loop"



Source: Circular Sourcing

Materials innovations are the solution

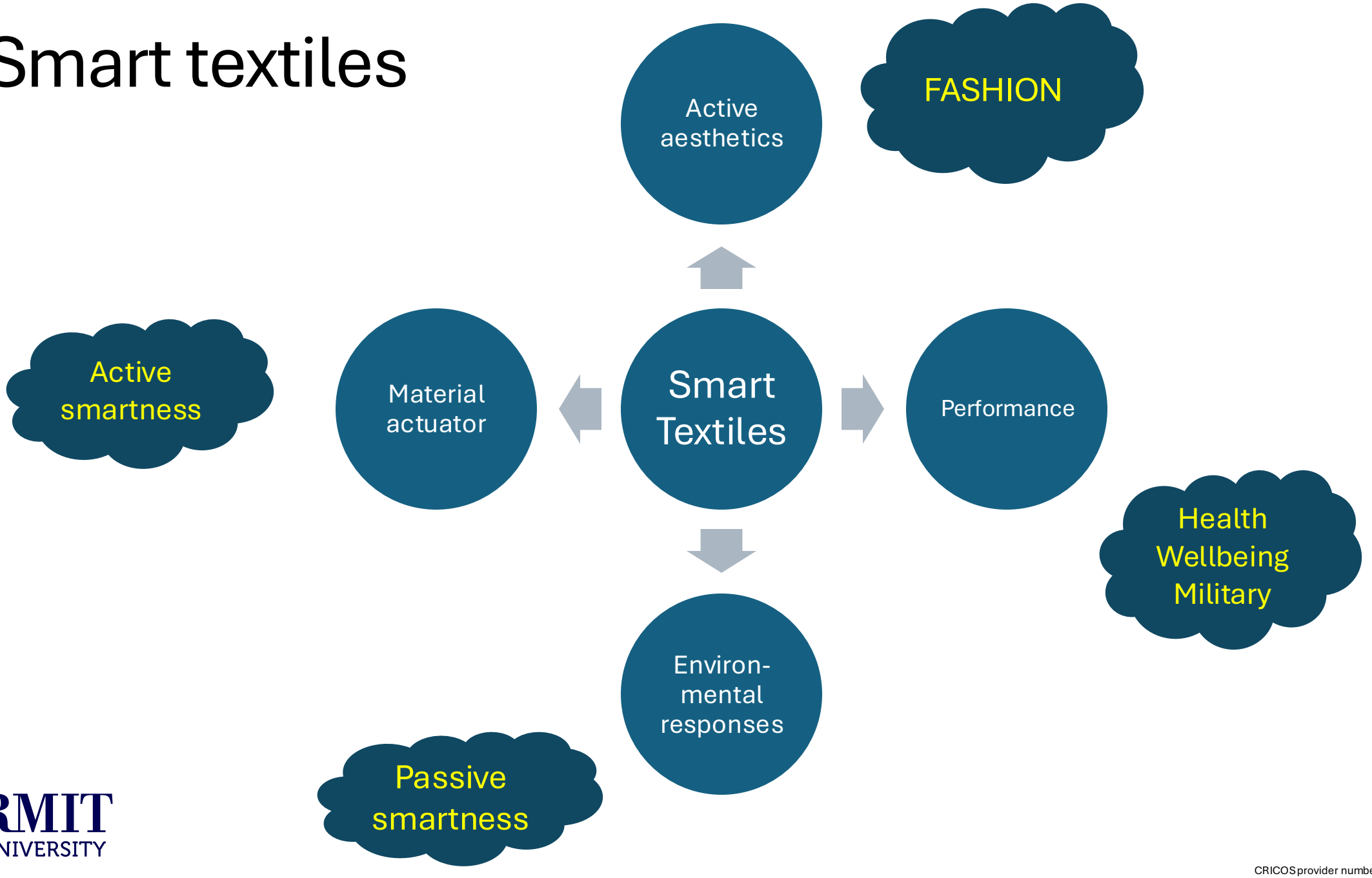
NOVEL MATERIALS, **SUSTAINABLE** RESOURCES, **REGENERATIVE** MATERIALS

ADVANCED TECHNOLOGY TO FABRICATE MATERIALS SERVING THE **GROWING NEEDS** AND ADDRESS THE CONCERNS IN **SUSTAINABILITY**

SMART TEXTILES WITH A FOCUS ON SUSTAINABILITY/CIRCULARITY TOWARDS NEW APPLICATIONS

HUMAN ECOLOGY CONSIDERATIONS WHEN DEVELOPING MATERIALS

Smart textiles



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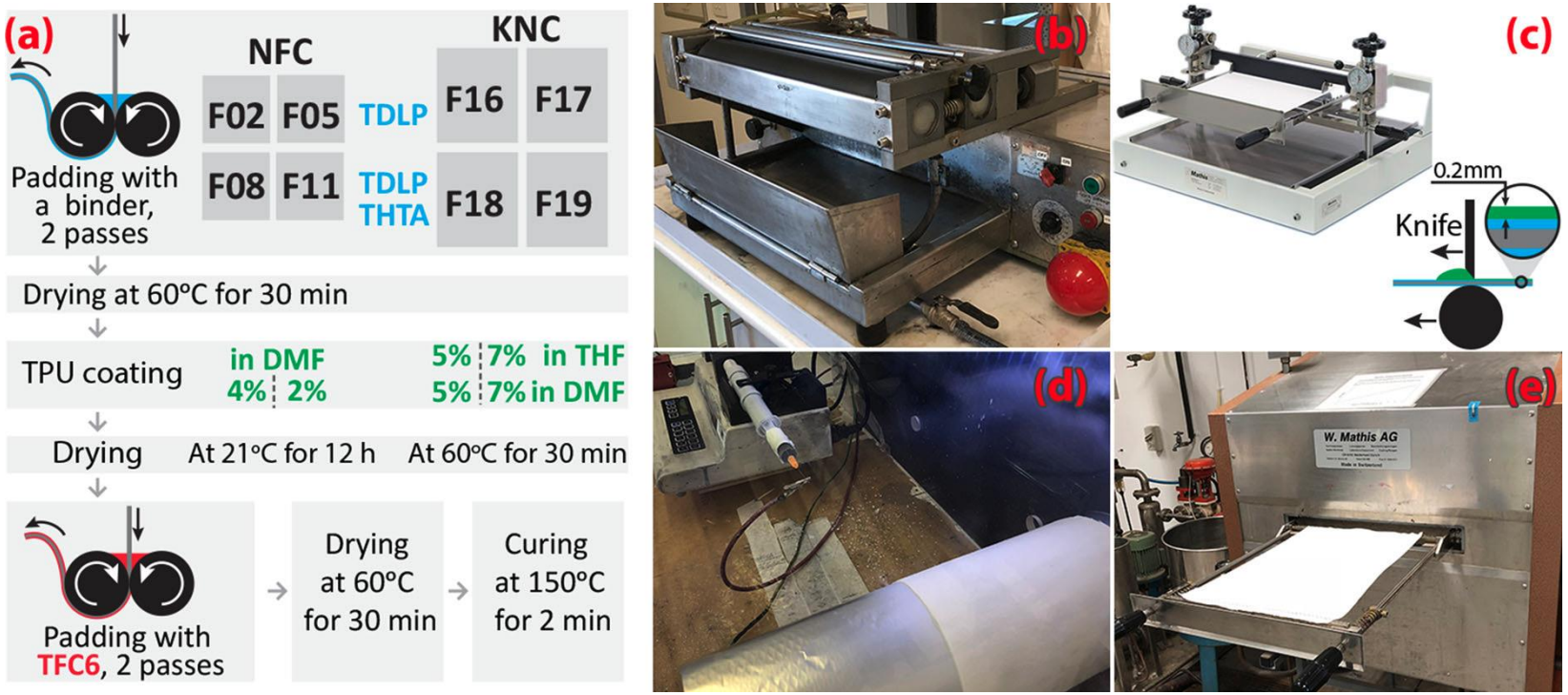
Performance – protection

Exploring nanofibrous coating on cotton fabric with versatile protection and dynamic comfort



Experimental design (a) and photos of padding mangle (b), knife coating device with schematics (c), electrospinning (d) and curing unit (e).

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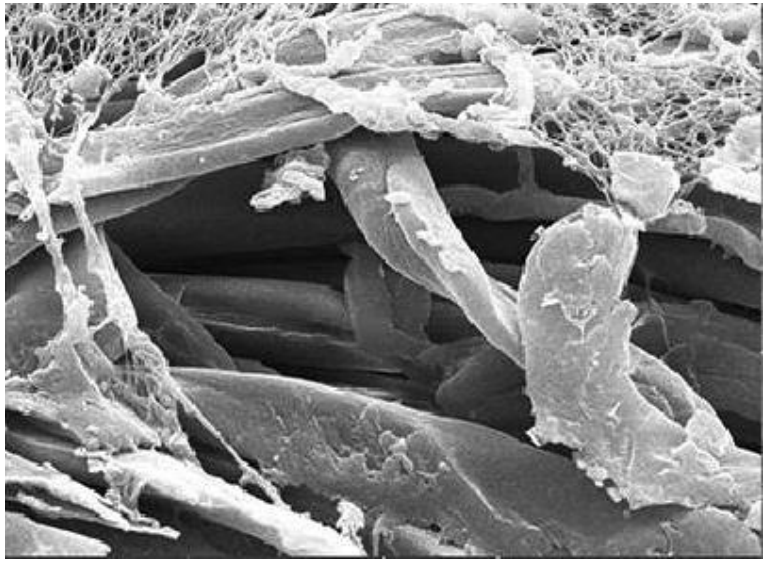
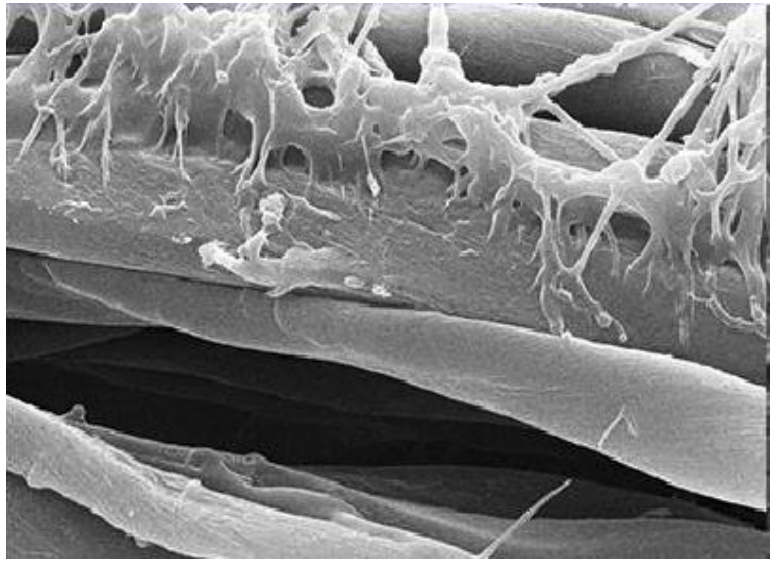
Olga Gavrilenko, **Xin Wang***. Functionalized nanofibrous coating on cotton fabrics. *Cellulose*, 26, 4175-4190 (**2019**).

Performance – protection

- Versatile coating on cotton fabric that protect against different liquids, oil and chemicals
- Electrospinning of polyurethane onto cotton fabric to form a nanofibrous substrate for further functionalization
- Wet chemistry and/or physical coating of functional components was conducted to functionalize the surface of cotton fabric





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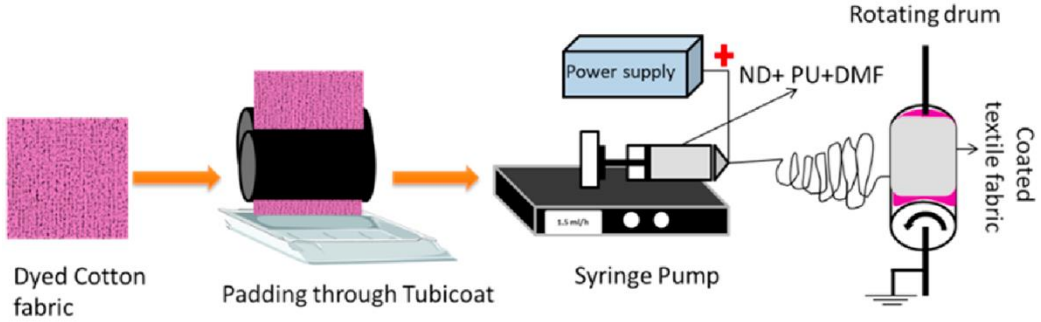
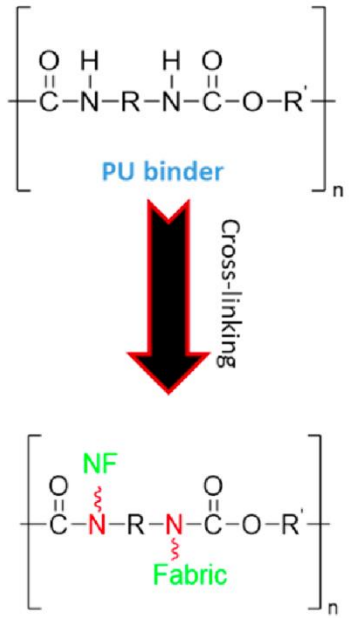
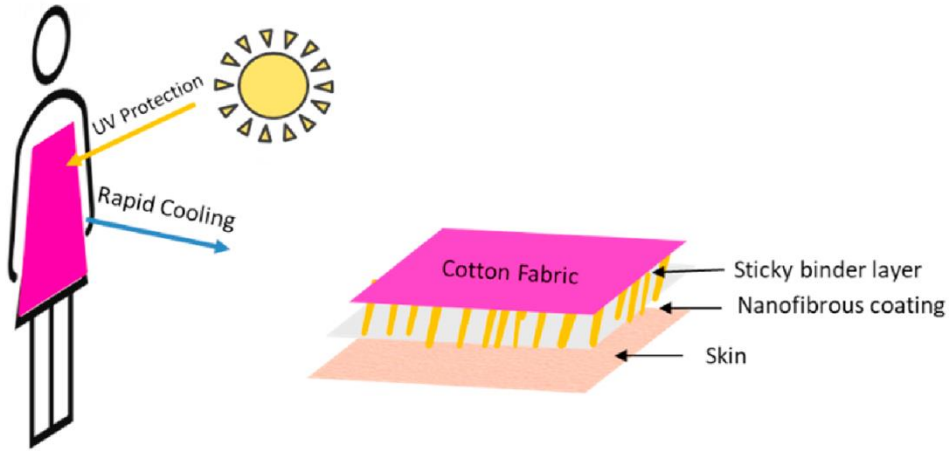
Performance - cooling textiles

- NDs are applied to the skin side of the fabric to promote heat dissipation towards the atmosphere.
- By incorporating ND into the fabric, the thermal conductivity is increased, allowing for more efficient heat transfer.
- Additionally, the improved wettability enables better moisture management and enhances the overall comfort of the fabric.



Sample Codes	Variable Parameter
CND-8	8 mL of PU/DMF/ND
CND-10	10 mL of PU/DMF/ND
CND-12	12 mL of PU/DMF/ND
CPU-10	10 ml of PU/DMF
CB	PU binder on fabric only
Control	Only dyed cotton fabric





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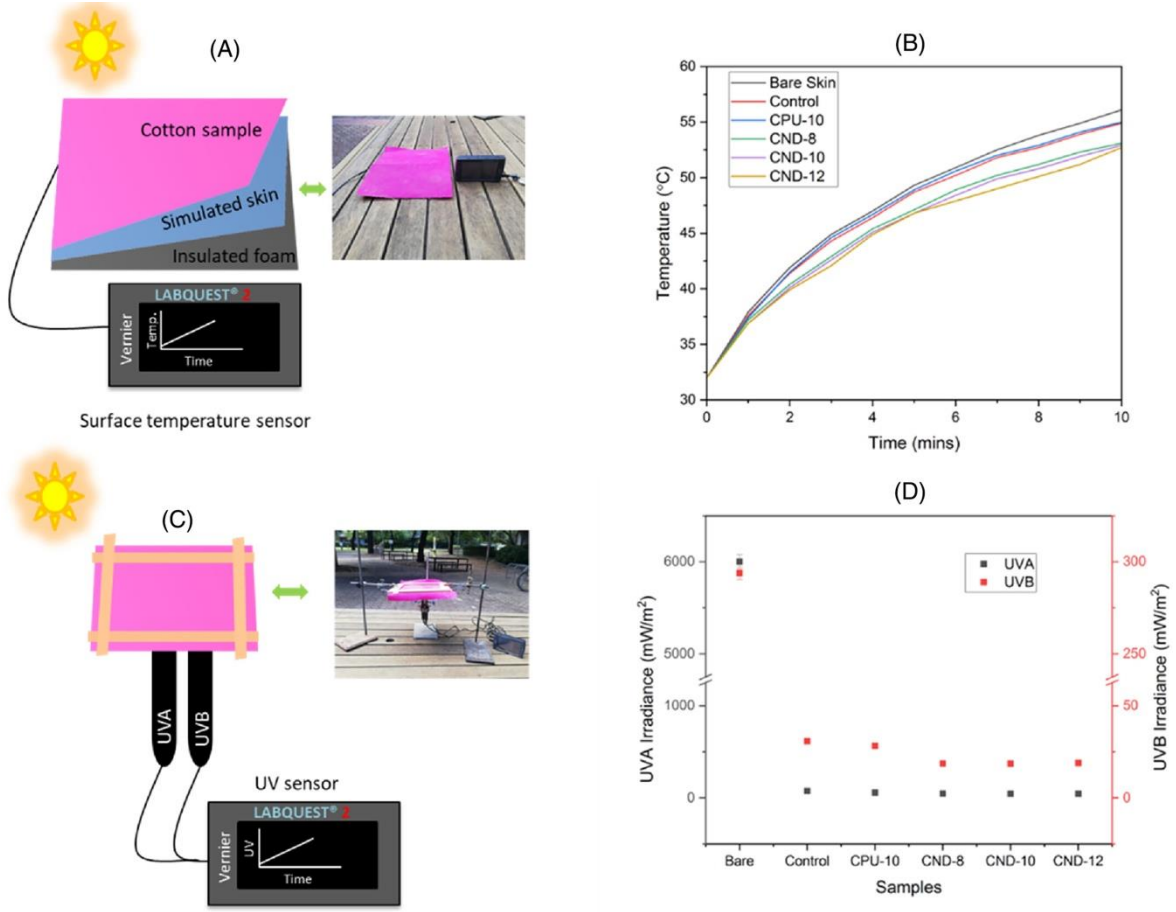
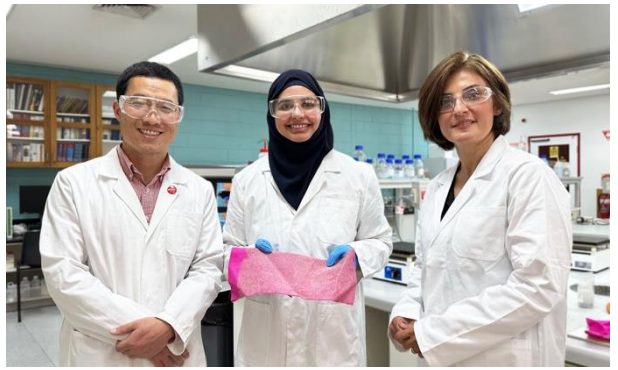
Aisha Rehman, Shadi Houshyar, Azadeh Mirabedini, Stephen Michielsen, **Xin Wang***. Immobilization of nanodiamond onto cotton fabric through polyurethane nanofibrous coatings. *Polymers for Advanced Technologies*, 35, e6222 (**2024**). **Wiley Top Viewed Article award**

Performance - cooling textiles

- Only one side of the fabric was coated with electrospun nanofibers, making such fabric promote heat transport from coated to the uncoated side and restrict heat transfer from the uncoated side to the coated side.
- This will promote rapid cooling of fabrics once heated due to heat exposure.
- Moreover, ND gave added advantage of UV protection to samples which are ideal for clothes that need to be worn during summer.
- The coating did not affect the air permeability and water absorbency of pristine cotton fabrics and were in the acceptable range.



(A) Schematic of real-life monitoring of temperature; (B) graphical presentation of real-life monitoring temperature; (C) schematic of real-life monitoring of UV; (D) graphical presentation of results of UV.



(L-R) Research supervisor and Senior Lecturer Dr Xin Wang, lead researcher Dr Aisha Rehman, and Senior Lecturer Dr Shadi Houshyar. Credit: Cherry Cai, RMIT University

The research has received 84 media pickups and was featured across industry and mainstream media with significant international interest. The research has reached over 70 million people with an equivalent advertisement value of >$2.5 million.

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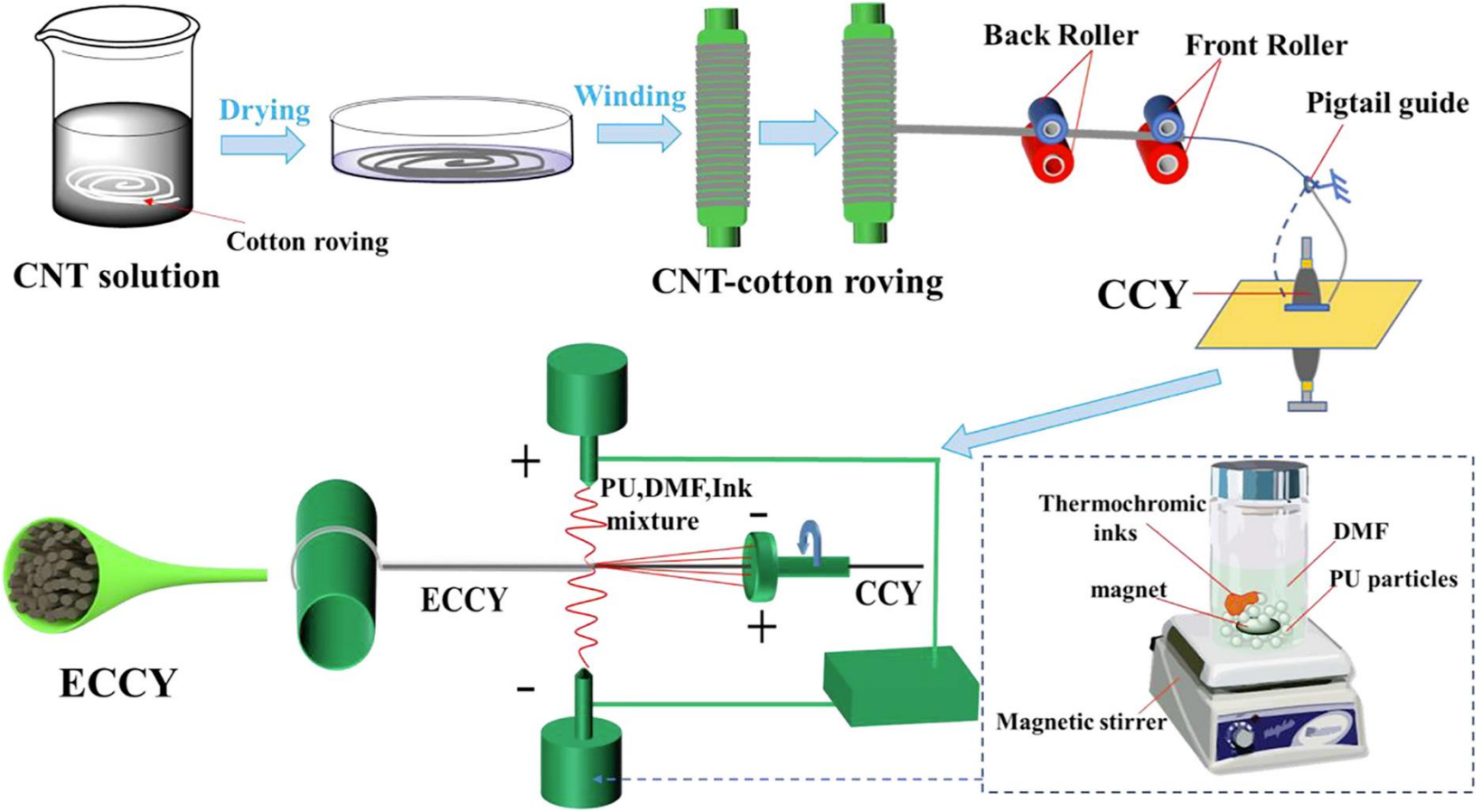
Materials actuators – wearable technology

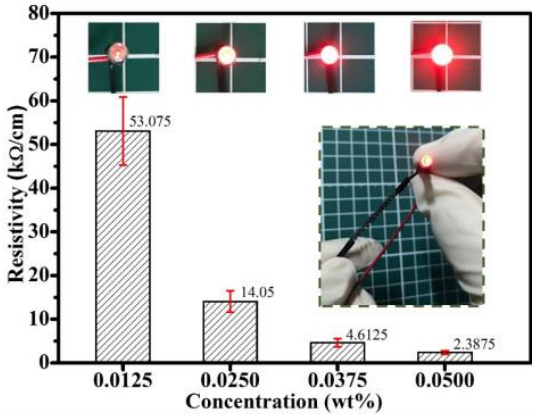
- Scaling-up the production of CNTs/cotton/spandex nanocomposite yarn for wearable applications
- A facile way of incorporating CNTs into traditional yarn manufacturing process by dipping-and-drying CNTs into cotton rovings and preparing CNT/cotton/spandex composite yarns via spinning



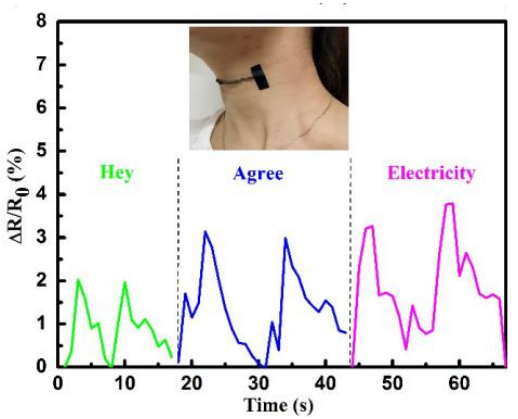
Junjie Pan, Baowei Hao, Pengjun Xu, Daiqi Li, Lei Luo, Jianqiang Li, Zhigang Xia, Deshan Cheng, Anchang Xu, Guangming Cai, **Xin Wang***. Highly robust and durable core-sheath nanocomposite yarns for electro-thermochromic performance application. *Chemical Engineering Journal*, 384, 123376 (**2020**).

Materials actuators – wearable technology

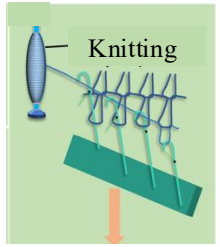
The manufacturing technology of nanocomposite yarn has led to an industrial-scale development of e-textiles for wearable applications

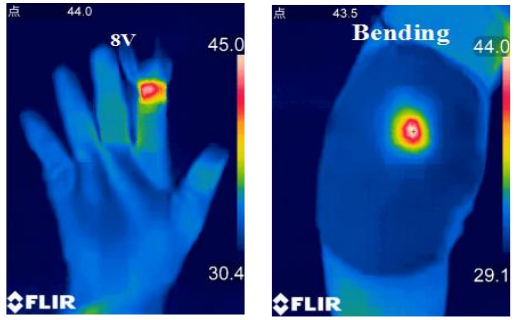


Electric conduction

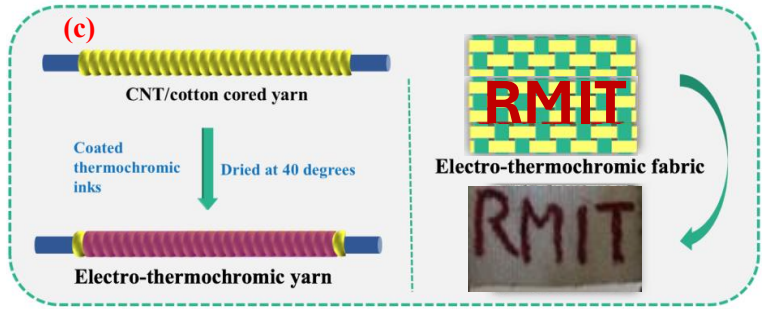


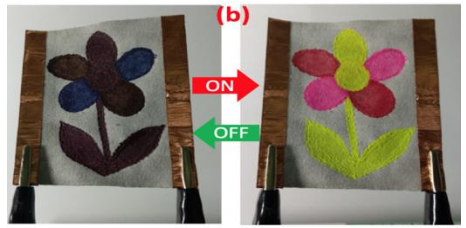
Sensors





Heaters





Colour changing & design

ACS Applied Materials & Interfaces, 15, 10994-11003 (**2023**).
ACS Applied Materials & Interfaces, 12, 29717-29727 (**2020**).
ACS Applied Materials & Interfaces, 11, 7338-7348 (**2019**).
Composites Part B: Engineering, 183, 107683 (**2020**).

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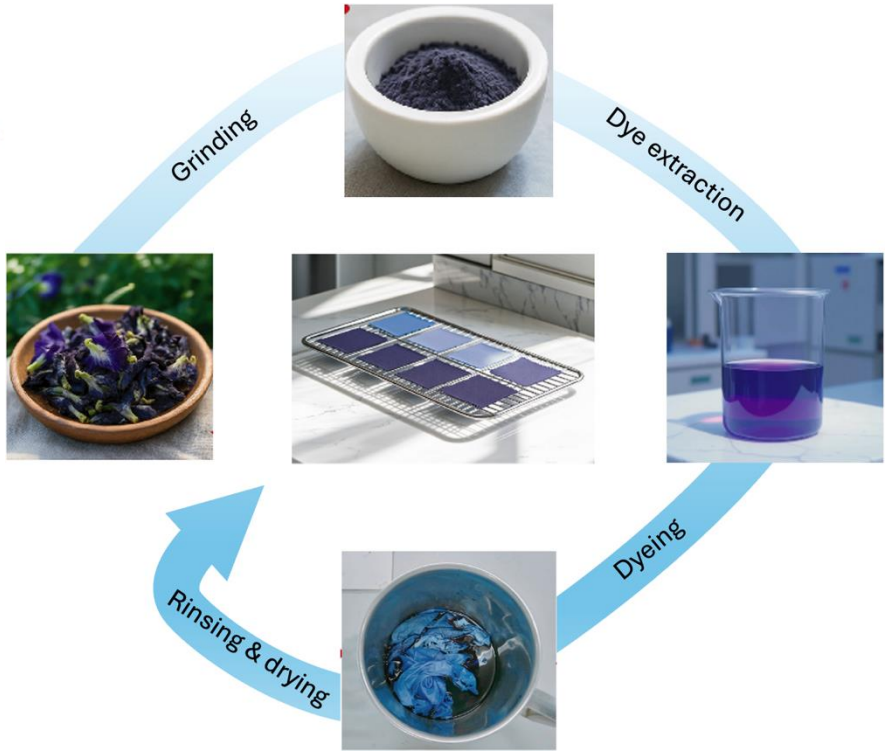
Environmental responses – chemical sensing

Smart textiles via dyeing with anthocyanins extracted from *Clitoria ternatea* flowers as a natural pH-sensitive dye

Dye extraction



Natural dyeing

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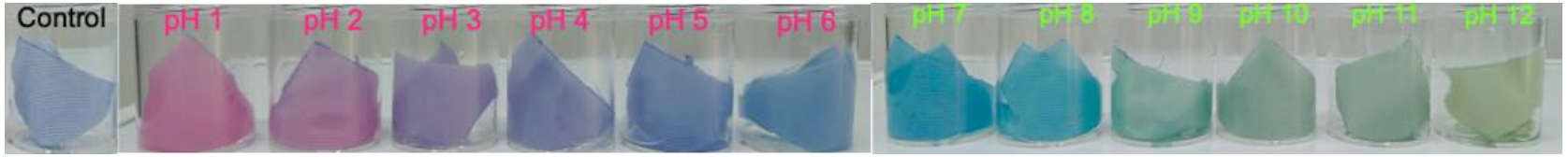
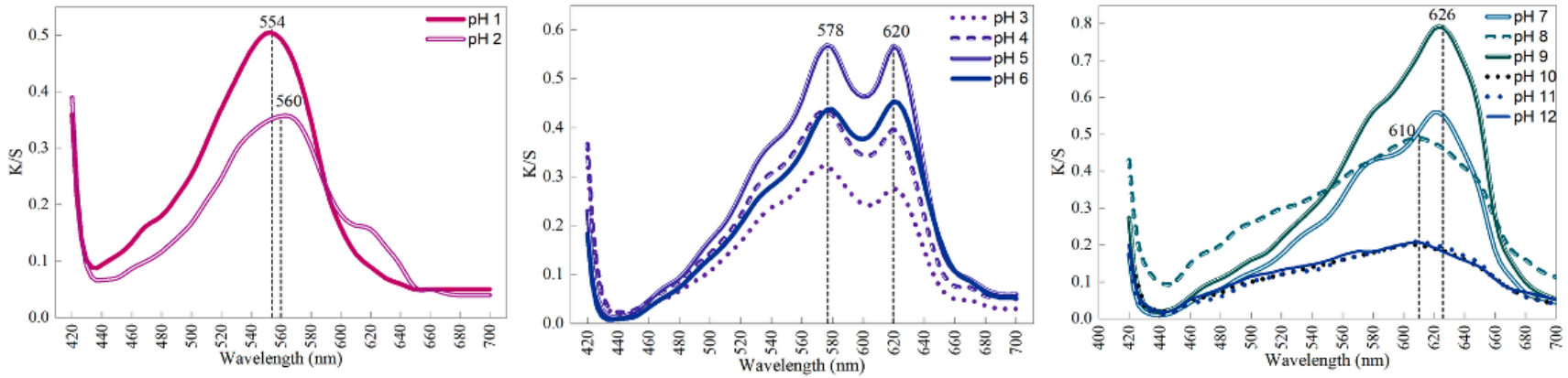
Environmental responses – chemical sensing

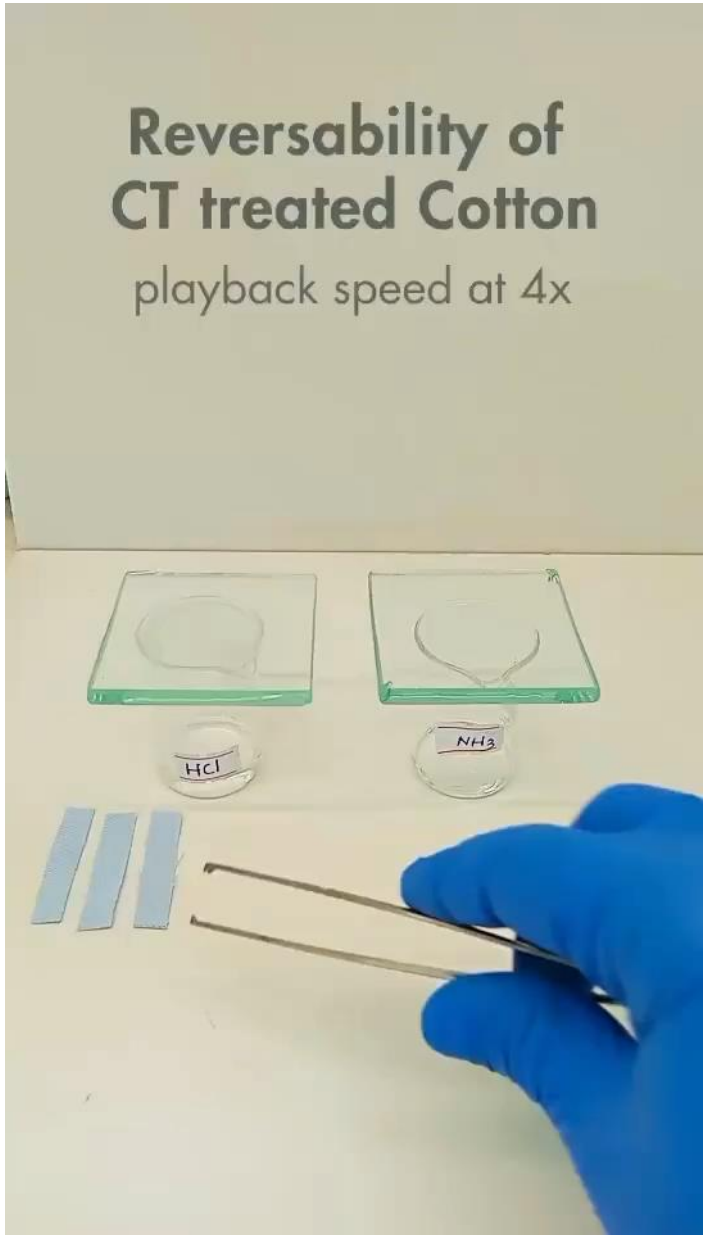
- The inherent halochromism of the anthocyanin dye was integrated onto cotton via natural dyeing
- The halochromic trends reflect pH-dependent structural transformations of anthocyanin species, primarily involving transitions from flavylium cation to quinonoidal bases, carbinol pseudobase, and chalcone forms



Halochromic behaviour



UV-Vis Spectra



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Conclusions

- Materials innovation is the key in developing future textiles with a focus on sustainability/circularity
- Novel materials such as nanomaterials can be integrated into fibrous system to develop smart textiles with performance and comfort
- Natural resources can be further explored to find applications in textiles as alternatives to benefit sustainable development
- Fit-for-purpose technology has to be developed to facilitate the development

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Acknowledgement

- Cotton Research & Development Corporation (CRDC) for sponsoring majority of the research work and this trip
- RMIT University for funding support
- Research team – Dr Aisha Rehman, Dr Olga Gavrilenko, Dr Arsheen Moiz,
- Collaborators – A/Prof. Shadi Houshyar, Prof. Steve Michielsen, Prof. Deshan Cheng (WTU), Prof. Guangming Cai (WTU)

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