



# Fibre Materials Research and Innovation

Professor Xungai Wang

Director, IFM (till 30 Nov'17)

PVC Future Fibres (from 1 Dec'17)



# **Guiding Principles**

(Fibre materials R&D @ Deakin)

**Green** (material and process)

**Fit for Purpose** (performance & function)

**Fashionable** (design and feel)

**Value-adding** (significance and cost)

# Major \$103 Million Infrastructure Development @ Deakin Waurn Ponds Campus in Geelong

## AFFRIC – Australian Future Fibres Research & Innovation Centre

- Supported by Federal (EIF Grant) and Victoria State Governments
- Collaboration between Deakin, CSIRO and VCAMM
- Supporting research in Carbon Fibre Composites, Functional Fibrous Materials, Green Natural Fibres, and Nanofibres
- \$34M used to establish the unique Carbon Nexus facility





**Australian Government**  
**Australian Research Council**

- Accelerate transformation of Australian fibre industry
  - Develop novel fibre technologies,
  - Sustainable, advanced manufacturing of fibre materials
  - Address global issues: environmental footprint & public health and wellbeing.
- ARC, 5 industry partners, and Deakin - \$8.7m over 5 years



**Empa**  
Materials Science and Technology



# Major \$58 million Deal

- Deakin University has licensed novel carbon fibre manufacturing technology to LeMond Composites of Oak Ridge, Tennessee, USA
- Potential to reduce the energy used in CF production by 75% and reduces the production process time from around 80 min to under 15 min
- The licence deal is valued at US\$44 million (A\$58 million) and is initially for a 20-year period
- The new technology was developed by PhD student Maxime Maghe and former Carbon Nexus General Manager Steve Atkiss
- LeMond Composites will also consider the development of a carbon fibre manufacturing plant in Geelong, which would invest more than \$30 million in construction and equipment and create dozens of jobs
- LeMond Composites were recently granted \$2.5 million from the Federal Government's Advanced Manufacturing Growth Fund to support the construction of their plant in Geelong





## GEELONG DEAL

Fmr cyclist signs carbon fibre venture with Deakin Uni

Uber chief executive officer quits after pressure from key investors

10 NEWS

22:54

# FIRST OEM PROGRAMS LAUNCHED

## The world's only one-piece carbon fibre wheel



*World First – Jan 2015 in Detroit Ford releases the Shelby GT350R Mustang with Carbon Revolution carbon fibre wheels fitted as standard.*



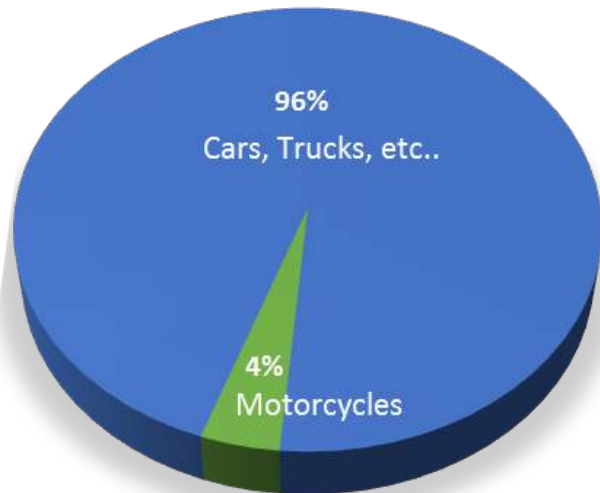
# High Value-added Applications

- Industry partner: **Draggin Jeans**
- World leader in protective denim apparel
  - Large number of injuries from motorcycle crashes come from abrasion
  - Motorcycle denim with protective liner, i.e. aramids
- Developing next-generation protective apparel
  - Fibre composition and fabric construction
  - Abrasion, burst, tear resistance





# Latest statistics in Australia

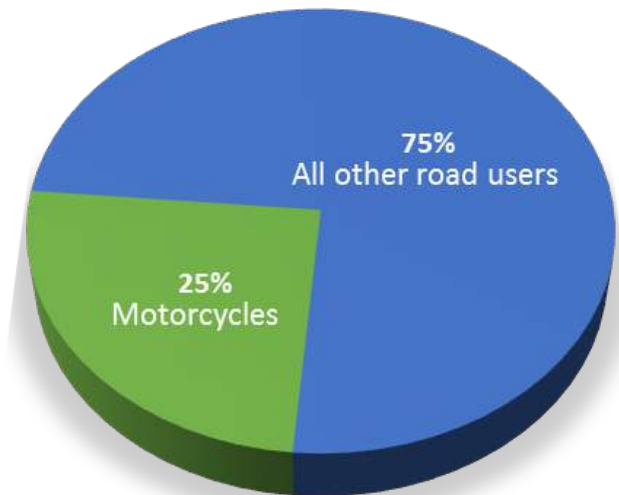


Motorcycles are 4% of all registered vehicles

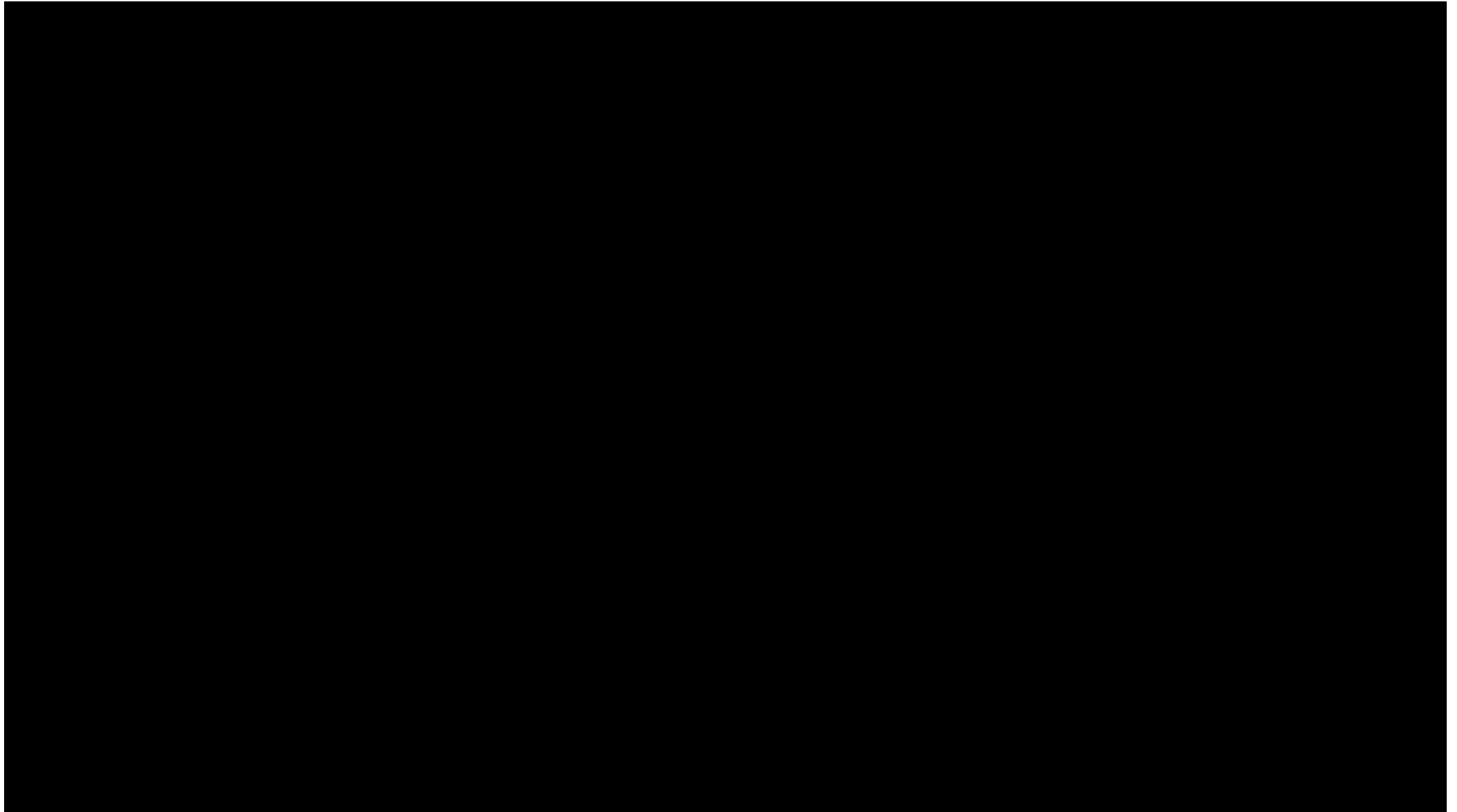


Road monitoring by Monash University in Melbourne shows that motorcycles are 1% of all road users

Motorcyclists make up 25% of people injured on Australian roads



## **Significant performance improvements through on-going R&D**



# High Value-added Applications

- Industry partner: Ear Science Institute Australia
- Address chronic eardrum perforation
- Collaboration via ARC LP, ARC Research Hub for Future Fibres
  - Thin, transparent membrane produced from silk fibres





# Device Manufacture



Silkworms



Silk Fibres



Degumming



Dissolving &  
Blending

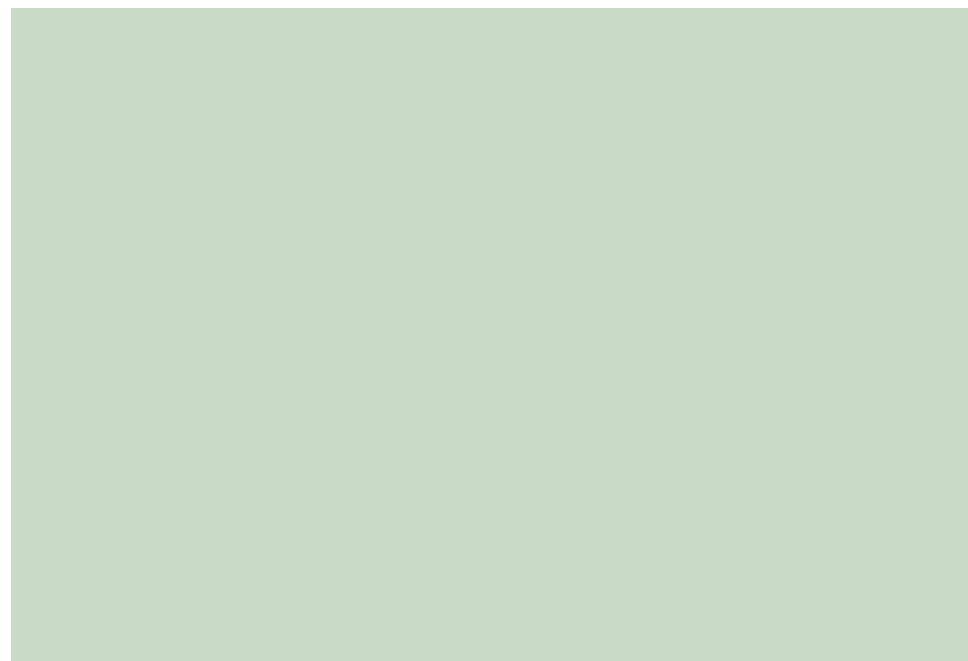
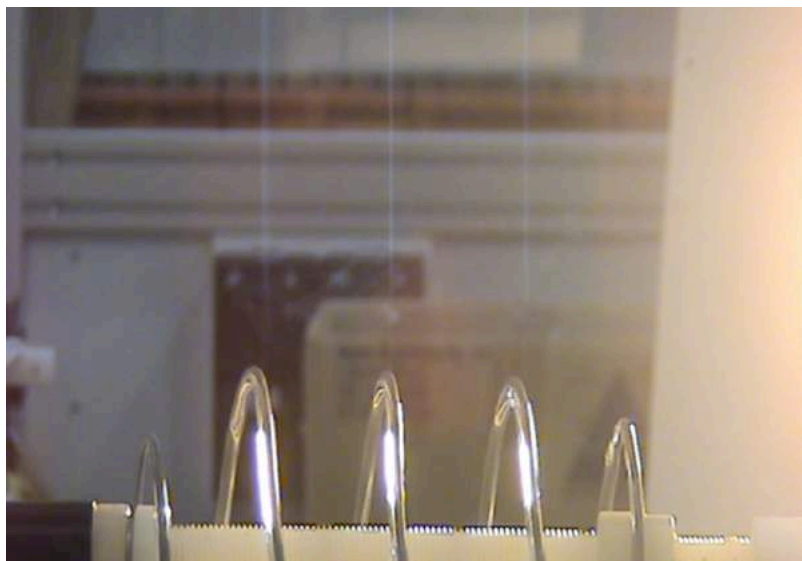


Casting



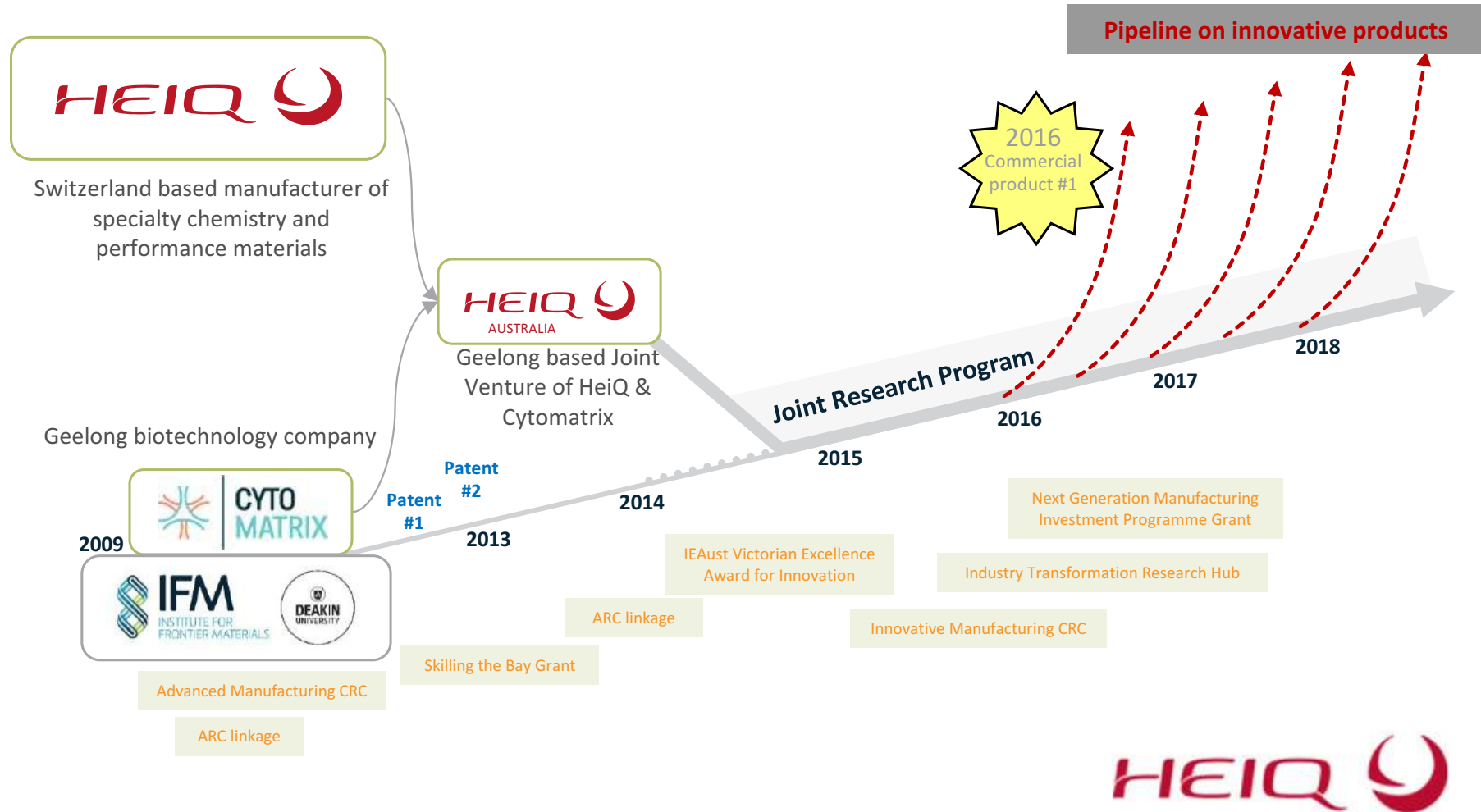
REPLICABLE AND SCALEABLE

# Nanofibres Research and Development



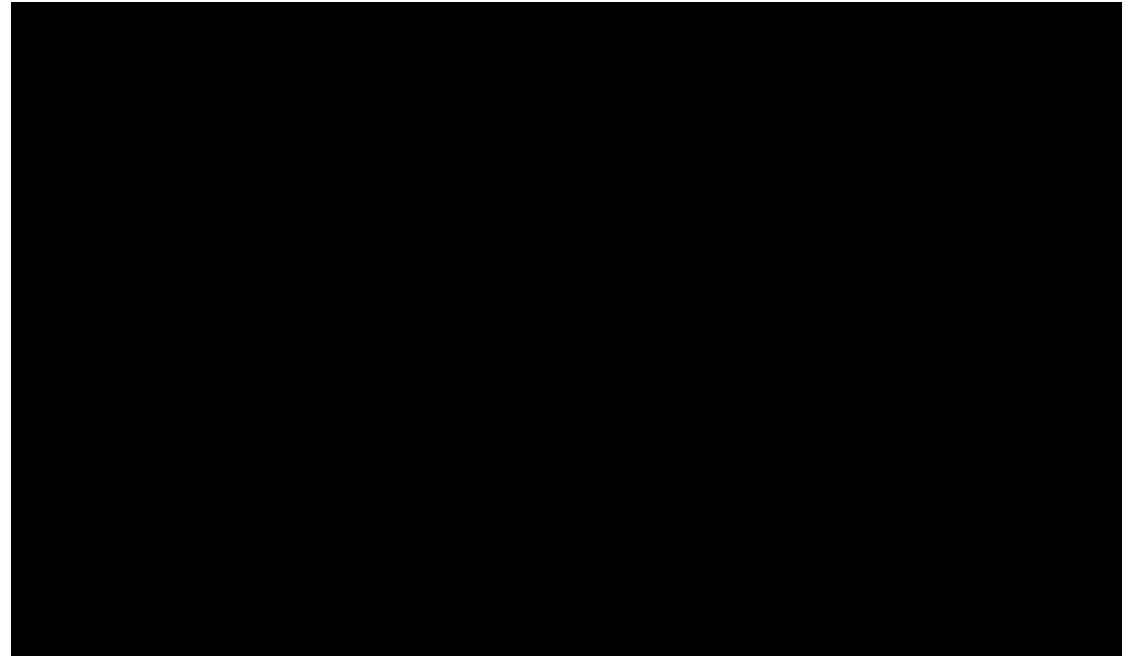
**Tong Lin, Xungai Wang, Xin Wang, Haitao Niu**  
PCT/AU2009/001373, WO2010/043002 A1. 2010

# HeiQ Australia





# Innovation in Ultrafine Short Fibres



Sutti A, Lin T, Wang X (2011).  
*J. Nanoscience and Nanotechnology*, 11(10) 8947-8952.

# Circular Denim – Denim Dyed Denim

(One of the top 5 winners out of 2885 entries)



## Old denim – fine powder (colour pigment) – Coat/Print – New Denim





## New Denim Jeans





Project team in Milan, Oct 2017



# Industry Relevant Research underpinned by Great Science

Knittable energy storing fiber with high volumetric performance made from predominantly Mxene nanosheetts

S Seyedin, E R S Yanza, J M Razal, (2017), Journal of materials chemistry A. doi 10.1039/C7TA08355F

Tailoring the fibre-to-matrix interface using click chemistry on carbon fibre surfaces

L Servinis, K Beggs, T Gengenbach, E Doeven, P Francis, B Fox, J Pringle, C Pozo-Gonzalo, T Walsh, L Henderson (2017), Vol. 5, pp. 11204-11213, Journal of materials chemistry A.

A waterborne coating system for preparing robust, self-healing, superamphiphobic surfaces

H Zhou, H Wang, H Niu, Y Zhao, Z Xu, T Lin (2017), Vol. 27, pp. 1-8, Advanced functional materials

Wet-spinning of highly conductive nanocellulose-silver fibers

J Wang, S Huang, X Lu, Z Xu, Y Zhao, J Li, X Wang (2017), Vol. 5, pp. 9673-9679, Journal of materials chemistry C

Polymer-metal schottky contact with direct-current outputs

H Shao, J Fang, H Wang, L Dai, T Lin (2016), Vol. 28, pp. 1461-1466, Advanced materials

PVDF/graphene composite nanofibers with enhanced piezoelectric performance for development of robust nanogenerators

M Abolhasani, K Shirvani Moghaddam, M Naebe (2017), Vol. 138, pp. 49-56, Composites science and technology

Rapid Bayesian optimisation for synthesis of short polymer fiber materials

C Li, D Rubin de Celis Leal, S Rana, S Gupta, A Sutti, S Greenhill, T Slezak, M Height, S Venkatesh (2017), Vol. 7, pp. 1-10, Scientific reports

Using ionic liquids to reduce energy consumption for carbon fibre production

M Maghe, C Creighton, L Henderson, M Huson, S Nunna, S Atkiss, N Byrne, B Fox (2016), Vol. 4, pp. 16619-16626, Journal of materials chemistry A



# THANK YOU!

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**Australian Government**  
**Australian Research Council**

