Smart Wool Products and Leading Edge Textile Innovation

IFC

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CSIRO

What Do We Do?

- **We have multifibre capabilities**

  - worsted and woollen processing
  - needle punch nonwovens and thermal bonding
  - carded and combed cotton processing
  - hydroentanglement
  - bicomponent fibre extrusion

- **Focus on Research, Development and Implementation in areas of market failure**

What Do We Do?

- **Objective Measurement**

  (ATLAS, Laserscan, Fleecescan)

- **Processing Prediction**

  (Team 2, Yarnspec, SiroFAST)

- **Process Efficiency**

  (Sirolan CF, Siroclear, Sirospun, Sirolan LTD, Self Twist)

- **New Products**

  (Superwash Wool, Optim, Sportwool®)

- **New Marketing**

  (Prickle factor, Cool Wool)

(nearly all jointly developed with Australian wool industry)

The Evolution of Intelligent Textiles

Functional

- protection against environment
- active moisture management

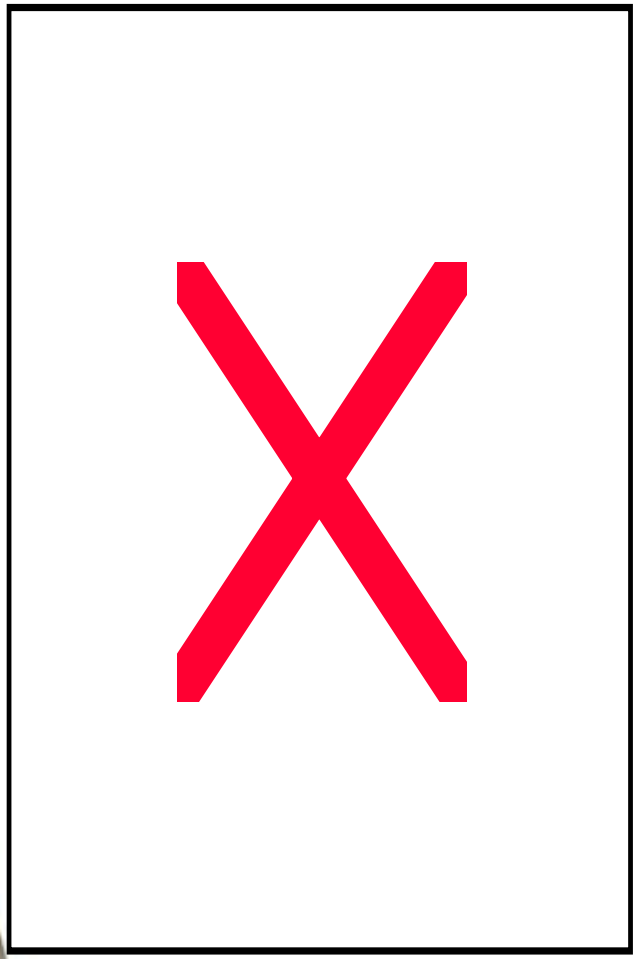
Smart

- sensing and monitoring changes in environment
- some electrical conducting function (electronic textiles)

Intelligent

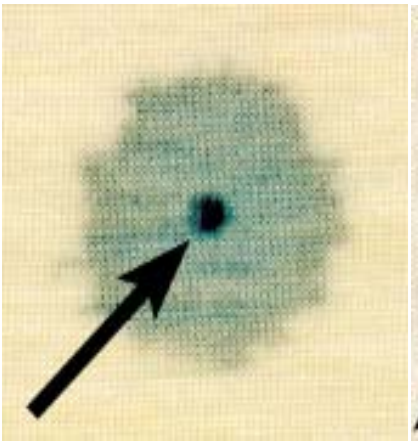
- react in some way in response to the “sensed” property
- most likely have electronic function

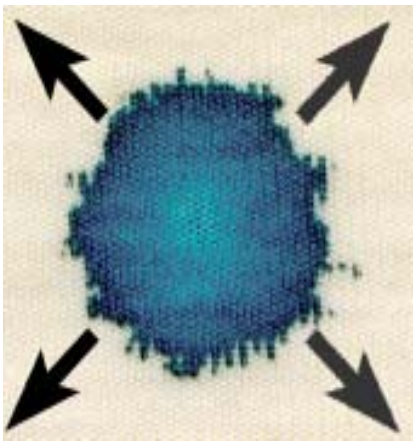
Functional Textiles



Skin side

Outer face





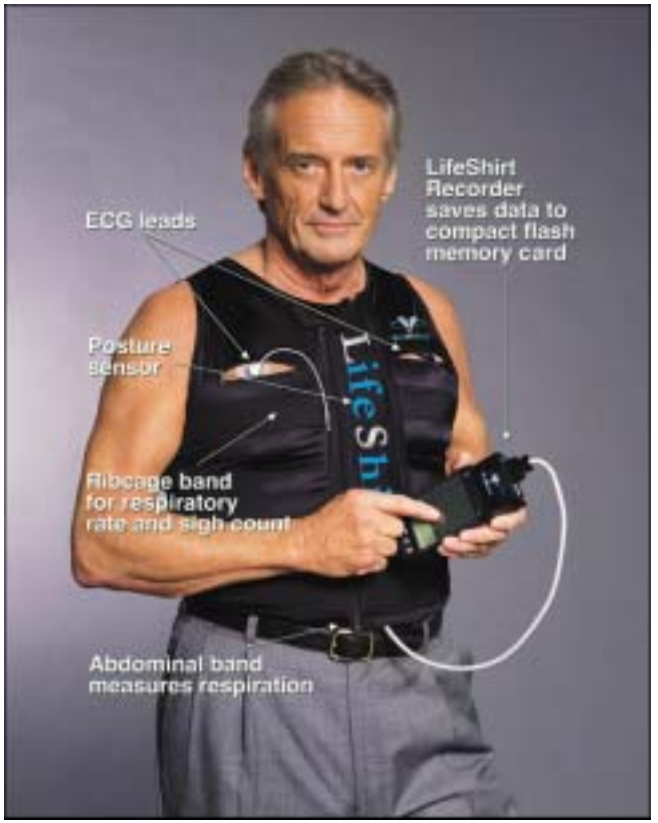
(Sportwool Pro® developed by CSIRO/The Woolmark Co Ltd)

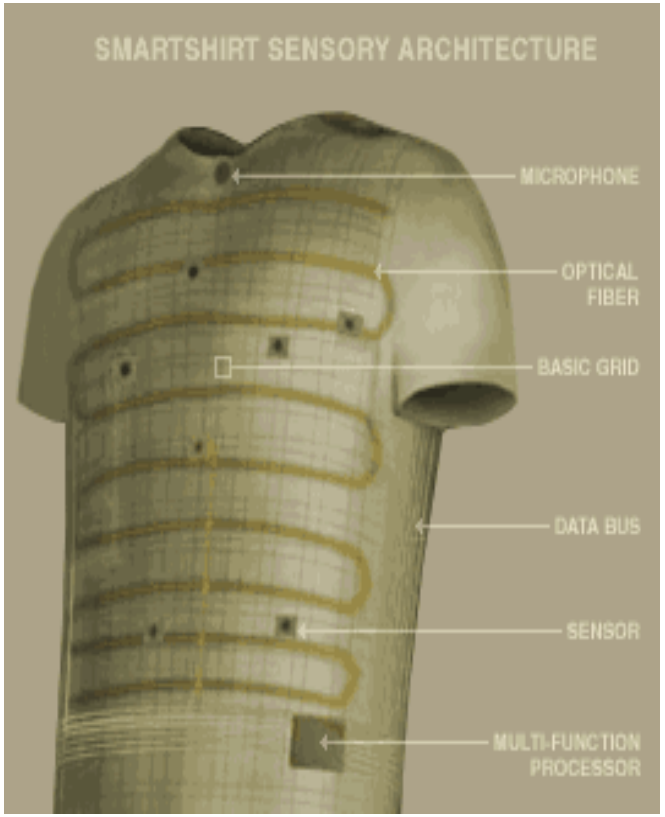
Wearable Computing

‘More than 60% of the U.S. population ages 15 to 50 will carry or wear a wireless computing and communications device at least six hours a day by 2007’ - Gartner

Intelligent Textiles

Physiological Monitoring



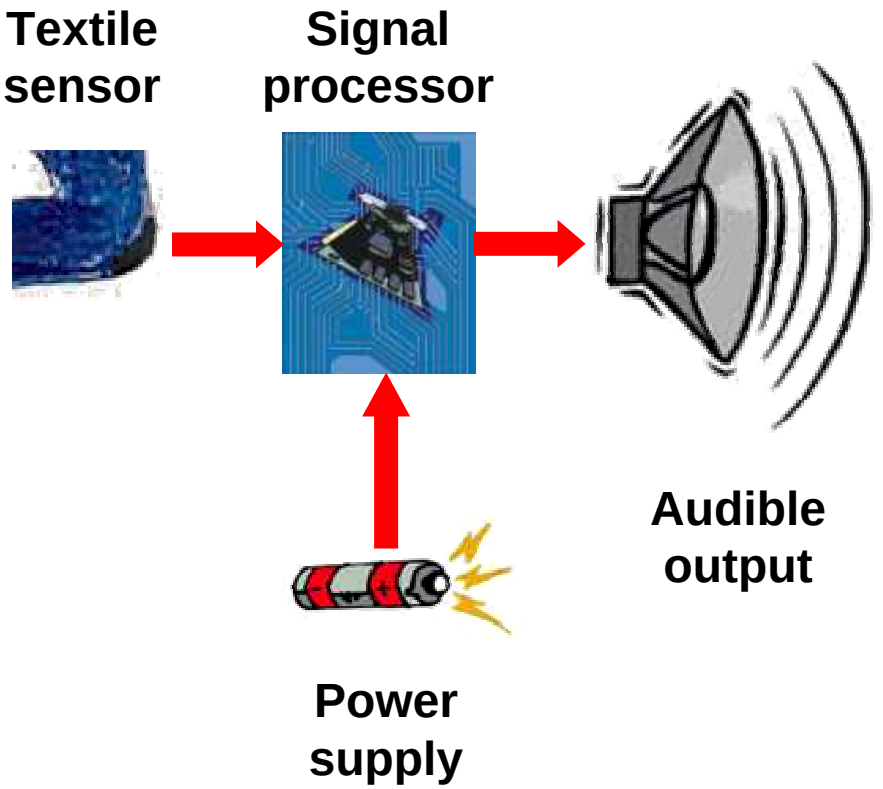


Lifeshirt by Vivo Metrics®

Intelligent Textiles

Training Device with Bio feedback

Layout of the components



Intelligent Knee Sleeve by CSIRO/UoW

Myth or Reality?

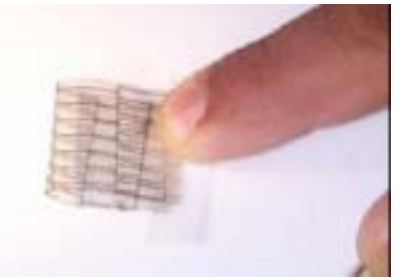
- **“By 2012, the potential market for interactive textiles may be worth $US 7 billion”.**

  (military component $2.5 billion)

Venture Development Corporation

Intelligent Textiles being Driven by Flexible Electronics



Polymer Films

Paper & Packaging

Textiles

Flexible Electronics Characterised by 7 SPECIAL Elements

- **S**ensors
- **P**athways
- **E**nergy
- **C**ommunication
- **I**ndicators
- **A**ctuators
- **L**ogic

Flexible Electronic Textiles at CSIRO

- Development of platform technologies to enable new electronic functionality to be introduced into textiles.

  Textiles that can:

  - Conduct,
  - Dissipate,
  - Or Generate Electricity

- Electronic Functionality seamlessly integrated into textile by incorporating:

  - Wires
  - Inherently Conductive Polymers,
  - Or Carbon Nanotubes

Forming Electrical Circuits in Textiles

Metallic Filaments May Play a Role as Interconnections

Inherently Conducting Polymers (ICPs)

The 2000 Nobel Prize in Chemistry was won by Alan J. Heeger (UC-Santa Barbara), Alan G. MacDiarmid (University of Pennsylvania), and Hideki Shirakawa (University of Tsukuba, Japan) for discovering that plastics, modified in certain ways, can conduct electricity.

Compared to metallic conductors, plastics are more flexible and potentially cheaper and easier to manufacture.

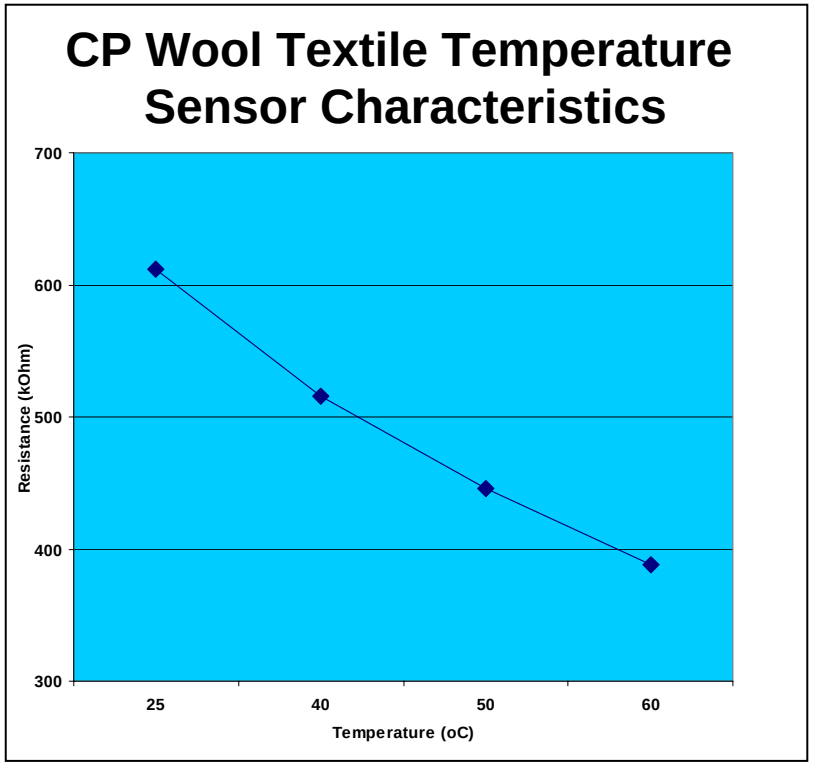
This flexible electronic circuit works even when bent.
Conducting polymers make plastic electronics possible.

ICP Application Methods Evaluated at CSIRO

- Best results with wool
- Versatile: - yarns, fabrics, garments, patterns, patches etc can be treated
- Issues of flexibility, launderability are being overcome for some methods & applications

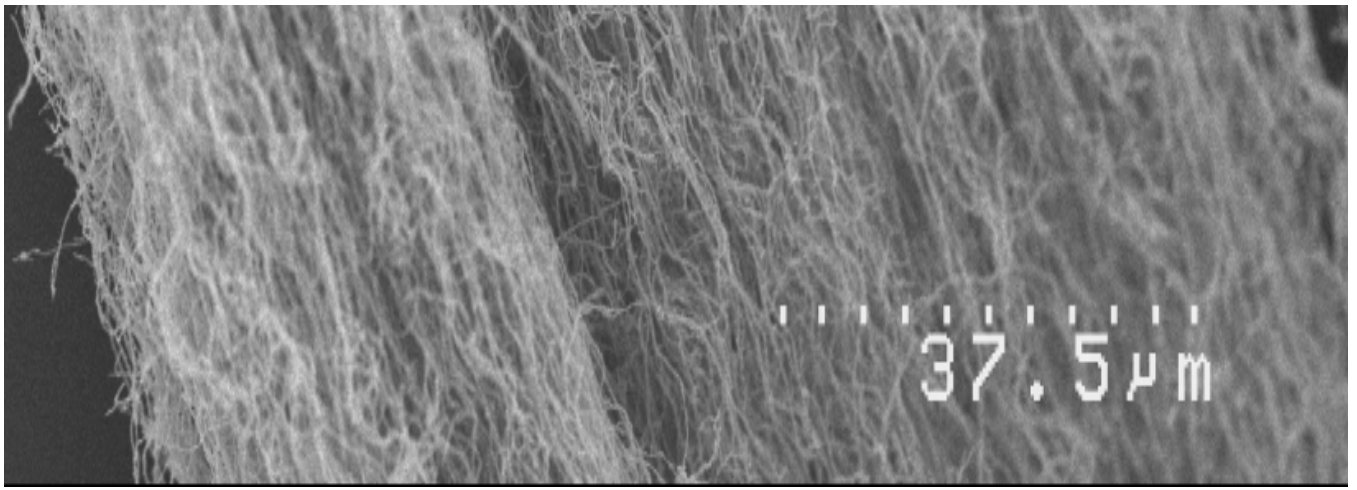
Conducting Polymer Wool Textile Sensors Being Developed at CSIRO/UoW

- Strain
- Temperature
- Humidity



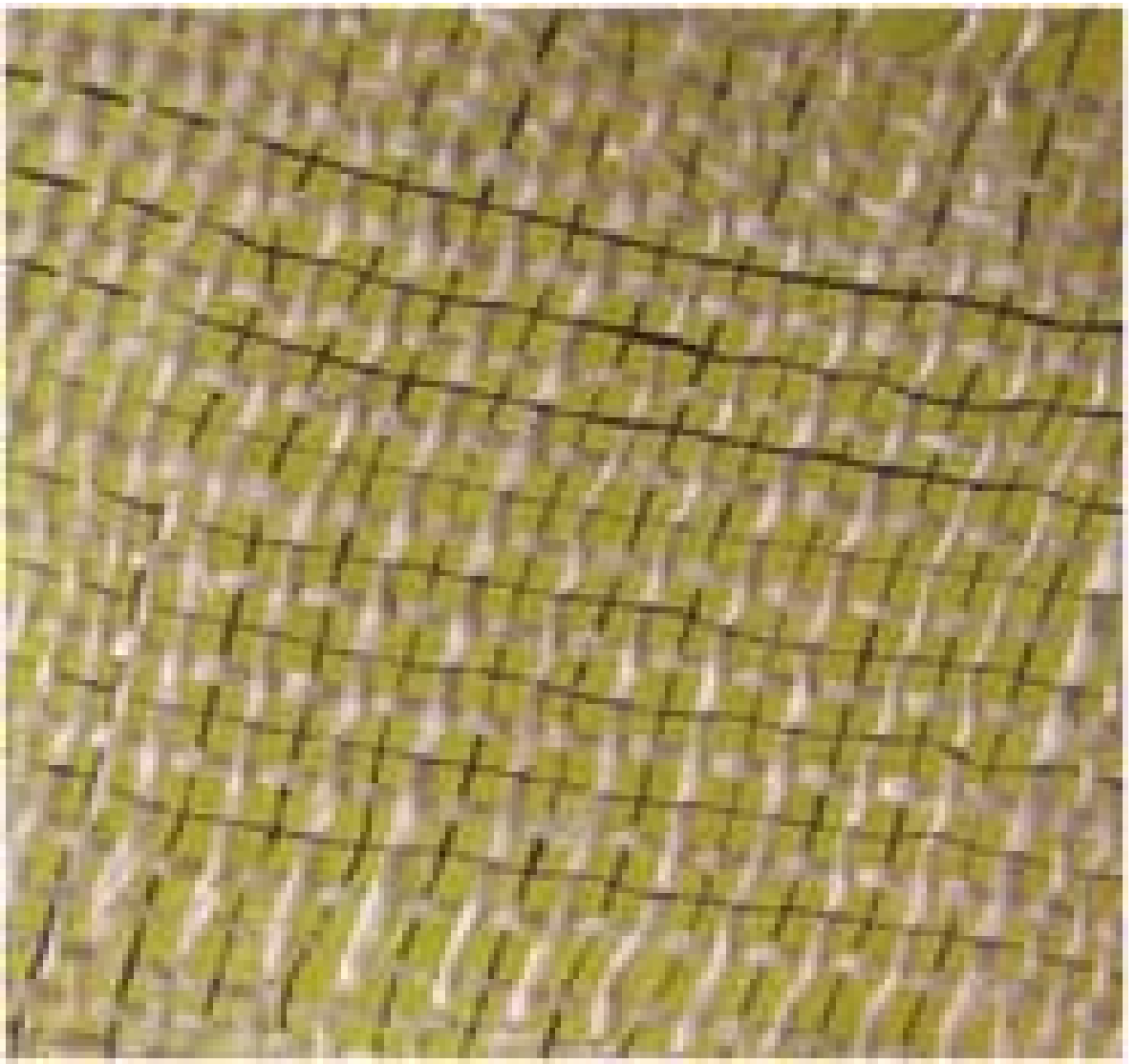
Carbon Nanotubes in Textiles

Sumio Iijima of NEC Corp discovered carbon nanotubes in 1991 in Tsukuba, Japan, The hollow nanotubes extend like straws with the same tendency to bend and spring back. Later research showed they formed in bundles of tubes within tubes (multi-walled) and a nanometer-wide tube (single-walled).



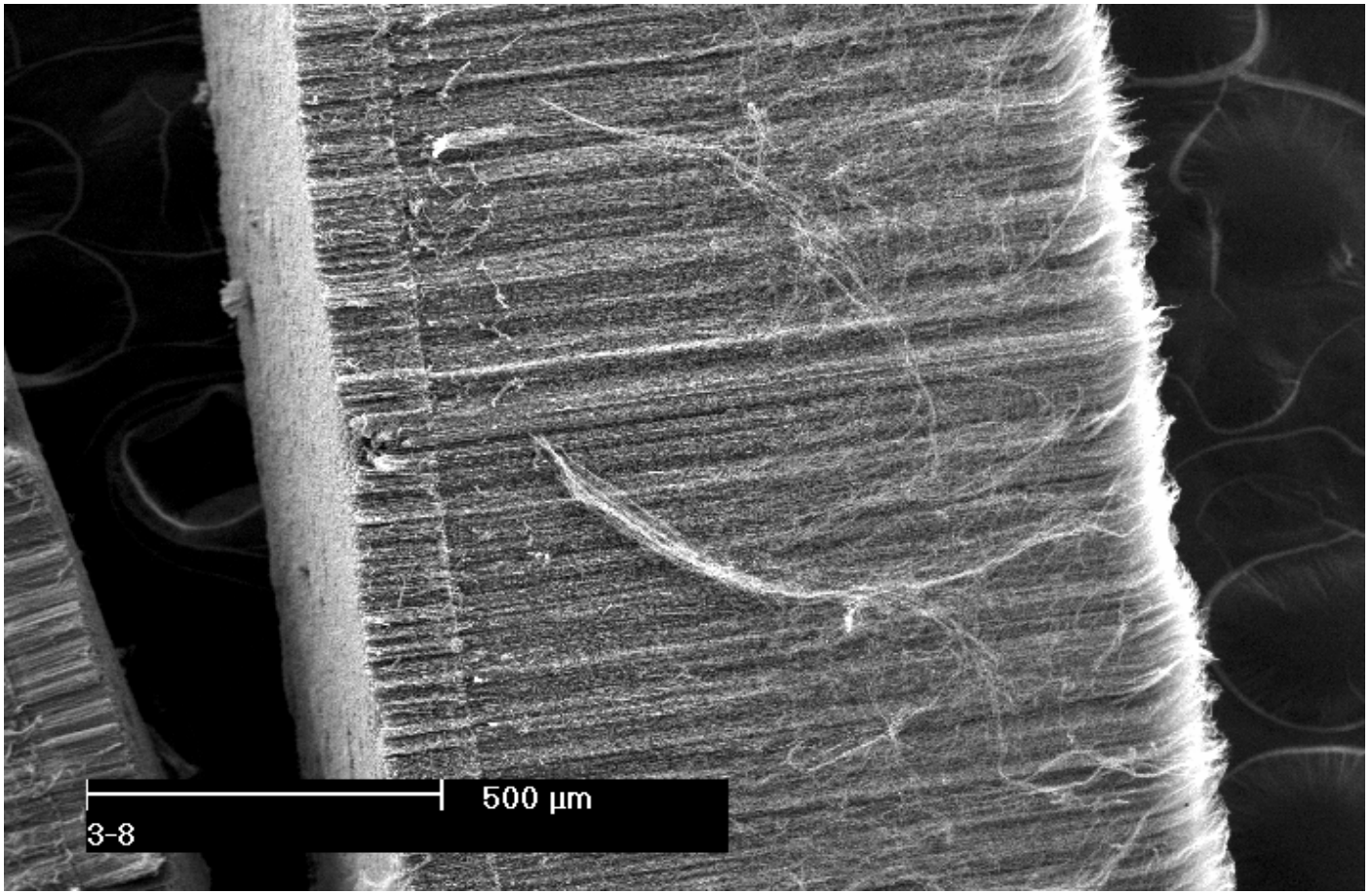
Potential Textile Applications Incorporating Carbon Nanotubes

- **Mechanical Properties:**
  - high strength composite yarns; engineering applications.
- **Electrical Properties:**
  - “intelligent” textiles, emf shielding, textile sensors
- **Thermal Properties:**
  - protective equipment (heat management)



(R. Baughman, AAPPS Bulletin, August 2003, 13(4) 13)

Low Res Image of CNTs @ CTFT



Dry-Spinning CNTs*

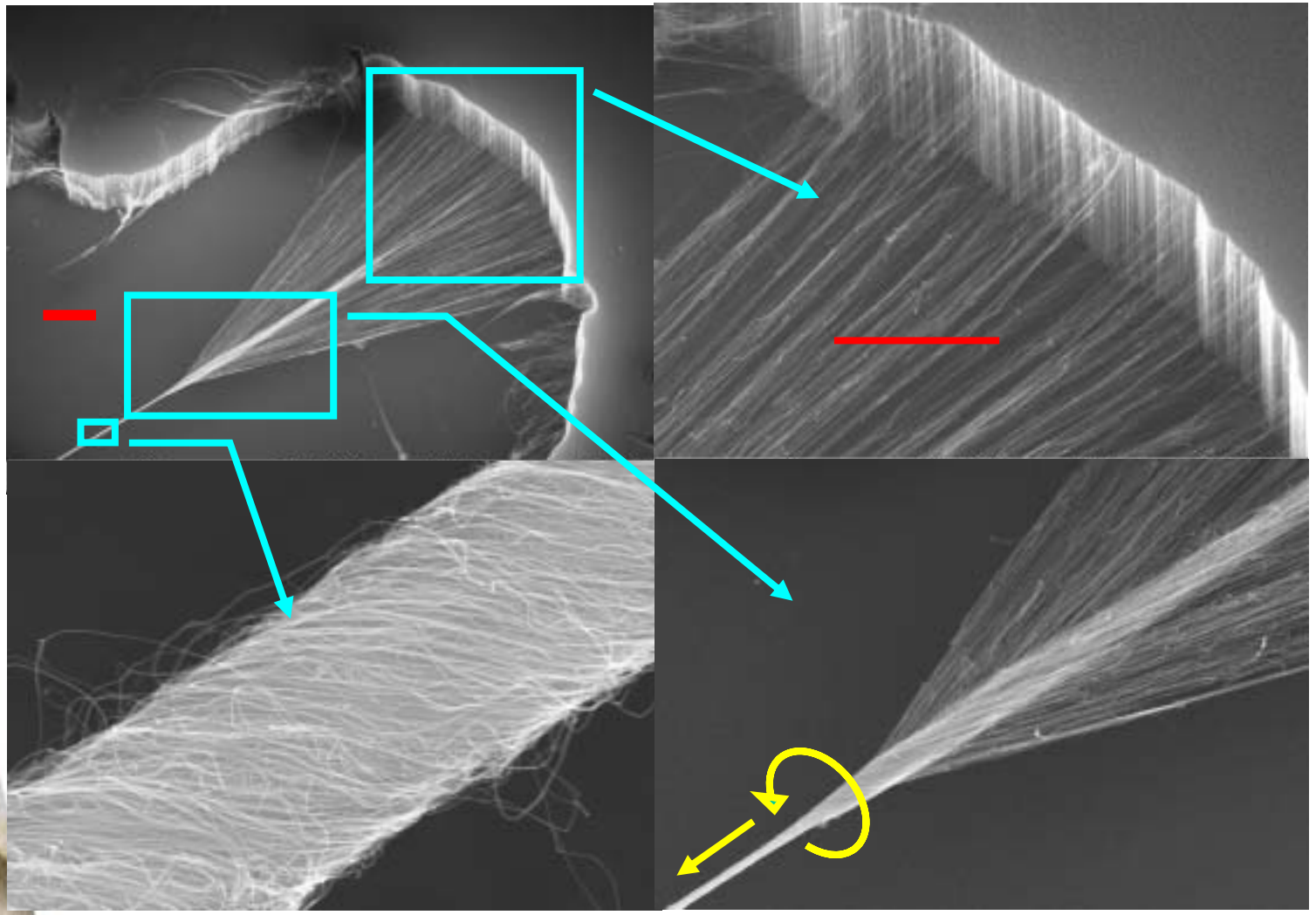
Work carried out in collaboration with the

NanoTech Institute

University of Texas at Dallas

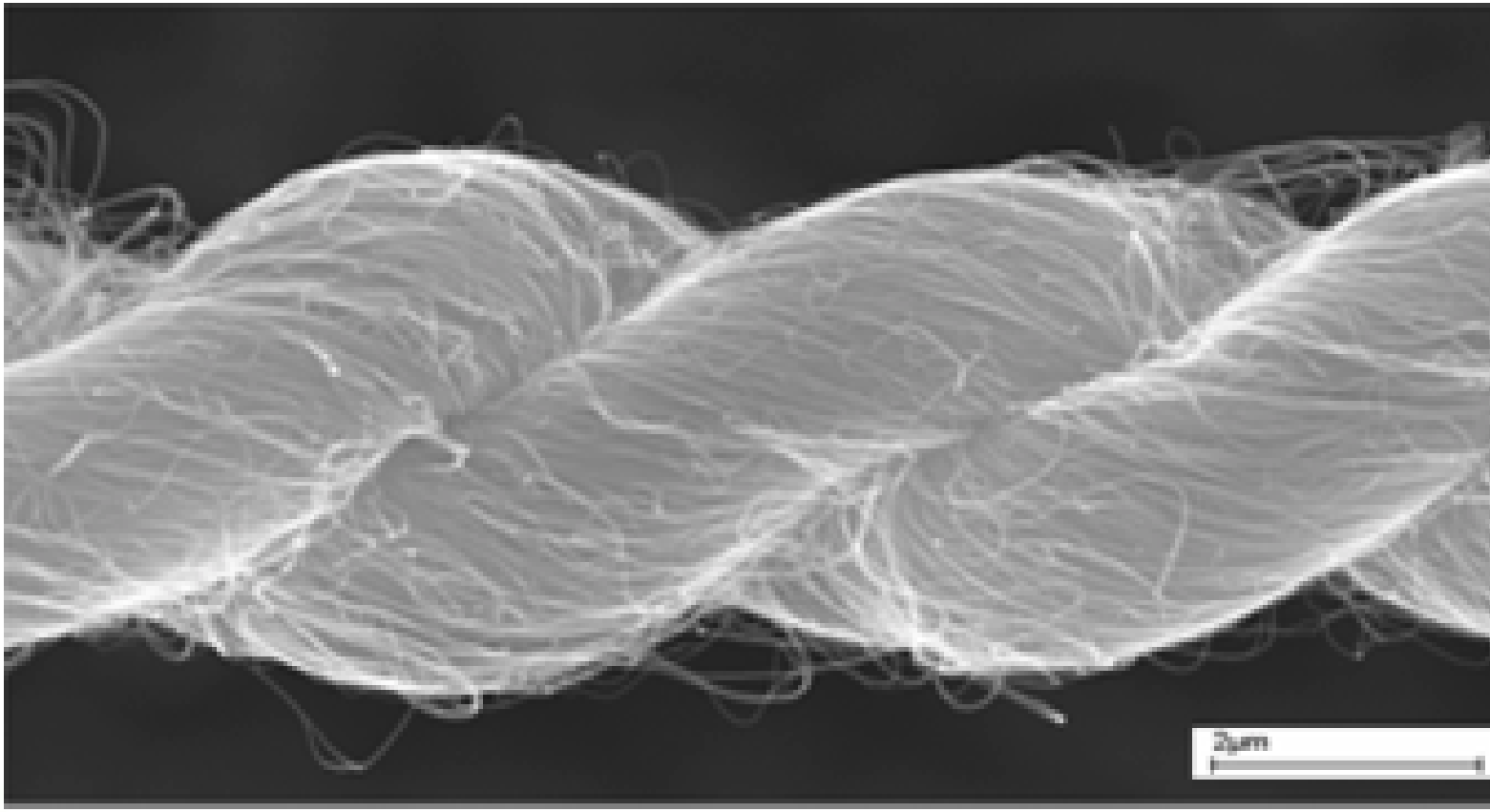
* ***Published: Zhang, Atkinson, & Baughman, Science, 306, 1358, 19 November 2004.***

Dry-Spinning Singles CNT Yarns



Yarn spun by Mei Zhang, Nanotech Institute, UTD.

Dry-Spinning CNTs



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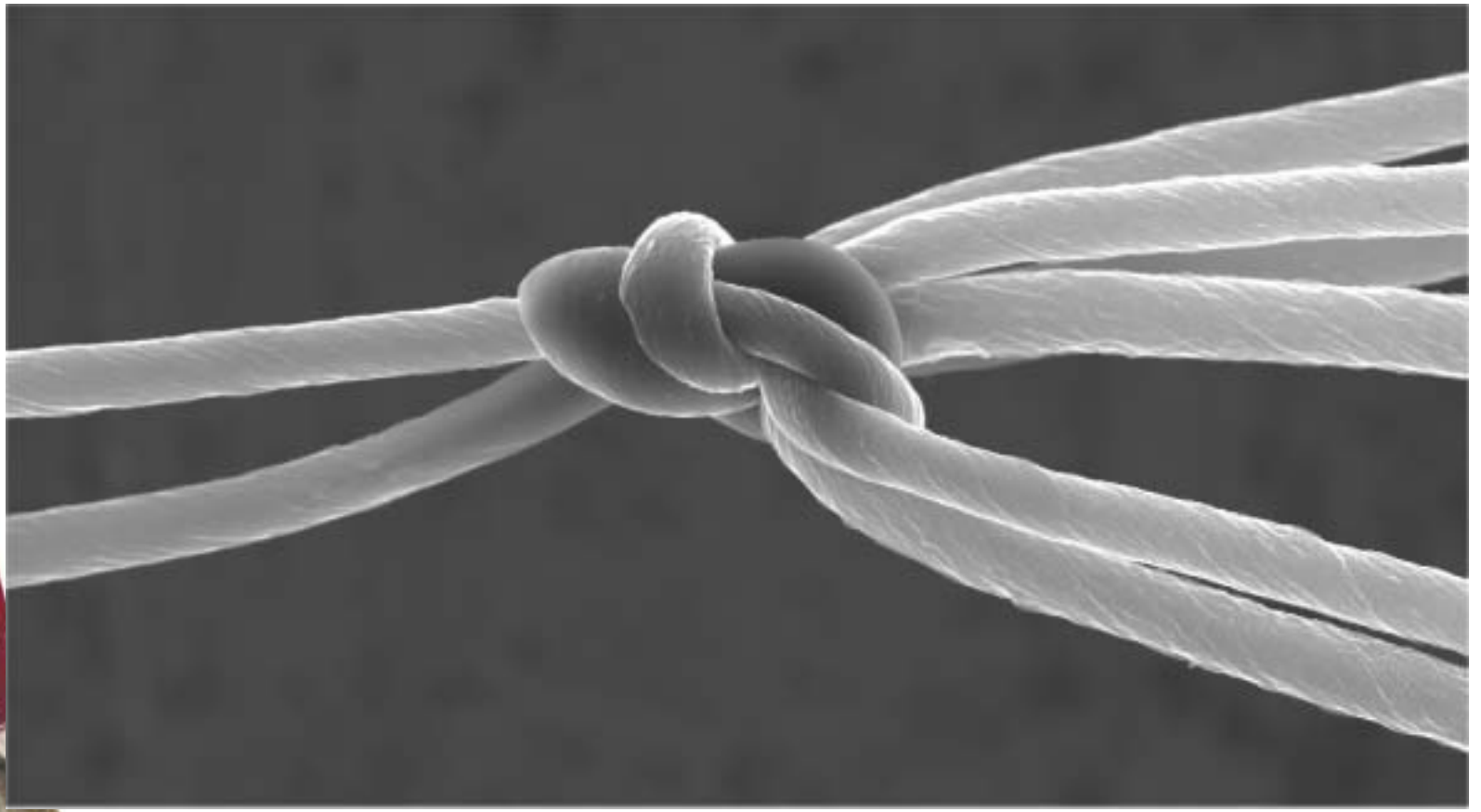
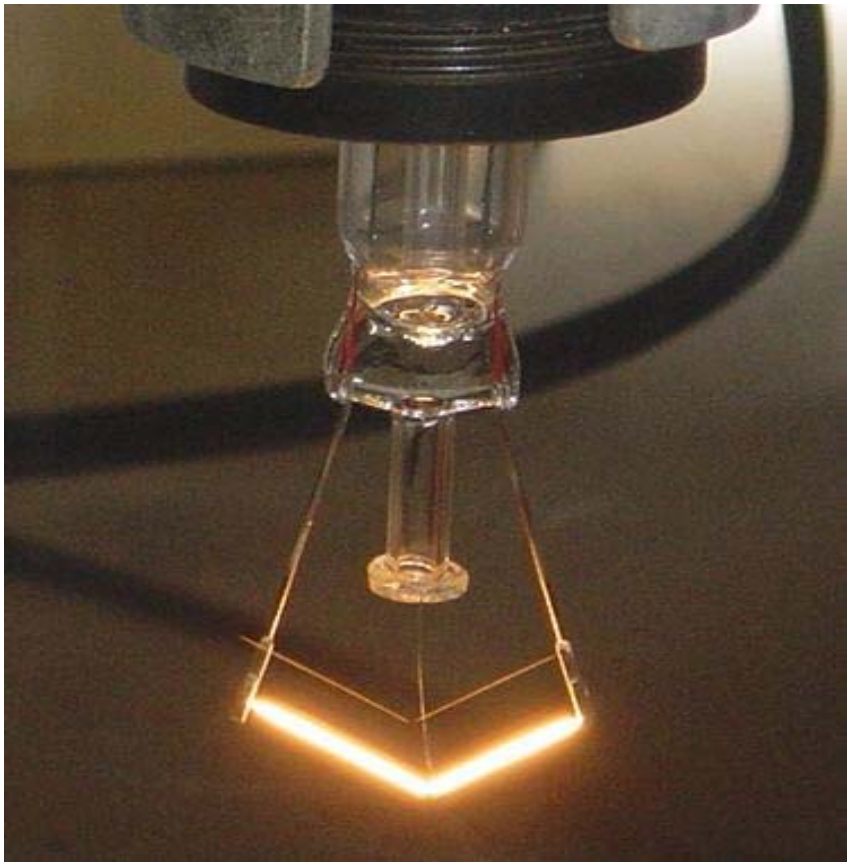


Two-Fold Yarn as Incandescent Filament



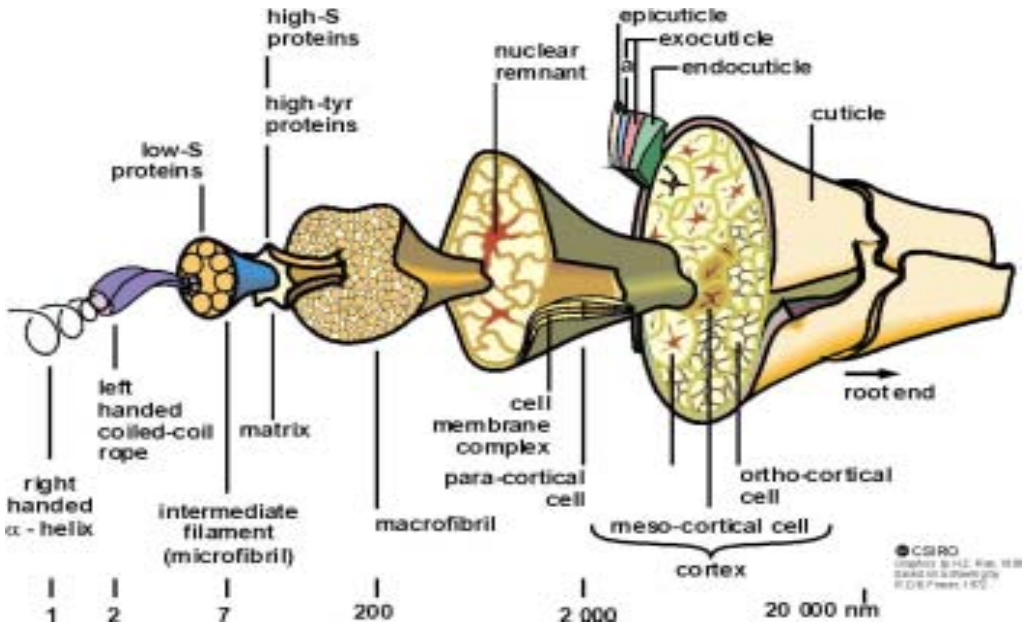
Yarn spun by Mei Zhang, Nanotech Institute, UTD.

The Challenges for Wool

- Must use wool's natural competitive advantage
  - moisture management
  - comfortable to wear
  - complex chemical functionality
- High value markets will benefit wool
  - healthcare
  - active leisurewear
- Must keep abreast of new trends to ensure wool can leverage where possible
- R&D essential to meet these challenges

Nanoparticle Opportunities for Wool

- **UV Protection**
- **Chromic (photo, thermo) finishes**
- **Flame resistance**
- **Abrasion resistance**
- **Conductive fibres for intelligent textiles**



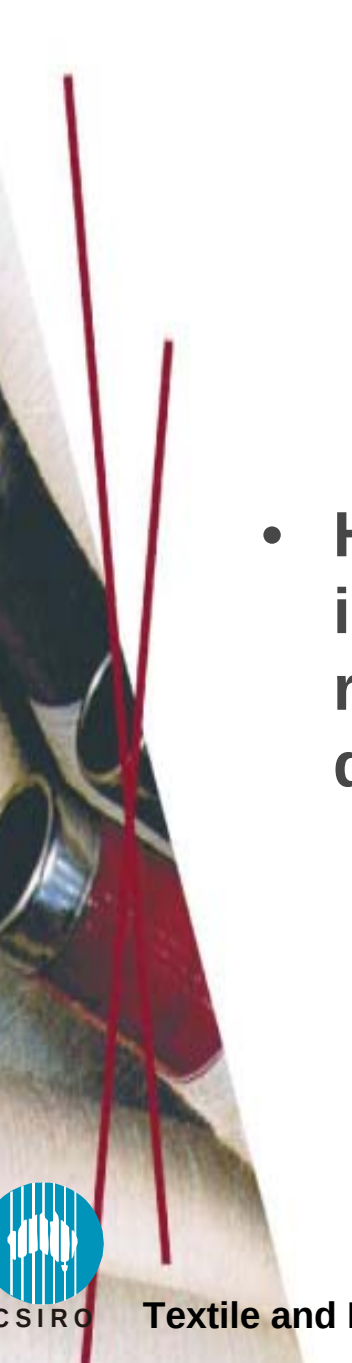
Project funded by AWI

Applications of Advanced Materials Currently Being Investigated at CSIRO

Smart Wound Dressings
(with AWI and Smith & Nephew)

Biomechanical Monitoring
(with UoW)

Physiological Monitoring
(with AWI)



Path to Market Partners with Brand Presence

Medical Textiles

- **Harnessing wool's natural attributes for insulation and moisture transmission in a range of injury prevention and wound dressing products providing:**
  - Optimum patient comfort and security
  - Control of wound surfaces
  - Integration of sensory systems

The next generation of products should be more than just dressings

Project funded by AWI

CTFT Medical Textiles
Next Generation Materials

- CTFT's 'Next Gen' Medical Textiles Project is in collaboration with UoW
- Funded by Australian Wool Innovation and Smith & Nephew to identify and develop novel wool based products
- The project addresses clinicians needs for a new generation of 'smart' wound-healing products

University of Wollongong

CSIRO Textile and Fibre Technology

CTFT Medical Textiles
Next Generation Materials

- Aimed at stimulation of the wound-healing process & targeting:
  - burns, ulcers, major trauma, palliative care, skin tears, necrotic conditions, and scar management

Generation-2 solutions will be ‘smart textiles’, i.e., textiles with integrated smart technologies tha sense and indicate physical conditions

Generation 3 will require biosensors for measurement, diagnosis, and control of biological systems

Summary

- Intelligent textiles can sense certain aspects of their environment and respond in a particular way.
- There would appear to be a growing market for intelligent textiles, driven primarily by defence and electronics.
- One of the world's newest fibres, carbon nanotubes, has potential to offer many advantages for new textile innovations.
- One of the world's oldest fibres, wool, has attributes that can be combined with other fibres to produce truly smart wool products which are at the leading edge of textile innovation.