

UPWEARS-TeX

## PhD thesis proposal:

# Eco-Friendly E-Textiles: Developing Sustainable Processes for Smart Sportswear Fabrics

## 1. Background

The clothing industry is a major contributor to environmental pollution due to issues like dyes, microplastics, poor recycling, and the transportation impacts. In response to this, the European project UPWEARS, which involves 15 international partners, aims to produce prototypes of recyclable smart clothing with limited environmental impact.

One of the primary goals of UPWEARS is to develop sustainable European textile fabrics for sport applications. This objective involves the use of functionalized biosourced materials considering biomimetic design to elaborate eco-sustainable hybrid fabrics using flax and hemp yarns. Innovative bio inspired woven fabric structures will be studied to achieve technical fabrics with high flexibility and mechanical resistance, comfortable and presenting water repellence. These fabrics will integrate biobased or detachable sensors for humidity, temperature and pollution detection based on electric resistivity in a prototype of cross-country biking.

The PhD candidate will work in close collaboration with CITEVE and TPENEDO.

The main hypotheses of the PhD project are:

- Biomimetic functions can be implemented in e-textile;
- Functionalization of biosourced fibres allows reaching the performance thresholds for e-textiles by adapting both the process and material properties;
- Large instrument characterization allows understanding mechanisms associated with fabrics properties to optimize the performance of flax/hemp based technical textile.

## 2. Main missions

The main tasks are:

- Contribute to the selection of most promising flax and hemp variety/cultural as well as cork according to technical indicators and definition of specifications for biomimetic design including concept translation into desired mechanisms for e-textiles;
- Gain deeper understanding of coating incorporation in textile through a combination of cork nano and/or micro additives;
- Contribute to the standard testing of developed composites, fabrics and functionalized materials involving both synchrotrons and lab instrumentation to evaluate multiscale textile properties such as hydrophobation/water repellence as well as fire resistance;
- Develop eco-sustainable hybrid fabrics using flax and hemp-based yarns according to bio inspired woven fabric structures;
- Tackle the integration of biobased or detachable sensors in e-textile and system for information monitoring;
- Contribute to the design, development, optimization and global integration of the proof of concept according to customers specifications of cross-country biking suit ;
- Implement a strategy for sorting and recycling based on prototype for separation of electronic components from the fabrics with two main outcome development of new



woven fabrics with from recycled fibres and feedstock material for 3D printing of sport equipment;

—Participating in the consortium meetings, dissemination activities, and communications towards partners, scientific community, and stakeholders.

### **3. Environment**

By joining [INRAE](#), the PhD candidate will benefit from excellent working conditions facilitated by the Institute's outstanding premises and facilities, cutting-edge technological equipment, and robust social support system, including, health initiatives and opportunities for sports and cultural activities.

The PhD project will be conducted within the multidisciplinary Plant cell wall and polymer ([PVPP](#)) team at INRAE-BIA, comprising 15 permanent scientists and technicians. INRAE BIA provides access to all the necessary equipment and methodologies for the study, supported by high performance computation facility. Additionally, long-term visits to [CITEVE](#) and [TPENODO](#) in Portugal are planned to enhance the research capabilities of the project.

### **4. Candidate background**

We are looking for a highly motivated PhD candidate to work in an international environment with partners in Sweden, Italy, Portugal, Belgium, UK and New Zealand.

The candidate would preferably have a strong background in textile engineering with a focus on sustainability and/or smart fabrics, material engineering, chemical engineering, mechanical engineering or a related field.

Strong interest in sustainable materials, smart textiles, and advanced manufacturing processes.

Practical experience in textile production, material characterization, or polymer science is highly desirable.

Excellent communication skills, both written and oral, with an ability to work in a multidisciplinary environment.

**Potential supervisors:** Sofiane GUESSASMA (INRAE), Gilda SAANTOS (CITEVE), Sandra VENTURA (TPENODO)

**Duration:** 36 months starting from November 2024

**Funding:** EU Fully funded position available for qualified candidate.