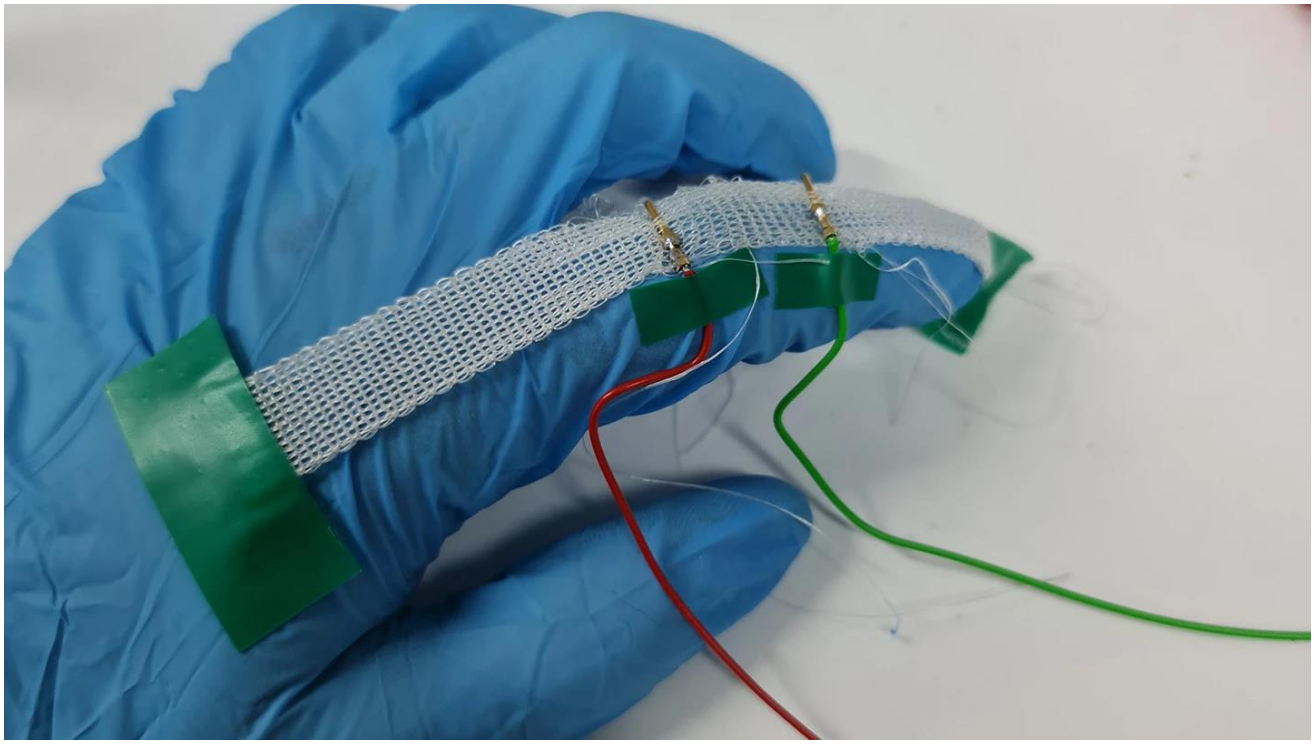
Ionofibres a new track for smart and functional textiles

Electronically conductive fibres are already in use in smart textiles, but in a recently published research article, ionically conductive fibres have proven to be of increasing interest. The so-called ionofibres achieve higher flexibility and durability and match the type of conduction our body uses. In the future, they may be used for such items as textile batteries, textile displays, and textile muscles.



Sample ionofibres on a finger. Photo Claude Huniade

The research project is being carried out by doctoral student Claude Huniade at the University of Borås and is a track within a larger project, Weafing, the goal of which is to develop novel, unprecedented garments for haptic stimulation comprising flexible and wearable textile actuators and sensors, including control electronics, as a new type of textile-based large area electronics.

WEAFING stands for Wearable Electroactive Fabrics Integrated in Garments. It started 1 January 2019 and ended 30 June 2023.

These wearables are based on a new kind of textile muscles which yarns are coated with electromechanically active polymers and contract when a low voltage is applied. Textile muscles offer a completely novel and very different quality of haptic sensation, accessing also receptors of our tactile sensory system that do not react on vibration, but on soft pressure or stroke.

Furthermore, being textile materials, they offer a new way of designing and fabricating wearable haptics and can be seamlessly integrated into fabrics and garments. For these novel form of textile muscles, a huge range of possible applications in haptics is foreseen: for ergonomics, movement coaching in sports, or wellness, for

enhancement of virtual or augmented reality applications in gaming or for training purposes, for inclusion of visually handicapped people by providing them information about their environment, for stress reduction or social communication, adaptive furniture, automotive industry and many more.

Claude Huniade © University of Borås

In Claude Huniade's project, the goal is to produce conductive yarns without conductive metals.

"My research is about producing electrically conductive textile fibres, and ultimately yarns, by coating non-metals sustainably on commercial yarns. The biggest challenge is in the balance between keeping the textile properties and adding the conductive feature," said Claude Huniade.

Currenty, the uniqueness of his research leans towards the strategies employed when coating. These strategies expand to the processes and the materials used.

Uses ionic liquid

One of the tracks he investigates is about a new kind of material as textile coating, ionic liquids in combination with commercial textile fibres. Just like salt water, they conduct electricity but without water. Ionic liquid is a more stable electrolyte than salt water as nothing evaporates.

"The processable aspect is an important requirement since textile manufacturing can be harsh on textile fibres, especially when upscaling their use. The fibres can also be manufactured into woven or knitted without damaging them mechanically while retaining their conductivity. Surprisingly, they were even smoother to process into fabrics than the commercial yarns they are made from," explained Claude Huniade.

Sample ionofibres. Photo: Claude Huniade

Ionofibres could be used as sensors since ionic liquids are sensitive to their environment. For example, humidity change can be sensed by the ionofibers, but also any stretch or pressure they are subjected to.

"Ionofibres could truly shine when they are combined with other materials or devices that require electrolytes. Ionofibres enable certain phenomena currently limited to happen in liquids to be feasible in air in a lightweight fashion. The applications are multiple and unique, for example for textile batteries, textile displays or textile muscles," said Claude Huniade.

Needs further research

Yet more research is needed to combine the ionofibres with other functional fibres and to produce the unique textile devices.

How do they stand out compared to common electronically conductive fibres?

"In comparison to electronically conductive fibres, ionofibers are different in how they conduct electricity. They are less conductive, but they bring other properties that electronically conductive fibers often lack. Ionofibres achieve higher flexibility and durability and match the type of conduction that our body uses. They actually match better than electronically conductive fibres with how electricity is present in nature," he concluded.

Source: University of Borås

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As a doctoral student in the research field of textile material technology, his research is focused on non-metallic electroconductive textile fibres for signal transmission and actuation. Huniade develops characterisation methods and sustainable coating processes for these fibres, allying chemistry and mechanics.

His background is initially in mechanical engineering and production science with a degree from the Institut Universitaire de Technologie de Tarbes, finished in 2015. He then obtained a textile engineer's degree (2018) from École Nationale Supérieure des Arts et Industries Textiles (ENSAIT) in technical textiles. There, Huniade specialised in smart textiles as well as in protection and comfort applications. Before starting working at the University of Borås in 2019, he had previously spent spring 2017 studying here as an exchange student.

He is part of the research group Polymeric E-textiles and currently active in the research project WEAFING, part of Horizon 2020 funded by the EU, which deals with the integration of electroactive textiles in garments.