



Hochschule Niederrhein
University of Applied Sciences

Sustainable Materials for Smart Textile Components

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Innovation and competence ecosystem in Tampere region
for sustainable and smart textiles
May 25th, 2023



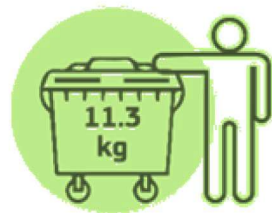
Trends in Smart Textiles



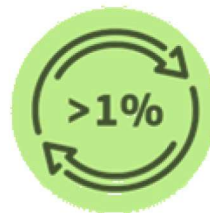
Sustainability – Situation in textiles

EU strategy for sustainable and circular textiles

ReSet the Trend - #ReFashionNow



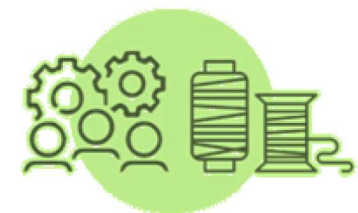
5.8 million tonnes of textiles are discarded every year in the EU. That's 11.3 kg per person.



1% of the material used around the world for clothing is recycled into new clothing.



Textile consumption is one of the top three pressures on water and land use.

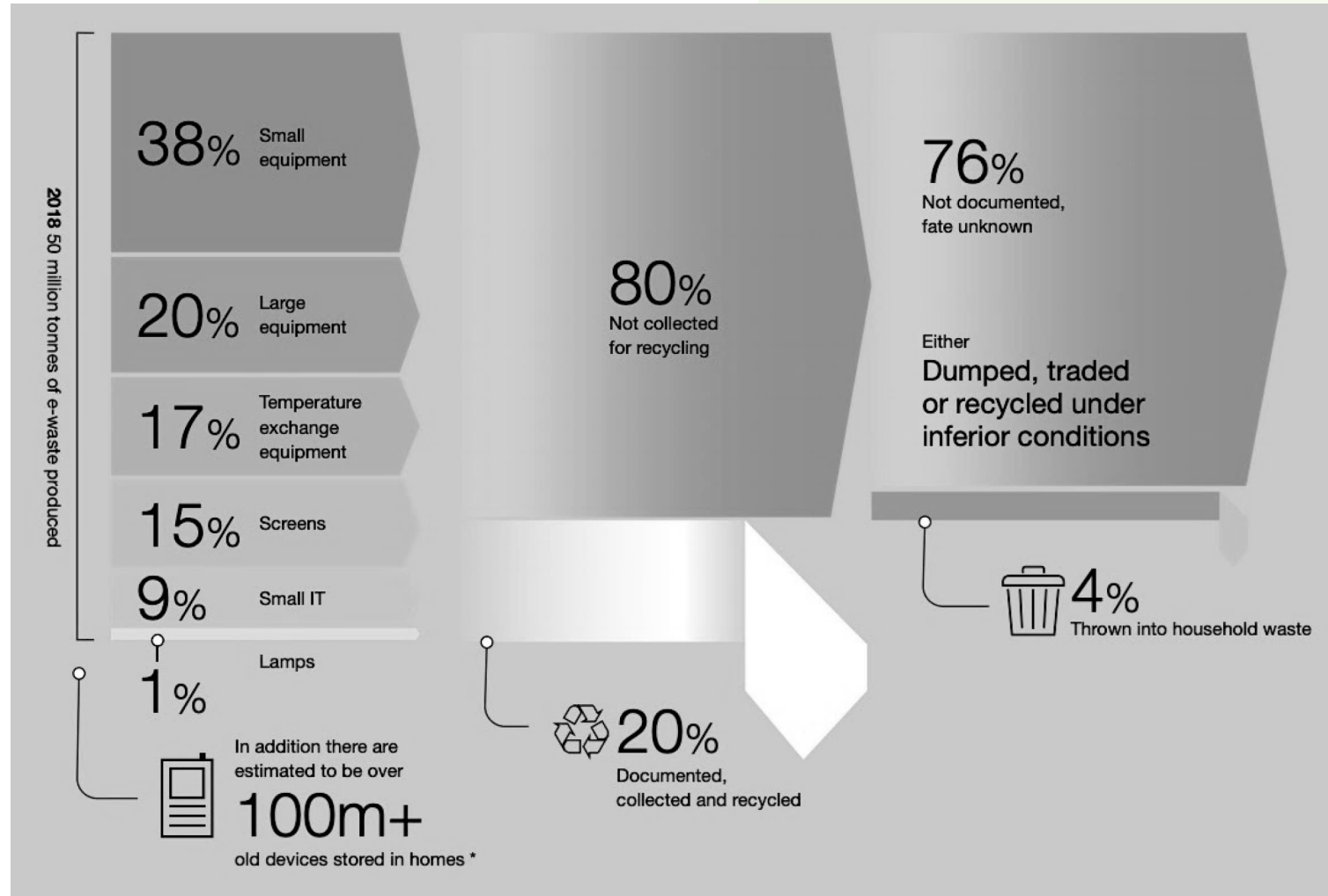


Textile and clothing employ 1.5 million Europeans, creating local jobs and business opportunities



Sustainability – Situation in electronics

Global E-Waste Monitor



Sustainability – Combining both industries

There is no doubt, the textile and the electronic industries have bad records on sustainability

Excessive use of water, energy, insecticides, and chemical treatments

Improper waste disposal after use

Unbridled consumerism leaving no space for durable products



Textile



Electronics

Great need for rare earth metals and minerals (i.e. gallium or indium)

Environmental pollution with heavy metals and toxic chemical compounds

Leading to social changes, which have not always been received positively

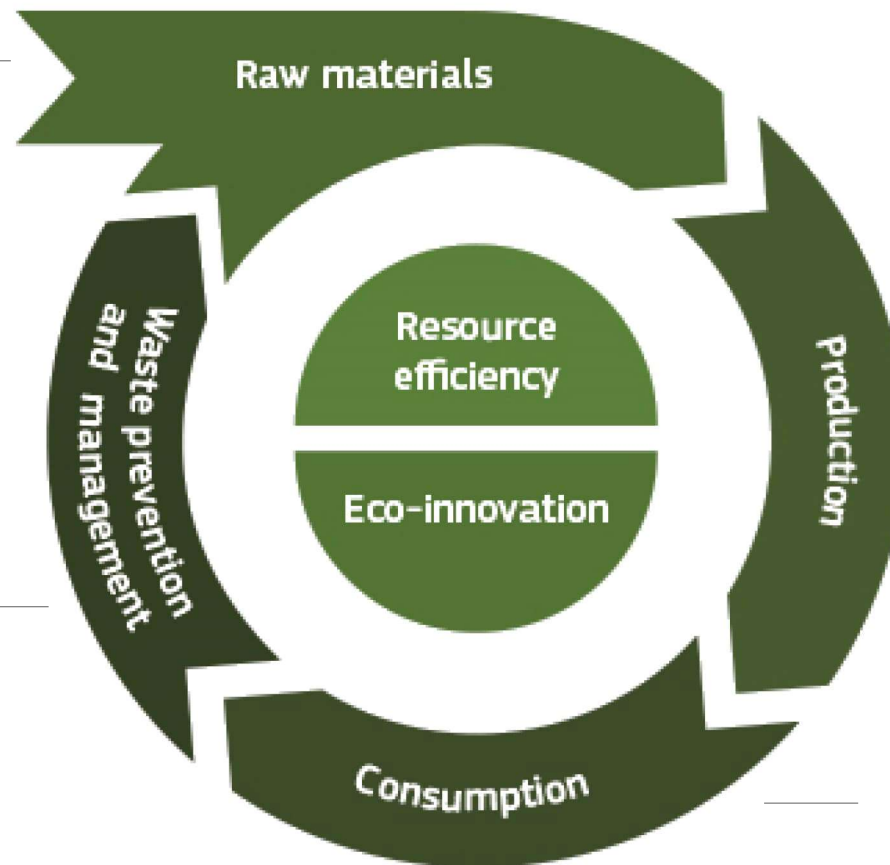


Circular Economy Action Plan

Part of the European Green Deal

Ensuring our use of raw materials does not deplete the planet's resources


Reducing waste and improving waste management



Promoting greener products and supporting greener companies and organisations

Providing transparent information to consumers enabling them to make greener choices



A top-down view of a wooden desk. In the center, a map of Europe is spread out. A person's hands are visible: one at the top holding a small white cup, and another at the bottom holding a black pen, drawing a circle on the map. To the left, a silver laptop is open, displaying a grid of images. To the right, a vintage camera is visible. The background is a dark, textured surface, possibly a wall or another part of the desk.

“A company can only reach truly sustainable production if it assumes responsibility for the resources to the end user, from the collection of raw materials to the end life of a product.”

Stijn Ossevoort, 2013



A top-down view of a wooden desk. In the center, a map of Europe is spread out. A person's hands are visible: one at the top holding a small white cup, and another at the bottom holding a black pen, drawing on the map. To the left, a silver laptop is open, displaying a grid of images. To the right, a black camera is placed on the map. The background is a dark, textured wooden surface.

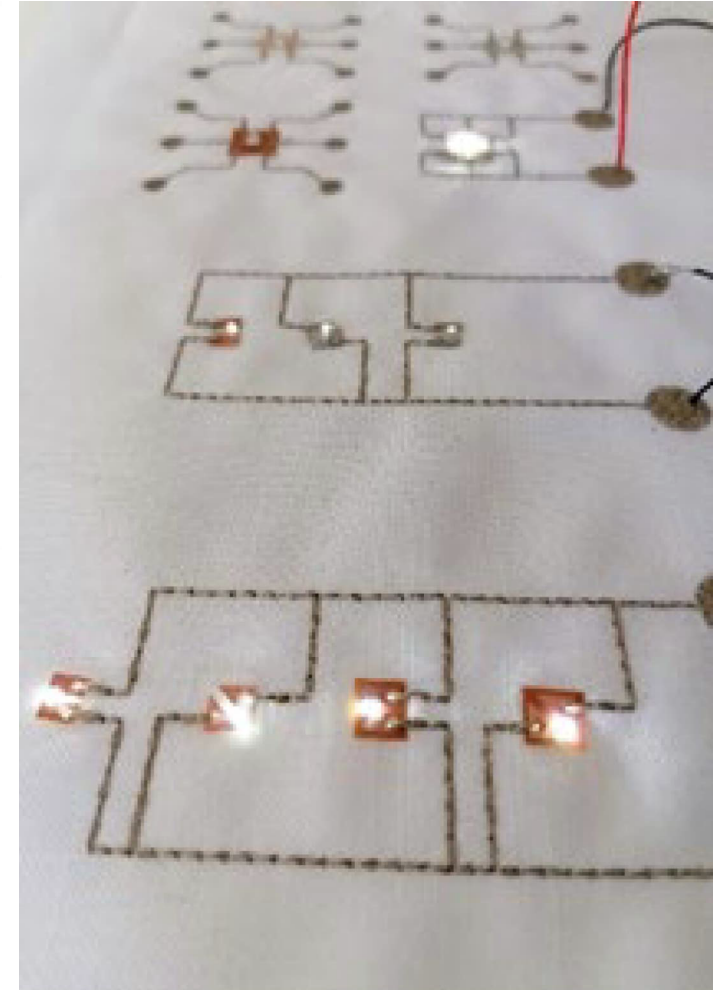
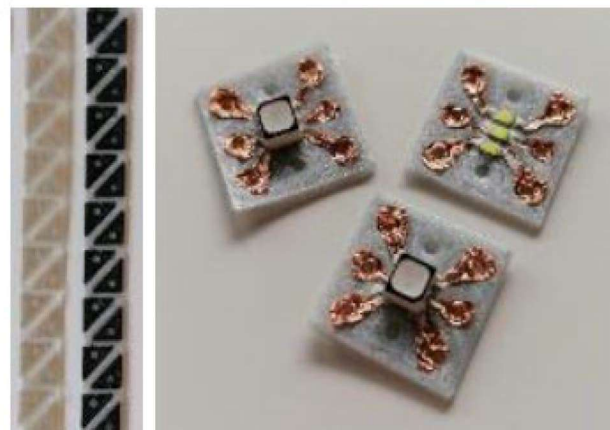
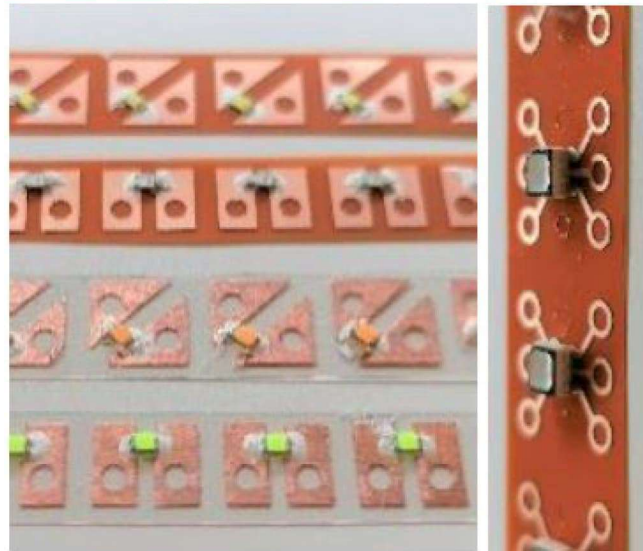
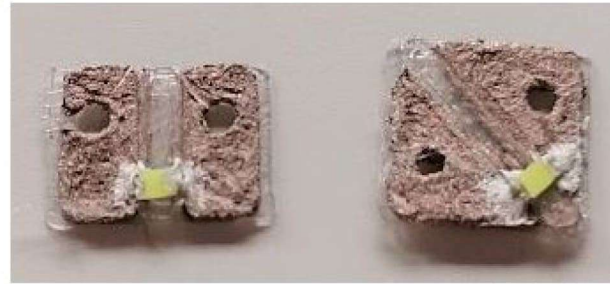
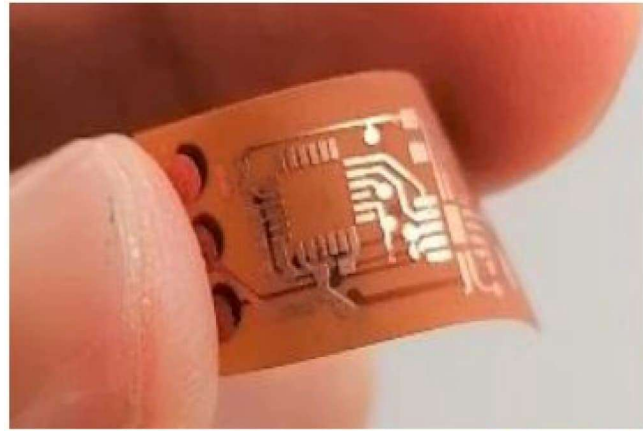
Keywords for research in smart textile:

*“A company can only reach truly sustainable **production** if it assumes responsibility for the resources to the end user, from the collection of **raw materials** to the end life of a **product**.”*

Stijn Ossevoort, 2013



Additive manufacturing of functional sequins for embroidery to reduce material consumption



Embroidery is a material efficient process



Smart textiles products for improved sustainability

Near body heating instead of heating up entire buildings to save energy

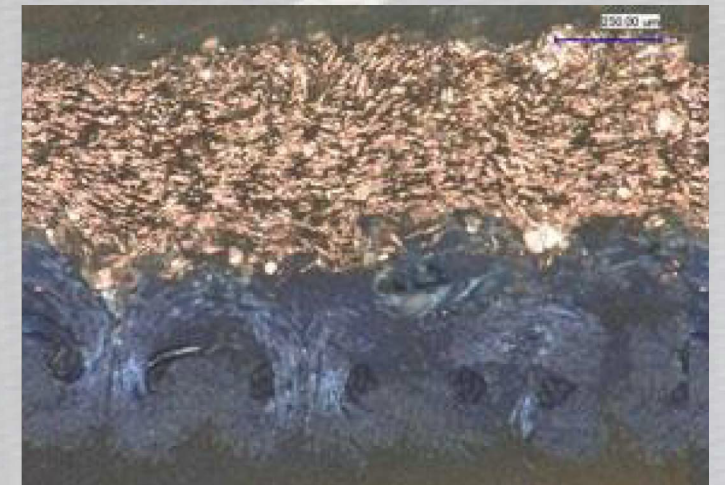
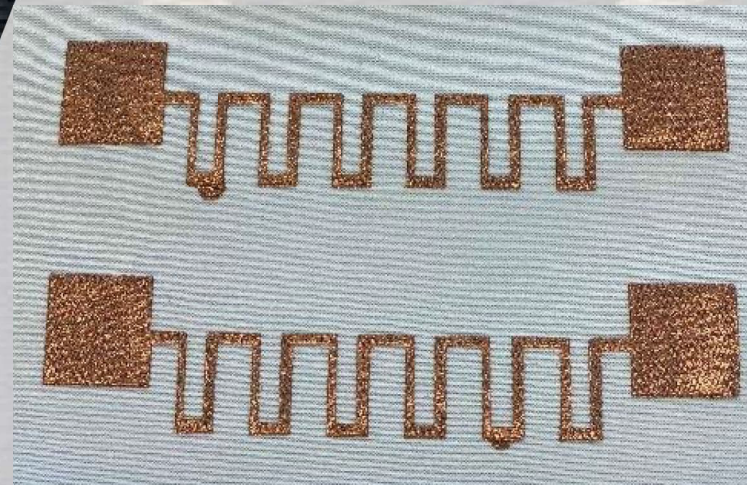
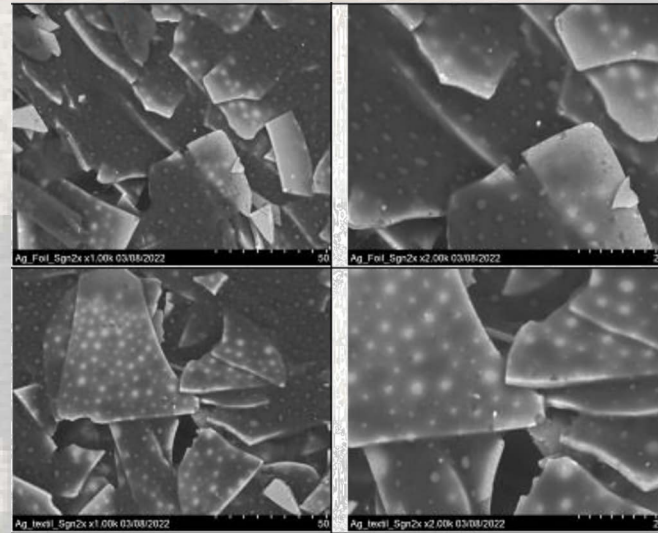


Example: Heating clothing by WarmX | Knitted structures

Based on Joule's law

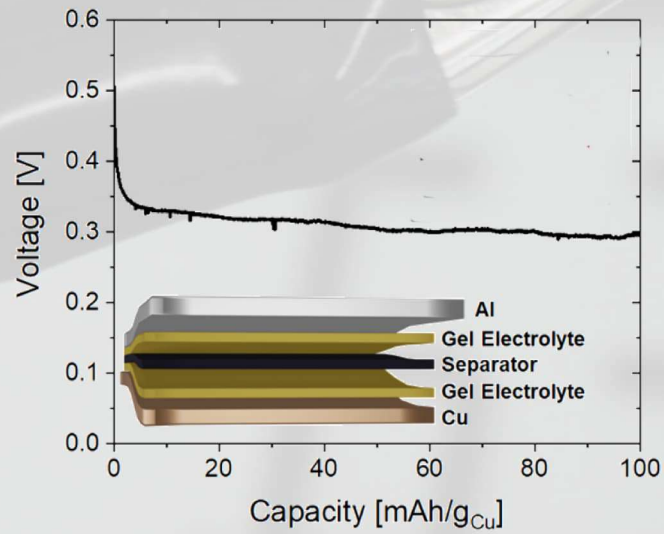
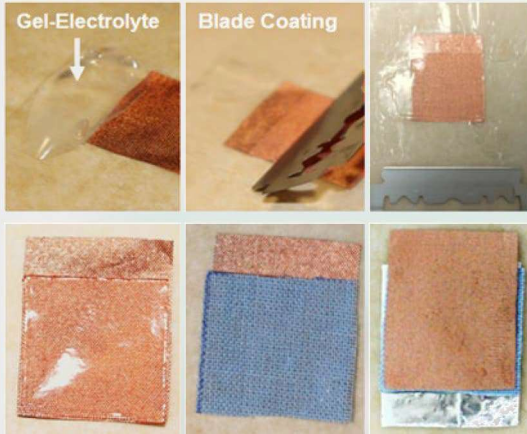


Materials: water-based conductive inks

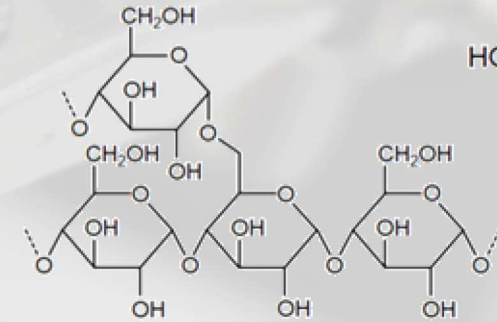


We work with water-based instead of solvent-based conductive inks

Textile battery...

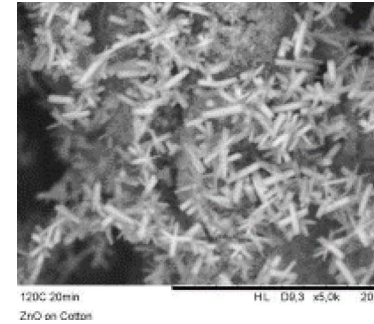
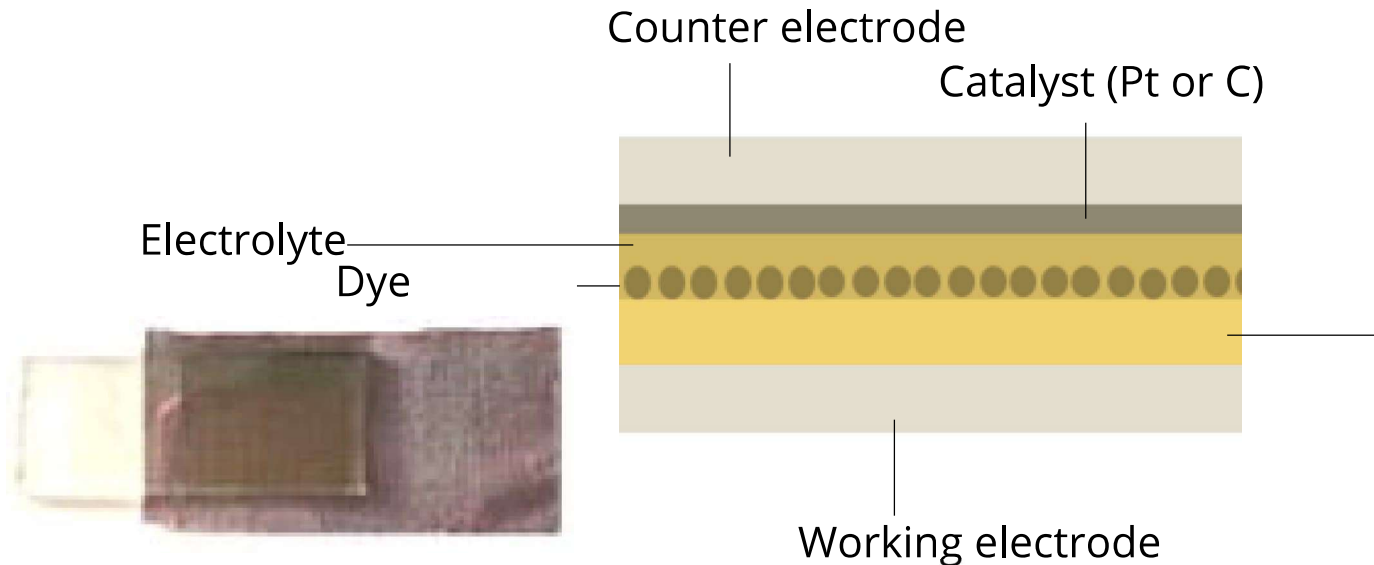


(b) Starch



...based on starch and citric acid

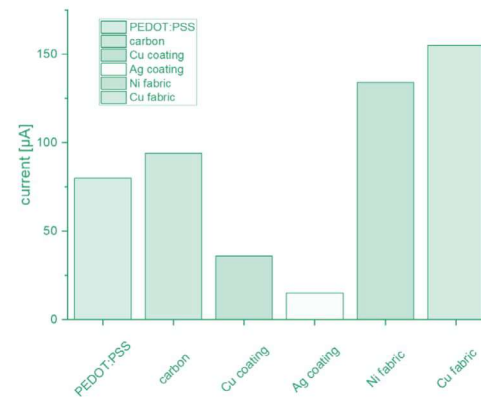
Textile dye solar cell with hibiscus and zinc oxide



Semiconductor layer: electrolessly deposited zinc oxide on conductive textiles

Colour extracted from hibiscus

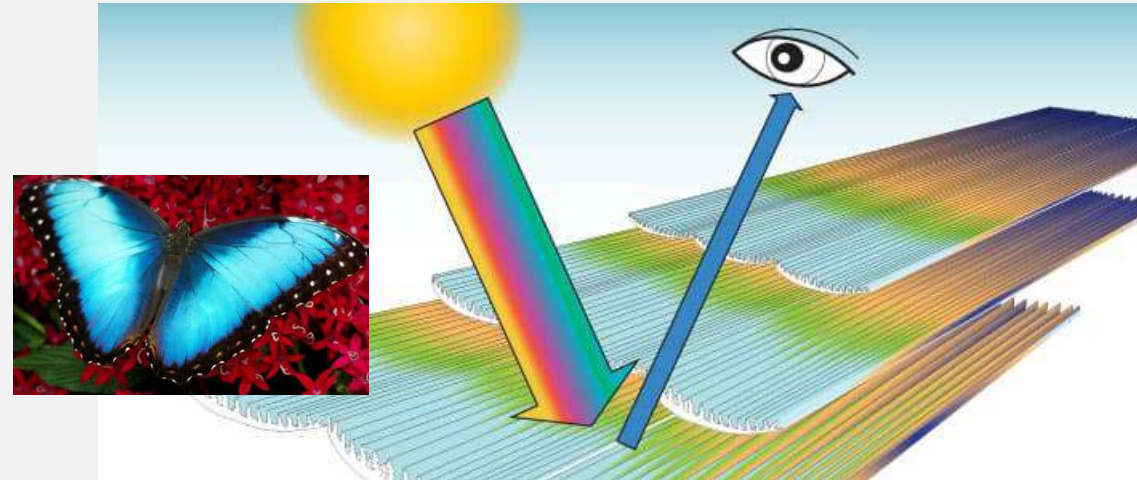
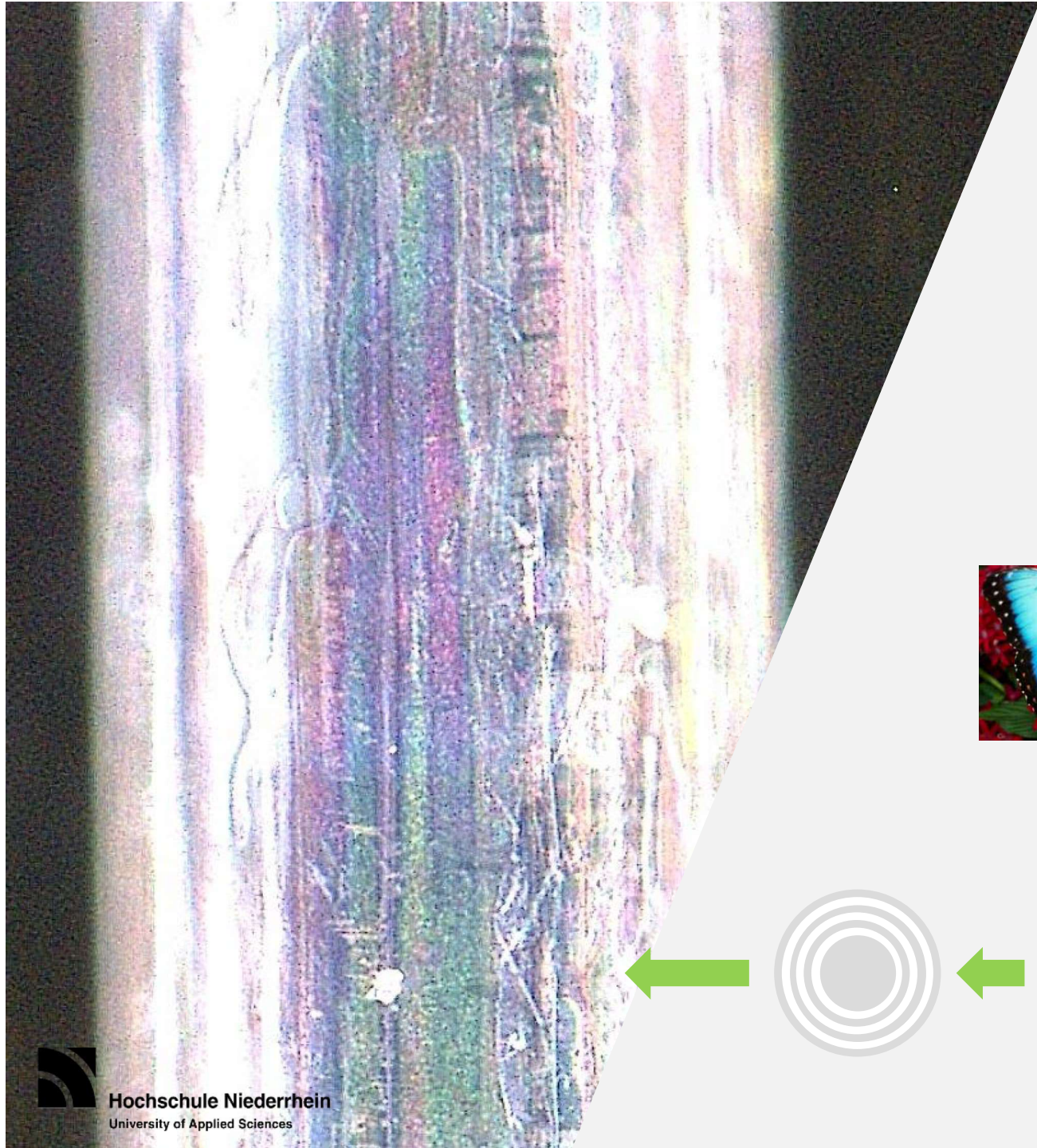
$$V_{OC} = 350 \text{ mV}; J_{SC} = 25 \mu\text{A}$$



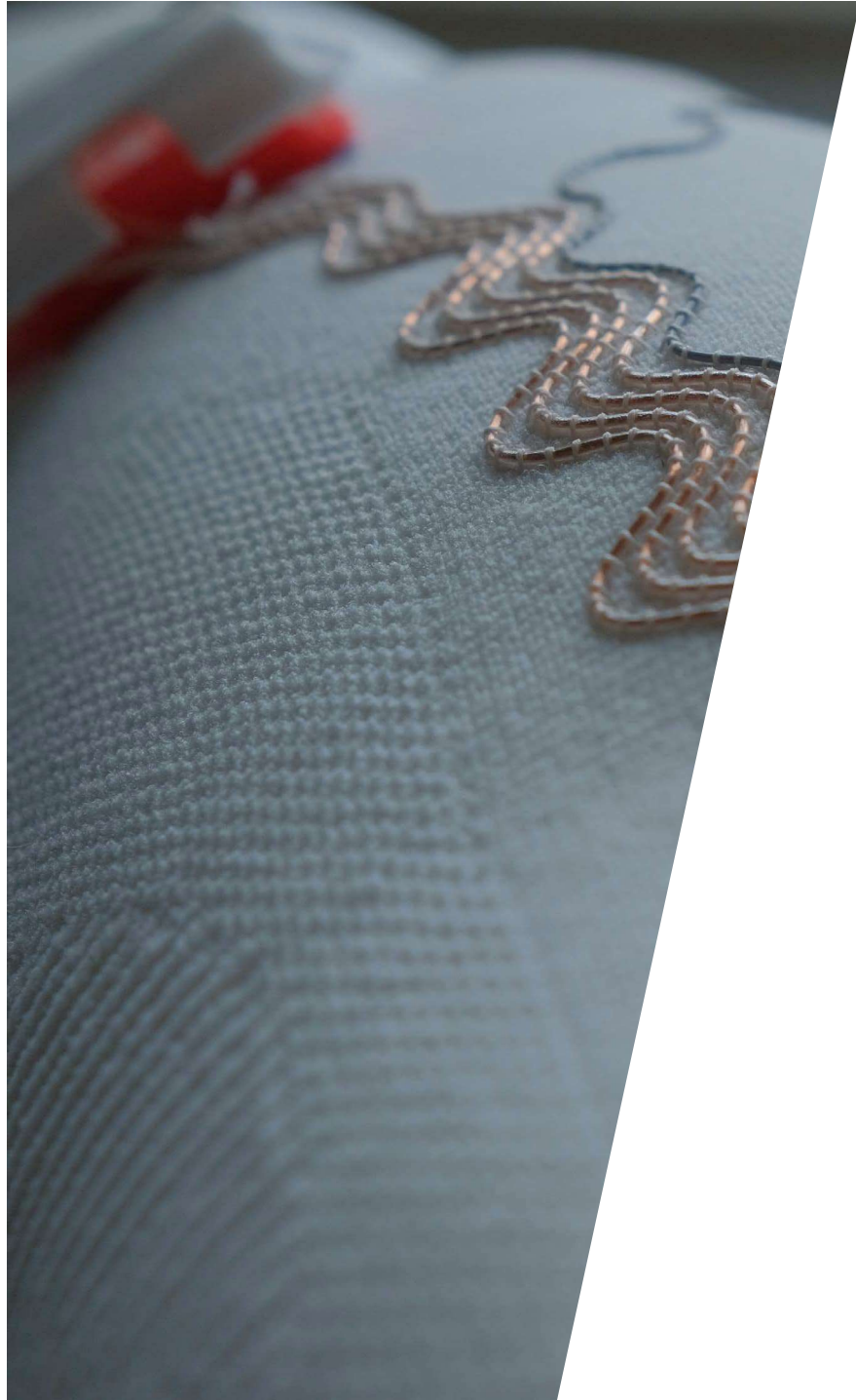
Best results for nickel and copper coated fabrics



Creating colours by physical effects



To achieve structural colour effect, multiple, alternate, very thin layers of PS and PMMA coated onto a filament



When you develop smart textiles, reduce the environmental burden

Simplicity: Use simple and straightforward designs, easy to separate

Material: Focus on a minimal use of materials, bio-based materials

Reliability and reparability: Ensure reliability through solid and exchangeable interconnections

Recycling: Provide design and materials for easy disassembly





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Thank you very much!

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