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Elastronics, Overview and Main Achievement

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Tampere University

Tampere University Electrical Engineering

- Tampere University is the second largest University in Finland.
- ICT and electrical energy systems form the main application umbrellas. The activities comprise the following three main areas:
  - Electronics and Embedded Systems
  - Electrical Energy Systems and Power Electronics
  - Communications Engineering and Radio Systems

https://www.tuni.fi/en
https://www.tuni.fi/en/about-us/electrical-engineering

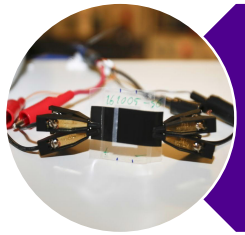
Electronics and Embedded systems

Printed Hybrid Electronics

- Flexible and stretchable
- 3D and structural electronics
- Wearable and skin conformable

Thin-film electronics

- Internet-of-Everything
- Thin-film devices and circuits based on printing and ALD



Electronics and energy

- Energy harvesting and management systems
- Low-power electronics
- Energetic systems

Embedded systems

- Ambient intelligence and augmented reality
- User interfaces, communication, IoT and services
- Smart textiles

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Tampere University
Laboratory for Future Electronics (LFE)

- LFE investigates technologies and solutions related to **energy-autonomy** (storage and harvesting), **sensors**, conformable **wearable** electronics (soft/stretchable, on-skin, textile), and **hybrid system** integration.
- Strong emphasis is placed on scalable, low-cost manufacturing methods such as **printing** as well as their integration with more conventional component assembly methods.
- LFE explores new device and circuit approaches based on printable organic and metal oxide semiconductors.

Elastic Electronics = ELASTRONICS

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Elastic Electronics

Conformable
Deformable
Unobtrusive

Health / sport

Automotive

Soft robotics /machinary

Aviation

Human-machine interface

Smart building

The aim of the ELASTRONICS –project is to enable the transformation of stretchable devices into a mass-producible technology.

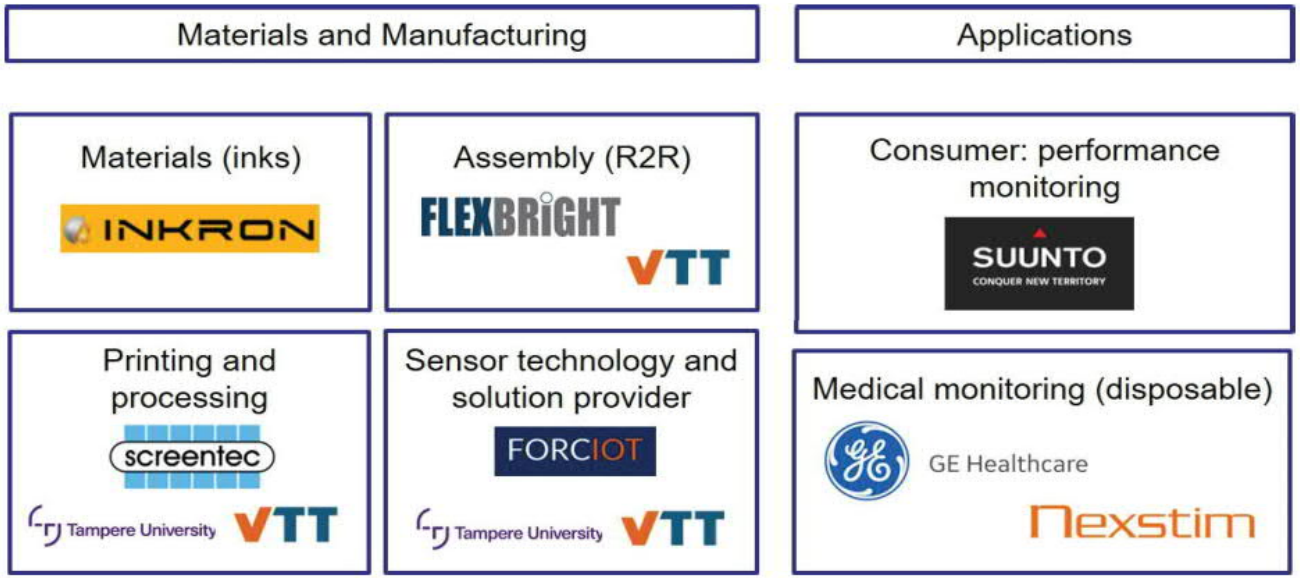
ELASTRONICS

BUSINESS FINLAND

Funding: Business Finland
Schedule: 9/2018-10/2020

ELASTRONICS - enabling the future of wearable electronics

ELASTRONICS focused on cost-effective **stretchable** and **ultra-thin** Hybrid Printed Electronics (HPE) to overcome the challenges of current bulky and uncomfortable wearable electronics (skin patches and e-textile).



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ELASTRONICS

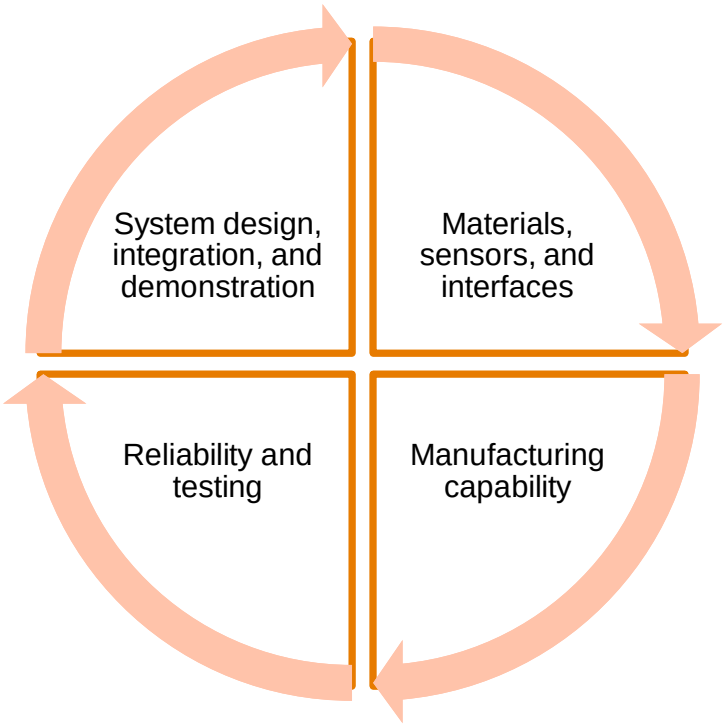
BUSINESS FINLAND

Funding: Business Finland
Schedule: 9/2018-10/2020

ELASTRONICS - enabling the future of wearable electronics

ELASTRONICS –project focus:

1. Stretchable electronics technologies suitable for mass manufacturing
2. Comprehensive understanding of failure mechanics, testing methods, and practical ways to improve the reliability
3. Design and manufacturing guidelines
4. Manufacturing capability for stretchable/soft electronics including assembly of thin circuits.



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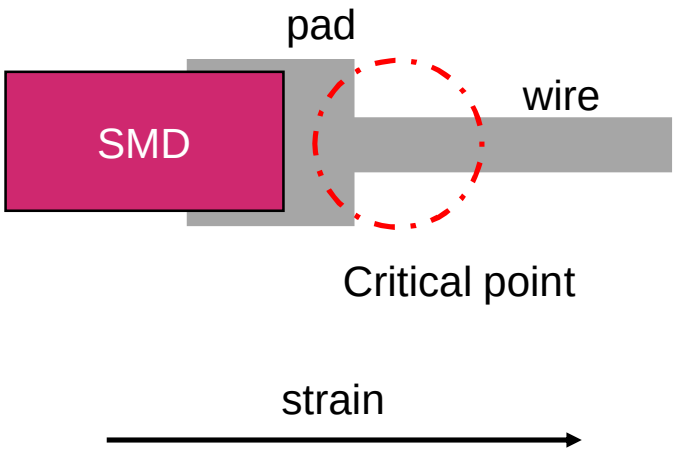
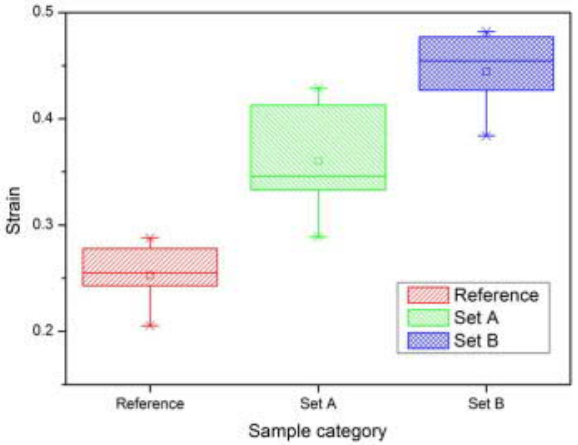
Improving the performance of printed stretchable electronics



The stretching performance can be improved by locally tuning the stiffness

1. FE Modeling
2. Measurements (DIC and electromechanical)



More information:

D. Di Vito, et al., Sci. Rep., vol. 10, no. 1, p. 12037, Dec. 2020.

M. Mosallaei, et al., Flex. Print. Electron., vol. 5, no. 1, p. 015004, Jan. 2020.

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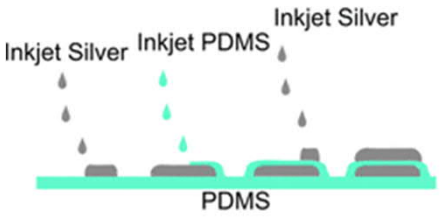
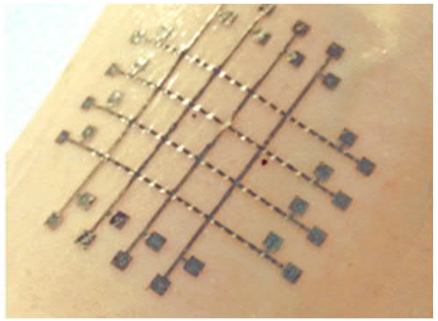
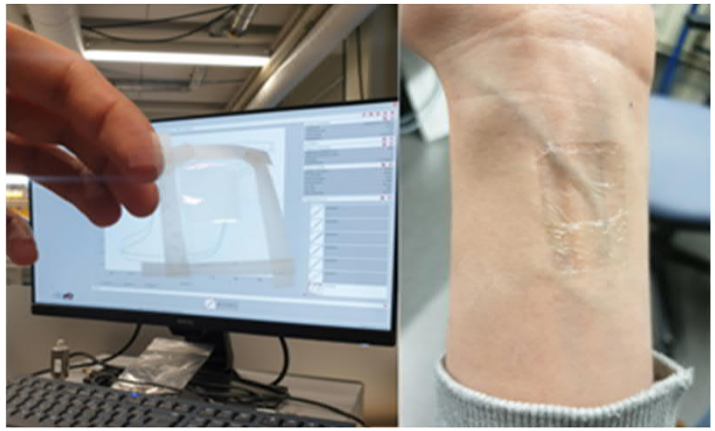
Fabricating epidermal electronics



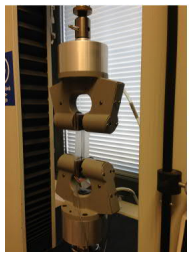


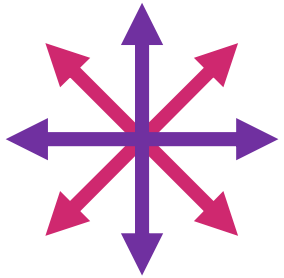
Pritting PDMS multilayers

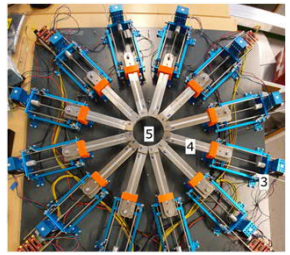


Transparent piezosensors

Testing







Uni-axial testing

Multi-axial testing

- Single-pull
- Cycling test
- Creep
- Rolling
- Environmental aging

More information:
R. Mikkonen, et al., ACS Appl. Mater. Interfaces, vol. 12, no. 10, pp. 11990–11997, Mar. 2020.
K. M. Lozano Montero, et al., in *Proc. of the 8th Electronics System-Integration Technology Conference (ESTC)*, 2020

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Summary

- Modeling, simulations, and testing are the key elements for estimating the reliability and durability of stretchable electronics
- Geometry modification together with hybrid printed electronics can provide the reliability and scalability needed
- Thin and conformable sensors are capable to produce high-quality signal
- Several scientific theses, journals and conference articles have and will be published. Please follow us in coming days.

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Acknowledgement

The team worked in the project.

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