Textile LEDs curtain lighting up by photovoltaic strips (EURECAT vision from 1D-NEON perspective)

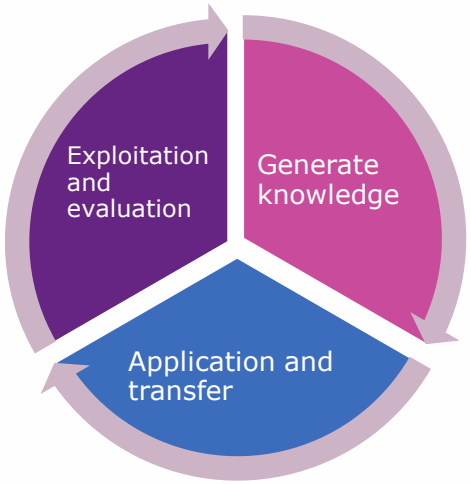
Dr. Petar Jovancic, Leader of Advanced Material Research, Functional Textile Unit

Terrassa, Textiles de uso técnico. Innovando con tecnologias fotónicas (Innovation Workshop), December 12, 2017

MODEL OF OUR TECHNOLOGY CENTRE

INNOVATING FOR BUSINESS

Private, non-profit entity dedicated to industrial research and technology knowledge transfer, providing the technical and human means for all companies, individuals, and entities interested in these areas to effectively apply them.



Mission

Boost the competitiveness of companies and the society through applied research, innovation, and knowledge transfer.

eurecat Centre Tecnològic de Catalunya

VISION: To become a leader in the area of industrial research and technological transfer for the innovation system across Catalonia.

FUNCTIONAL TEXTILES UNIT

TWO LOCATIONS

Mataró

SMART TEXTILES LAB
CHEMISTRY LAB

Canet de Mar

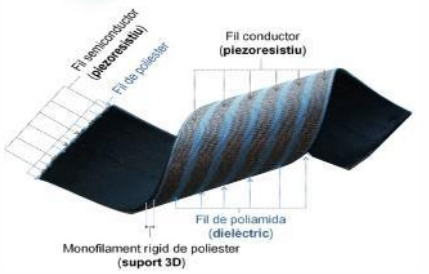
TEXTILE MANUFACTURING LAB
TEXTILE TESTING LABS

R&D FOCUS

FUNCTIONAL TEXTILES

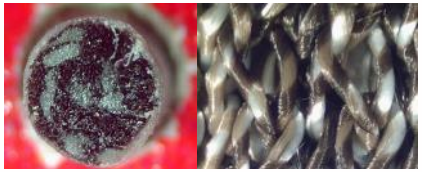
E-textiles: Designing & Prototyping

Sensors into garments; bio signals, flexion, posture, and motion
Heating, lighting, and sound emitting actuators



Multifunctional Fabrics: Designing & Industrializing

Intelligent properties with stimuli-sensitive biopolymers
Functional materials into complex fabric structures



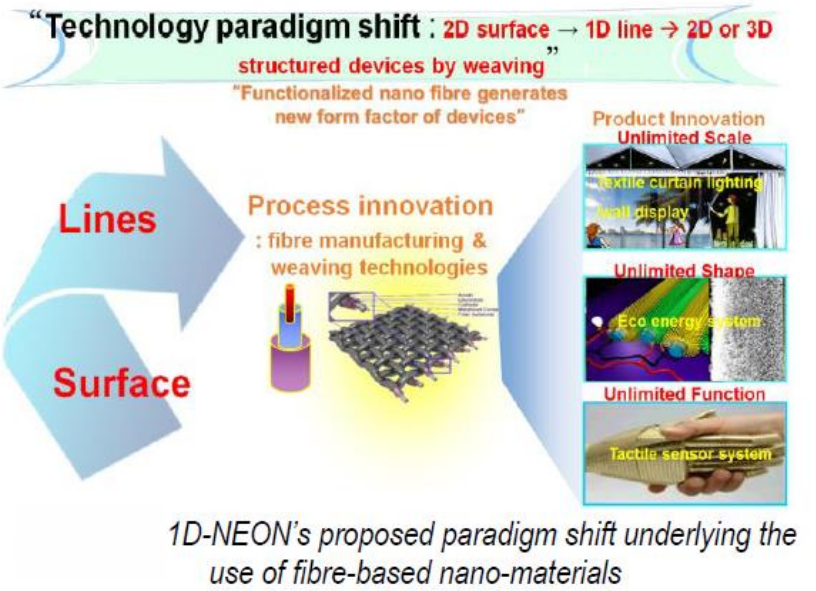
Composites: Materials & Structures

Pre-formed reinforced fabrics to optimize structures and processes
Hybridizing materials to optimize performance

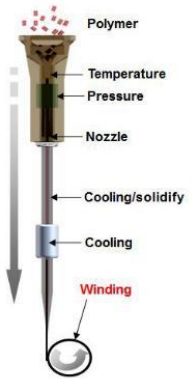
1D NEON

Project numbers and facts (www.1d-neon.eu)

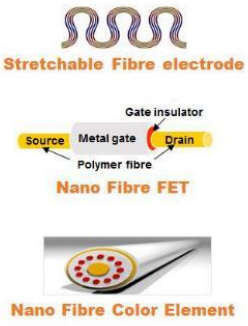
Title of the project: 1D Nanofibre Electro-Optic Networks (1D-NEON)
Grant agreement: 685758
Type of project: NMP (Nanotechnologies, Advanced Materials and Production)
Duration: 48 months (1st April 2016 to 31st March 2020), 14 partners
Total budget: EUR 9106237,25 (EU contribution EUR 7995648,88)
Total manpower: 1191.3 person-months
Project coordinator: Prof. Jong Min Kim (University of Cambridge)



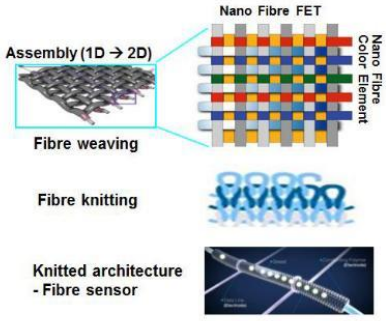
1D-NEON's proposed paradigm shift underlying the use of fibre-based nano-materials



(a) Fibre drawing



(b) Fibre elements



(c) Fibre weaving/knitting

1D-NEON (1D Nanofibre Electro-Optic Networks) project has received funding from the European Union´s Horizont H2020 research and innovation programme under grant agreement No. 685758

EURECAT´s role in 1D-NEON

Work Package #	WP3				Start Date or Starting Event						M6 to M48			
Work Package Title	*Manufacturing Process Development*													
Participant #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Short Name	OxU	CU	UNOVA	CeNTI	EURECAT	TITV	SILVACO	SAATI	RELATS	SSPI	HENKEL	LG	PHILIPS	BIOAGE
Person/months	0	0	0	18	50	52	0	6	8	0	6	0	0	0

WP1=2PM WP2=10PM WP4=15PM WP7=3PM WP8=2PM

Start date of 1D-NEON 01/04/2016

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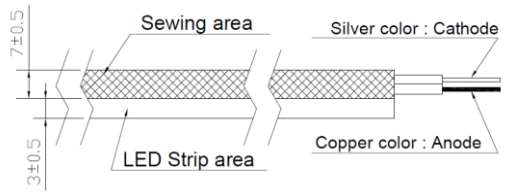
Textile LEDs Curtain Development

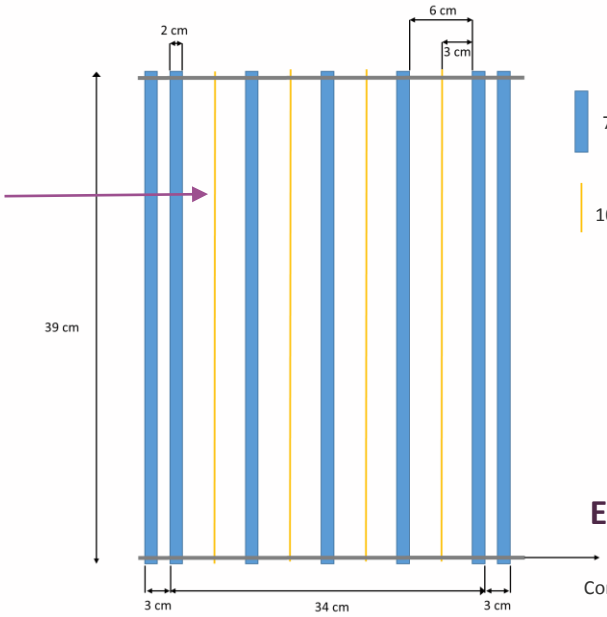
Harvatec LED MX01 Serie (input voltage DC 4.5 V; maximum current 250 mA/m; LED pitch 40 mm



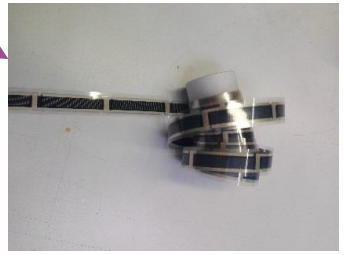
Locklite Ablesstik CE 3103WLV (HENKEL)

Technology	Epoxy
Appearance	Silver
Cure	Heat cure
Product Benefits	• Electrically conductive • Pb-free alternative to solder • Low cure temperature
Filler Type	Silver
Filler Weight, %	76
Application	Electrically Conductive Adhesive
Surfaces	Sn, Sn/Pb and OSP coated Cu
Typical Package Application	SMD component attach

Volume resistivity after the curing process 0.0008 Ω/cm



High efficiency OPV stripe (InfinityPV Aps)



Elitex 235/34 dtex yarn four (2x2) plied to improve conductivity:

Single 235/34 dtex yarn =**15.6 Ω/cm**
Four (2x2) plied yarn = **3.8 Ω/cm**

Integrated demonstrator* (small scale) with commercial OPV photovoltaic stripes (InfinityPV Aps, Denmark), commercial fibre embedded LEDs (Harvatec, Taiwan) connected by ELITEX conductive yarns (TITV, 1D-NEON partner) and conductive adhesive (Locklite Ablesstik CE 3103WLV (HENKEL, 1D-NEON partner).

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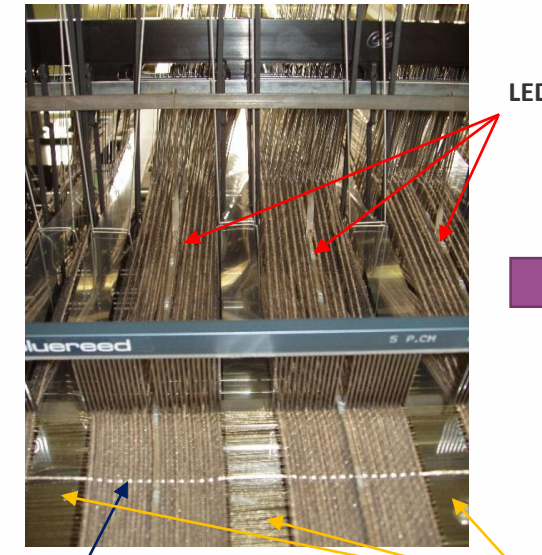
Textile LEDs Curtain Development



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Textile LEDs Curtain Development

NEXT STEPS

- **Design of fibre-based energy storage material as a part of LED curtain** for storage energy during the sunny day(s) or by a sun simulator for lighting up the LEDs during the night using **advanced weaving and knitting fabrics**;
- **Design of yarn embedded LEDs** with textile properties;
- **Establish a set of mechanical and electrical characterization tests** for functional fibres/yarns before and after their implementation into woven and knitted structures in order to choose proper methodology of protection of the functionality(is);
- **Standardize adhesive materials for interconnection** of selected component/functionality using Henkel´s materials (adhesive, inks, coatings, encapsulants …);
- Optimize the process of **protection of electronic interconnection** by lamination and protective solutions (silicones, acrylates and PU formulations).

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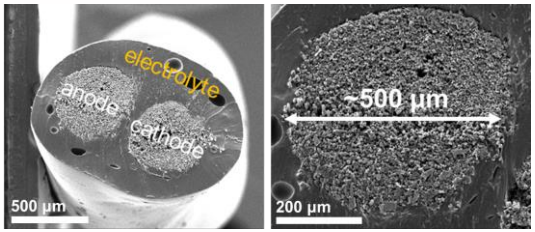
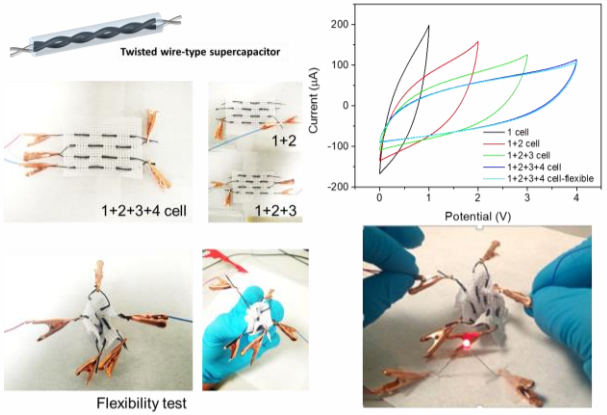
Fabrication of single-body F-storage for weaving process

Gel-type solid electrolyte
PVA
KOH

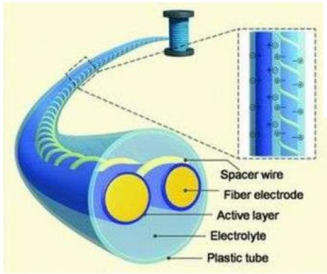
Ionic sources* : cation ion sources (H_2SO_4, H_3PO_4, and KCl)
: anion ion sources (NaOH, KOH, and LiOH)
Ion concentration : 40~60 wt% vs. 40~60 wt% polymer
Polymer** : Polyvinyl alcohol (PVA) (almost), PAAK (potassium polyacylate)

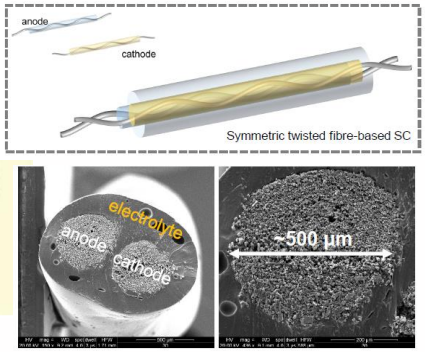




- ✓ **High ionic conductive and stable electrolyte**
- ✓ **Fabrication and structural evaluation of single-body F-storage**
- ✓ **Integration and electrical characterization of single-body F-storage (~120 μF/cm)**

Textile integration of fibre energy storage device (fiber based supercapacitors) by weaving





Electrochemical properties of fibre-based SC after insertion into the fabric

	Capacity (μF)	Resistivity(Ω)
№3	669,7	70
	664,9	67,26
№4	667	66,2
	656	71,3

Series circuit: 320.5 μF, Rs=137.4 Ω
Parallel circuit: 1310 μF, Rs=43.9 Ω

- ✓ **Design of single-body F-storage**

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