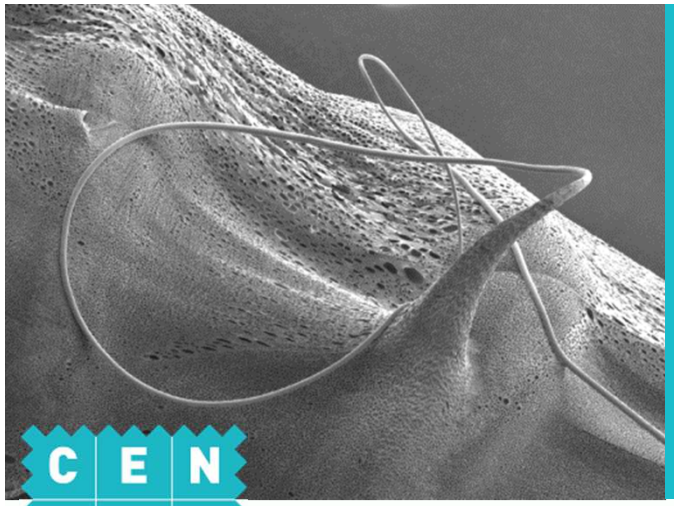

Improving the mechanical properties of PiezoPLA tapes for energy harvesting and sensing applications

CEN TEX BEL

Interreg
France-Wallonie-Vlaanderen

UNION EUROPÉENNE
EUROPESE UNIE

GoToS3
BIOHARV

Birgit Stubbe

Elastoplast closing event

16/03/2021

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About Bioharv

CENTEXBEL

BIOHARV INTERREG V Project

"Bio-based piezoelectric textile materials for the production of electrical energy"

Objectives

- ✓ Evidence, evaluate and enhance shear PE of PLA materials using melt-state processes
- ✓ Design 100% polymer-based PEH prototypes and test energy harvesting efficiency
- ✓ Development of cross-border FR/BE expertise in electroactive materials

http://www.gotos3.eu/bioharv

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BIOHARV INTERREG V Project

PLA Formulation & characterization

PLA textile structures

PLA/Electrode Prototyping

Structural characterization

Electromechanical characterization

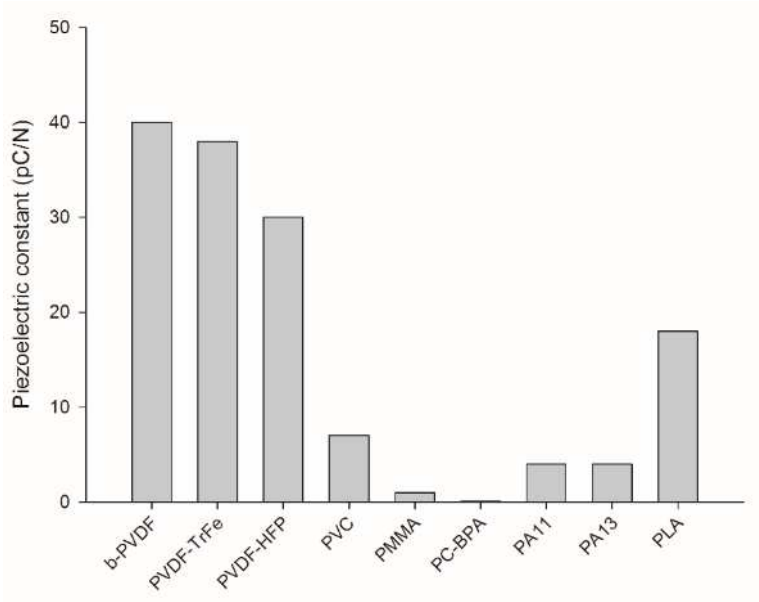
Interreg France-Wallonie-Vlaanderen

GoToS3 BIOHARV

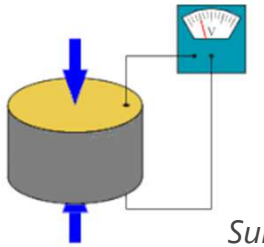
PiezoPLA

Potential of PLA

- ✓ Biobased and biodegradable
- ✓ Low price and easy processing
- ✓ Shear piezoelectricity without poling



The piezoelectric effect

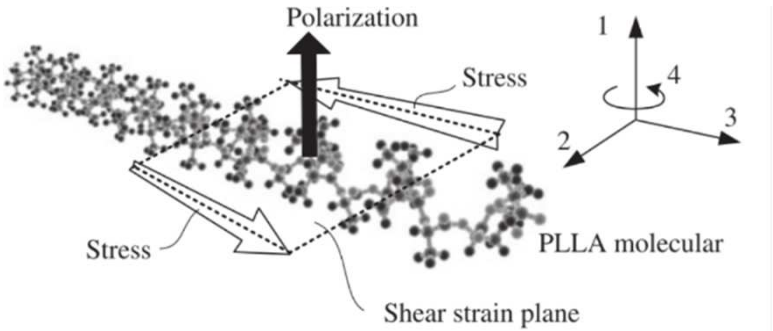


Mechanical Stresses/ Strains

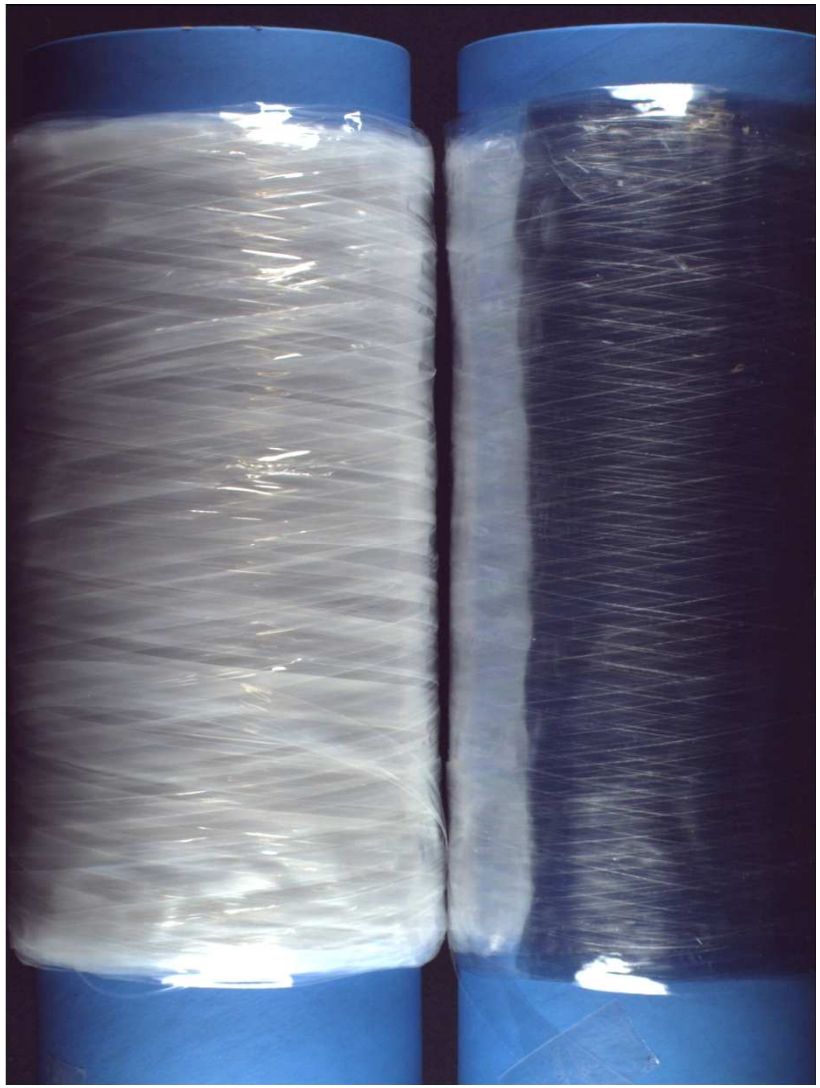
Direct ⇕ *Inverse*

Surface Charges & Electrical Power

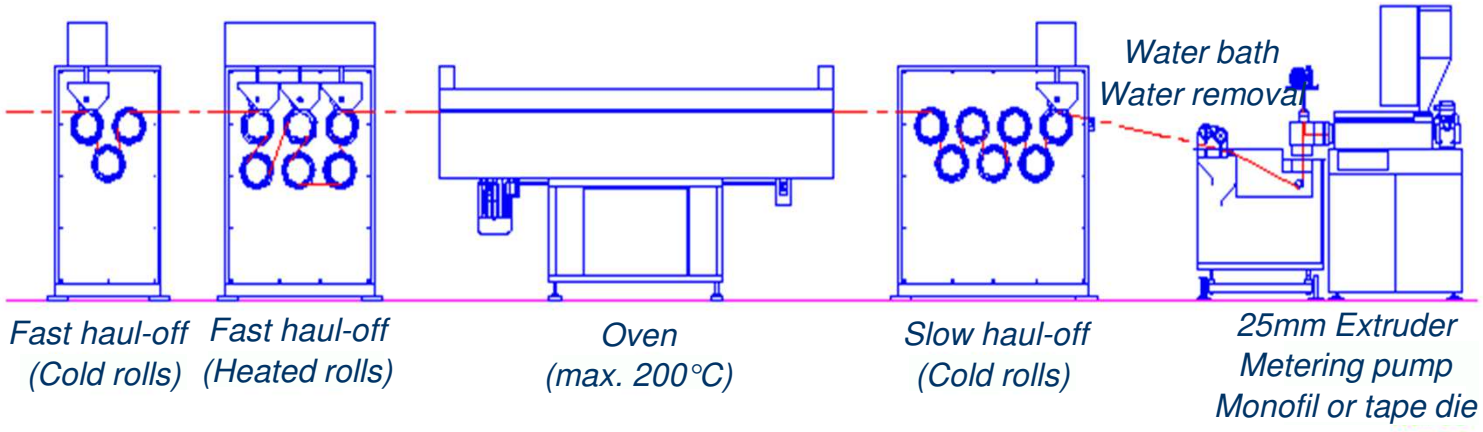
Optically-active polymer with
SHEAR PIEZOELECTRICITY

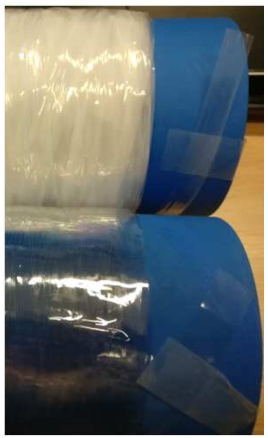


PiezoPLA tape-based prototypes



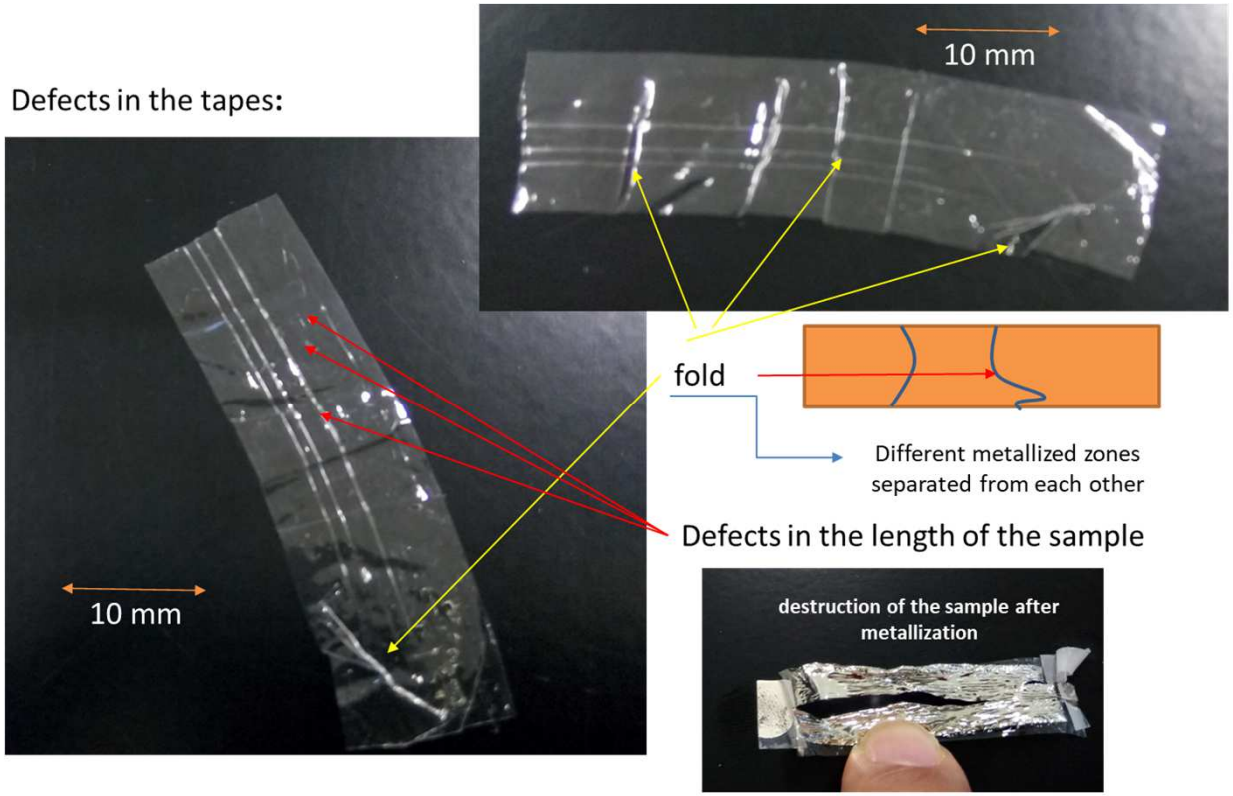
PiezoPLA tape production





PiezoPLA tape-based protoypes

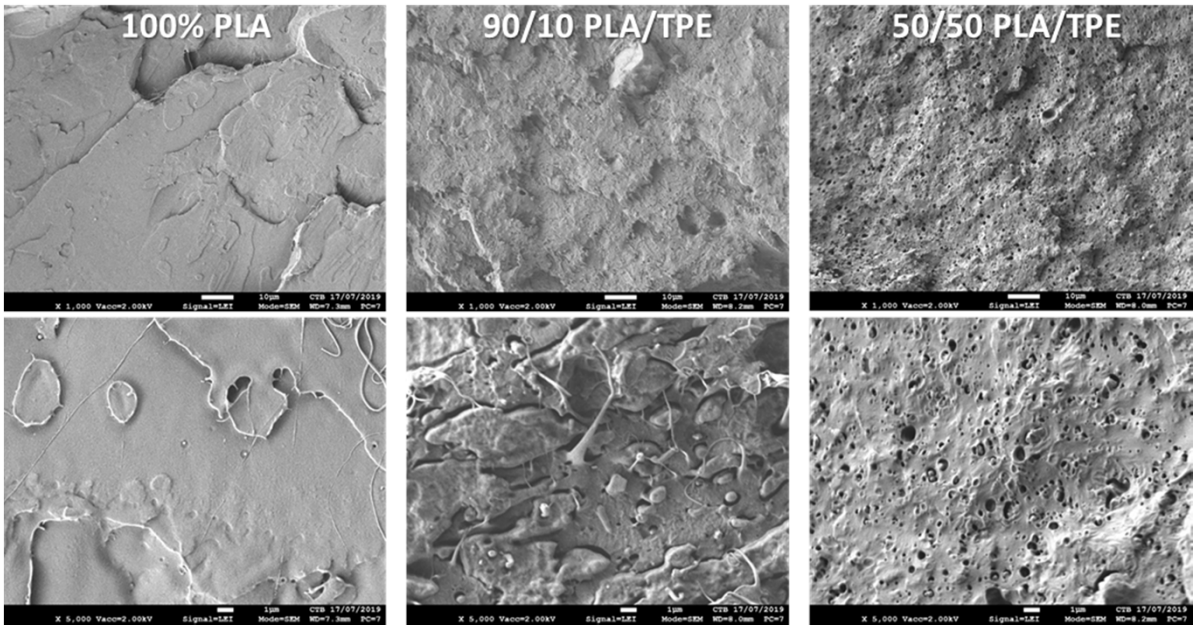
Pure PLA-tape
is too brittle
for prototyping



PiezoPLA tape optimization - 1

Reduce brittleness & splitting by adding a TPE

- PLA: Luminy® L130 (Total Corbion)
- TPE: Thermolast®K TF7ADN (Kraiburg) – SEBS based



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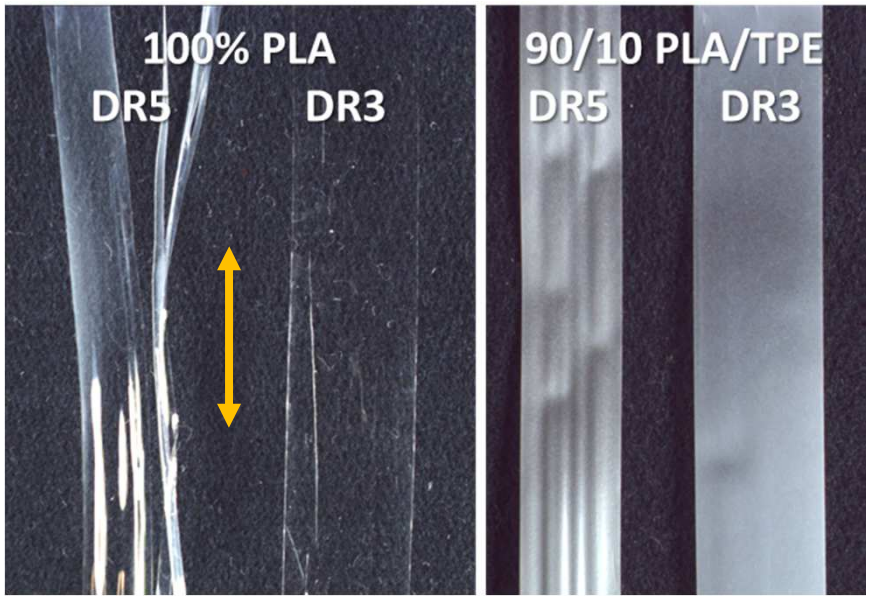
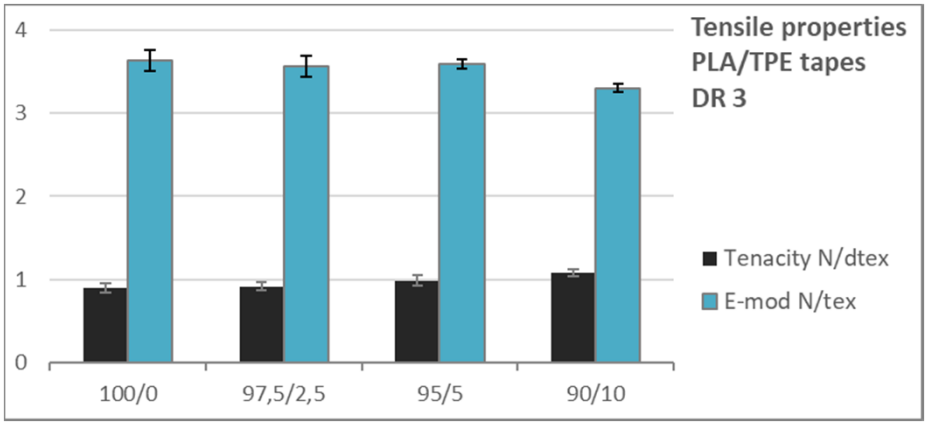
PiezoPLA tape optimization - 1

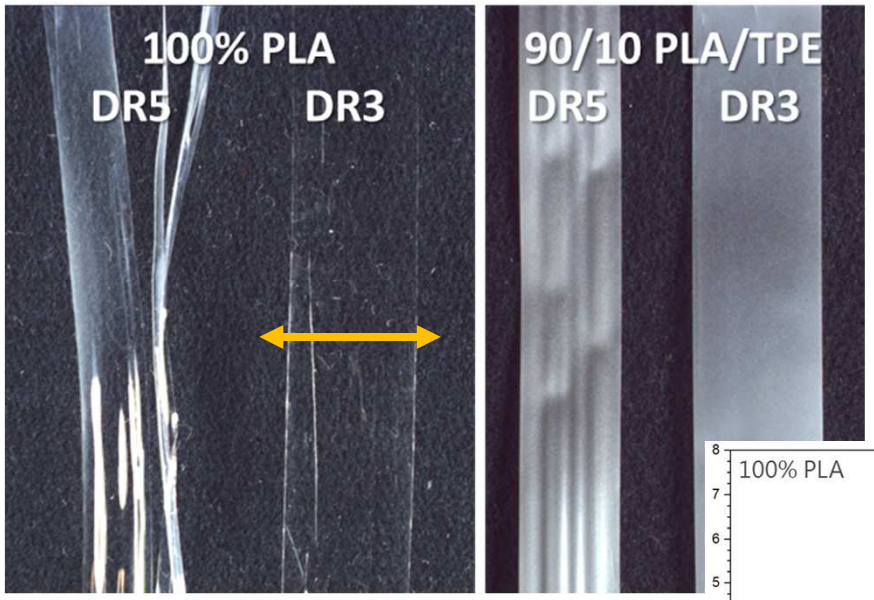


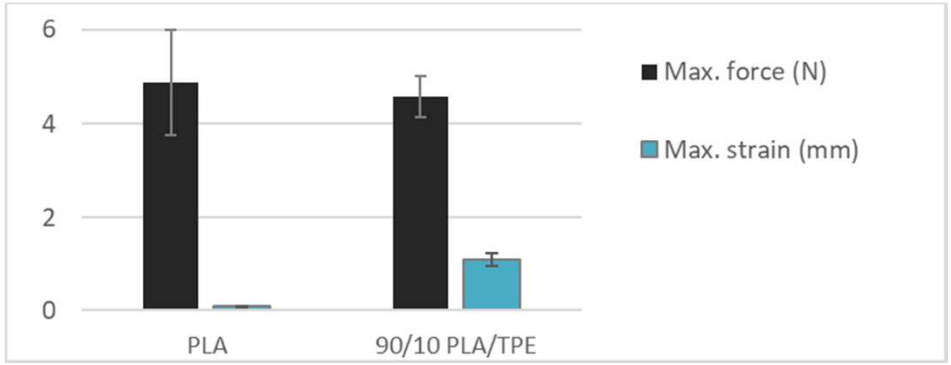
Splitting *No splitting*



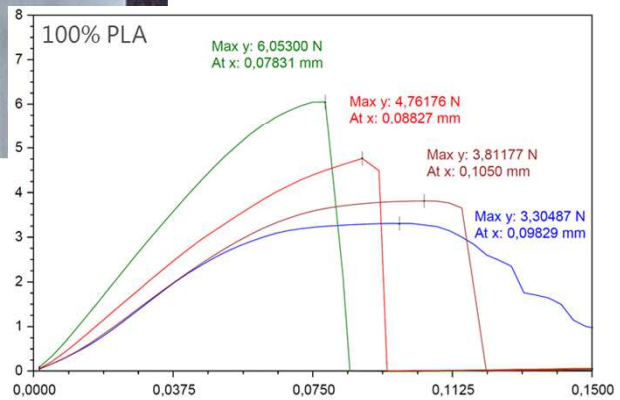
✓ Virtually no change in tenacity or modulus in machine direction

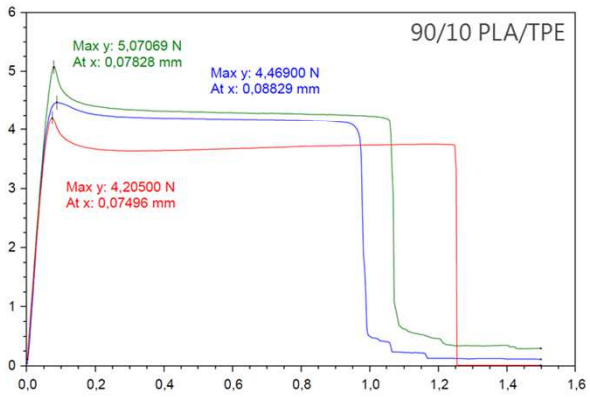
PiezoPLA tape optimization -1





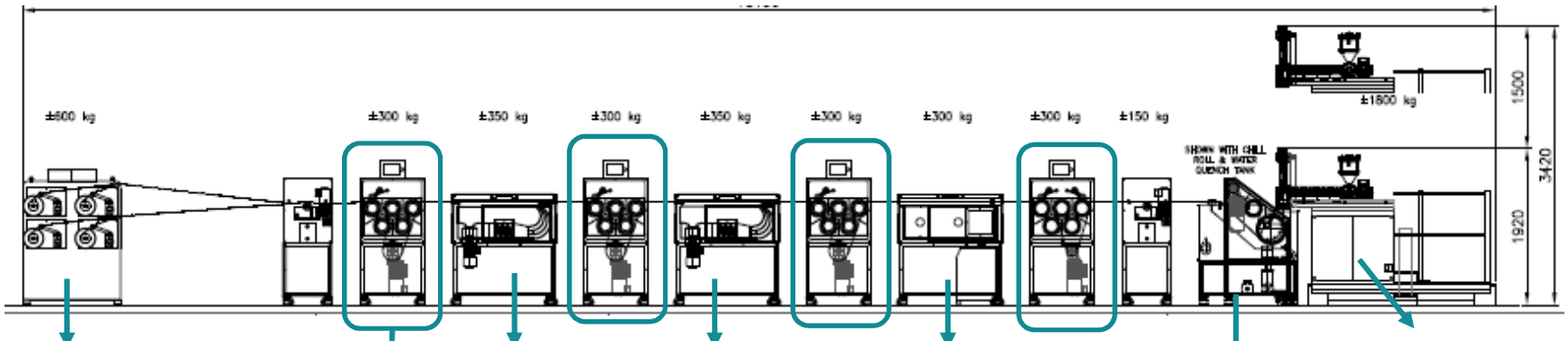
- ✓ Increase in strain + ductile fracture in the transverse direction of the tape





PiezoPLA tape optimization - 2

Improve the piezoelectric properties



4 winding positions
Max speed 200 m/min

4 sets of godets with adjustable temperature
3 stretching zones

Hot air ovens

Steam oven

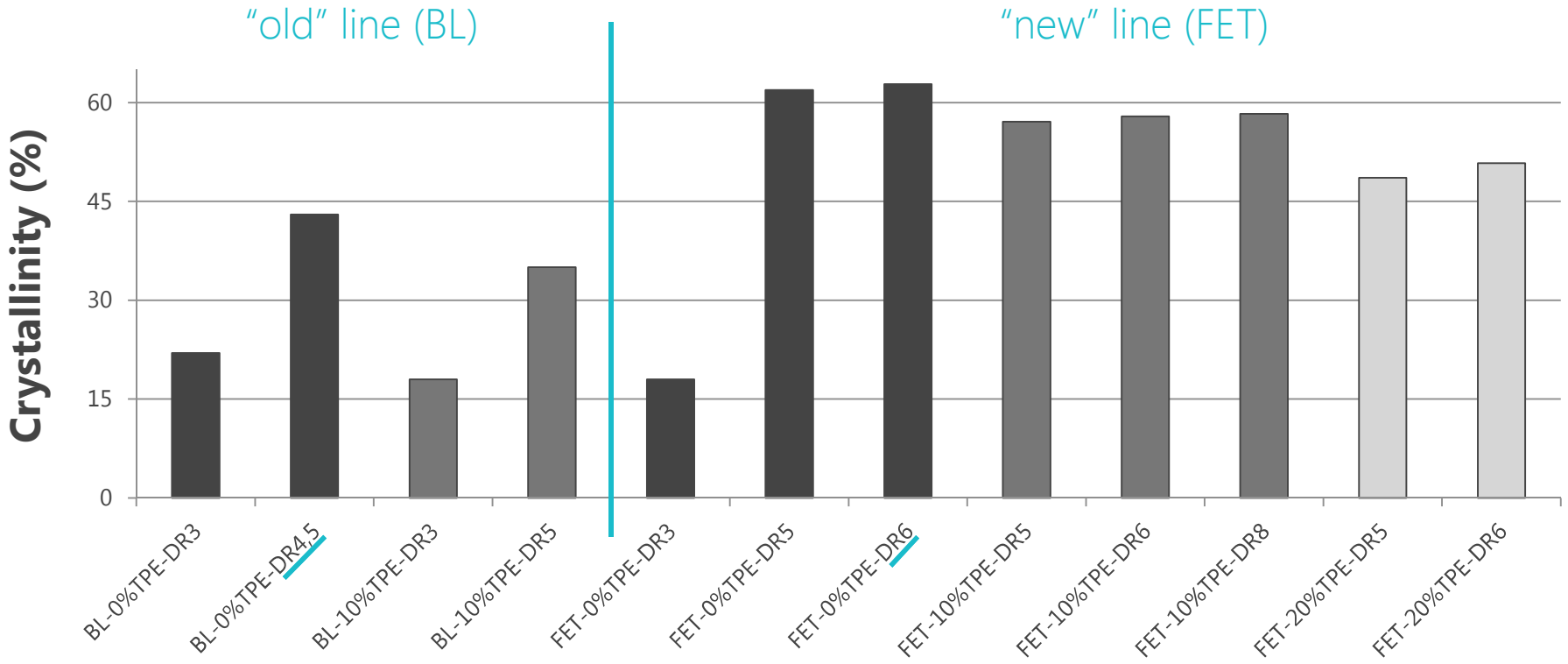
Throughput
0.2 to 5 kg/h

Monofilament Ø 40µm - >2000 μm
Bundle of monofils: Ø 20 μm/fil
Tape (film 4 cm) or fibrillated tapes

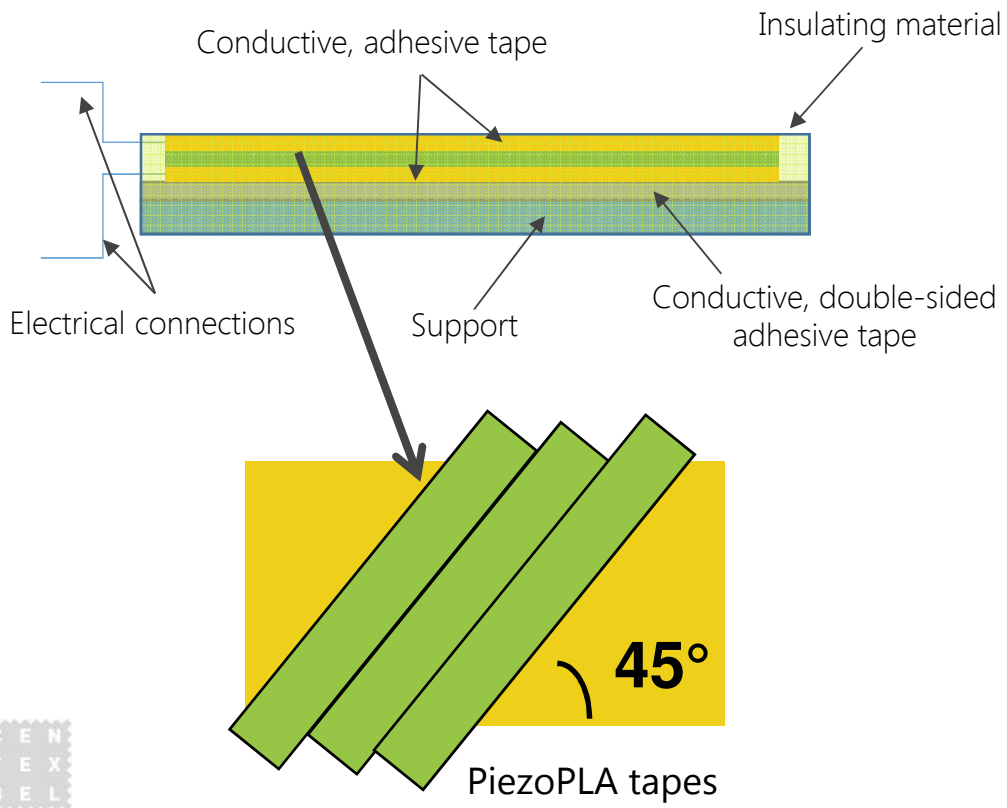
Quenching:

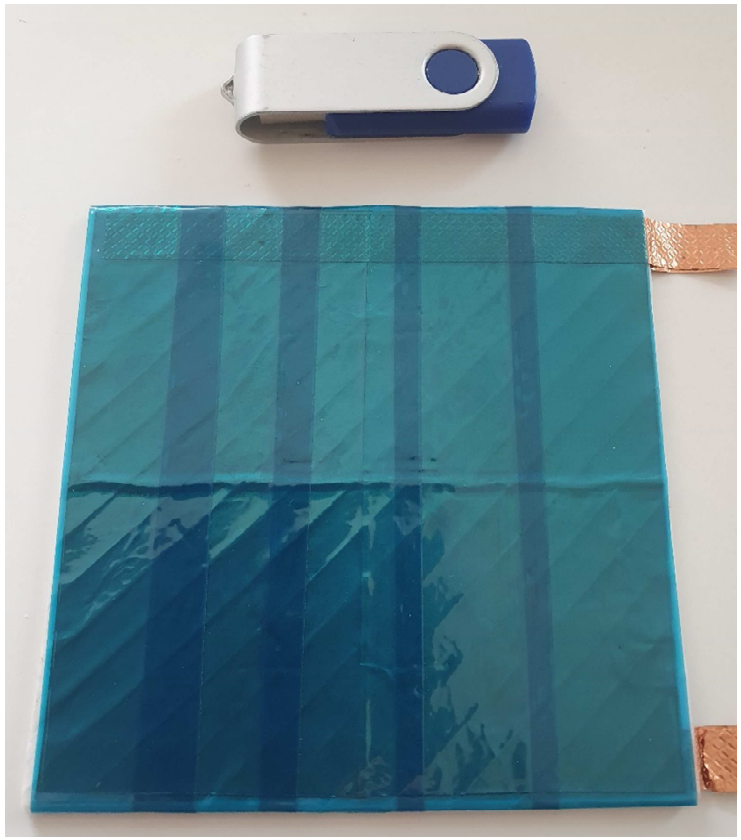
- Standard water bath
- Air cooling
- Hybrid (water +air)
- Chill roll for tapes

PiezoPLA tape optimization - 2



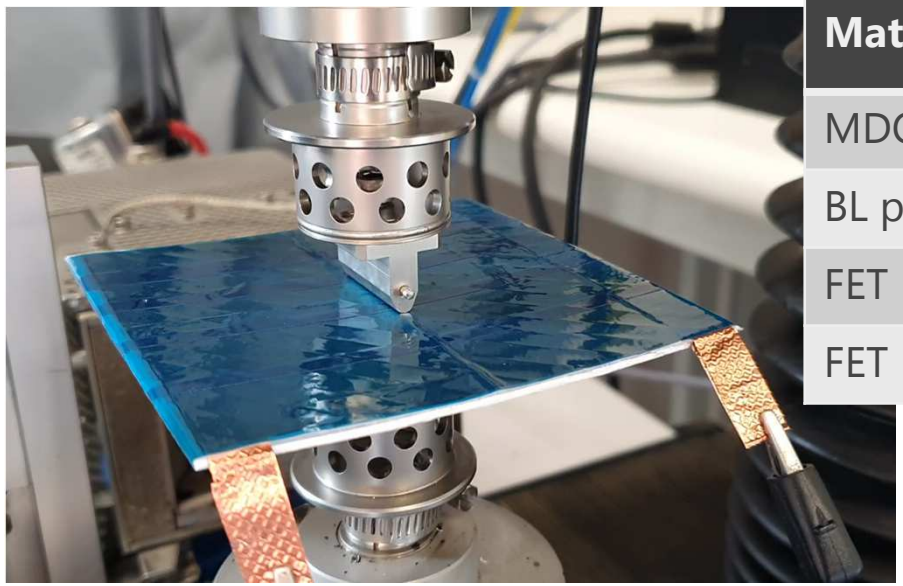
PiezoPLA tape-based protoypes - 2





PiezoPLA tape-based protoypes - 2

Prototype active in 3-point-bending tests (2 Hz)



Materials	V_{pp} (mV)	V_{rms} (mV)
MDO PiezoPLA film	105	20
BL piezoPLA tape	175	65
FET piezoPLA tape	330	115
FET piezoPLA-TPE tape	170	60

(DR 5, PLA L130)

Conclusions and future perspectives

- Successful production of mono-oriented PiezoPLA tapes
- Demonstration of the shear piezoelectricity
- Improved mechanical properties but reduction in energy recuperation upon addition of TPE

- Perspectives – maximizing the energy recuperation while maintaining improved mechanical properties

Acknowledgements

IMT Lille Douai – TPCIM

- *Dr. Cédric SAMUEL*
- *Prof. Jeremie SOULESTIN*
- *Prof. Marie-France LACRAMPE*
- *Prof. Patricia KRAWCZAK*

ULille – UMET

- *Dr. Sophie BARRAU*

Centexbel

- *Dr. Birgit STUBBE*
- *Dr. Isabel DE SCHRIJVER*

UMons – SMPC

- *Dr. Jean-Marie RAQUEZ*
- *Prof. Philippe DUBOIS*
- *Dr. Philippe LECLERE*
- *Dr. Valentina SESSINI (Post-Doc)*
- *Thai Cuong NGUYEN (PhD)*

UPHF – LMCPA

- *Prof. Christian COURTOIS*
- *Dr. Mohamed RGUITI*
- *Mohamed Aymen BEN ACHOUR (PhD)*
- *Dr. Georges NASSAR (UPHF-IEMN)*

Project supported by

Interreg

France-Wallonie-Vlaanderen

UNION EUROPÉENNE
EUROPESE UNIE

Co-financiers

Wallonie

AGENTSCHAP
INNOVEREN &
ONDERNEMEN

met de steun van
west-vlaanderen
de gedreven provincie

Thank you!

Centexbel

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