



ELECTROSPINNING NEEDLELESS TECHNOLOGY: FROM LAB TO MARKET

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SKE Research Equipment - Our history

Born in 2007, we are an **italian company** with more than **15 years of know-how and experience** on **nanofibers** and **nanotechnology**.

We strongly believe that **nanotechnology will change the world** as we know it.

Our management is made of **former researchers**, who worked in **first person with nanofibers equipment** and **share their needs** to create a new experience.

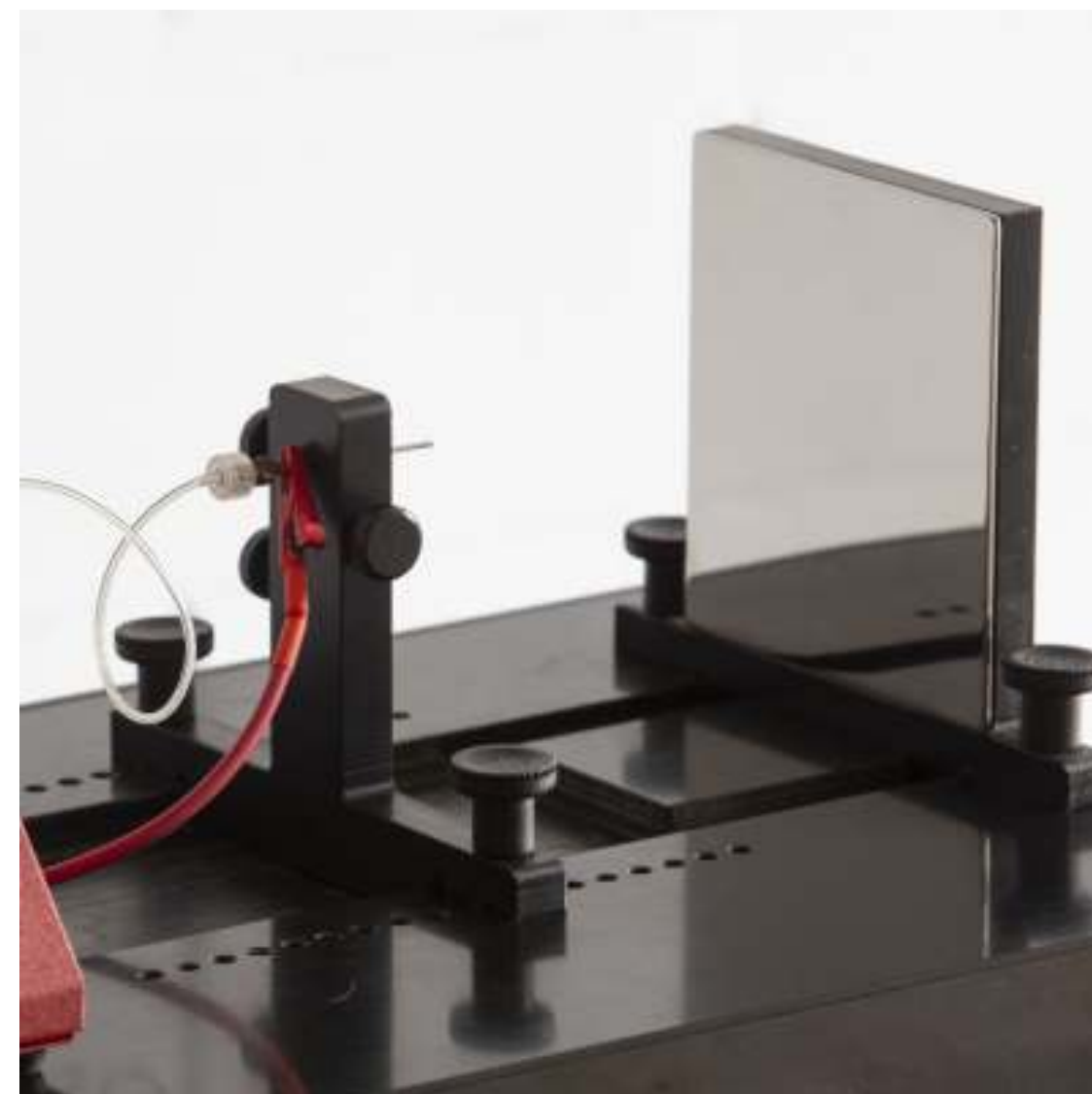
Never recommend something that you haven't first tried: our parents company are the first users of our research and industrial equipment.

Our divisions:

- **Research and Industrial Equipment**
- **R&D and services**
- **Manufacturing**

SKE Research Equipment - Research and Industrial Equipment

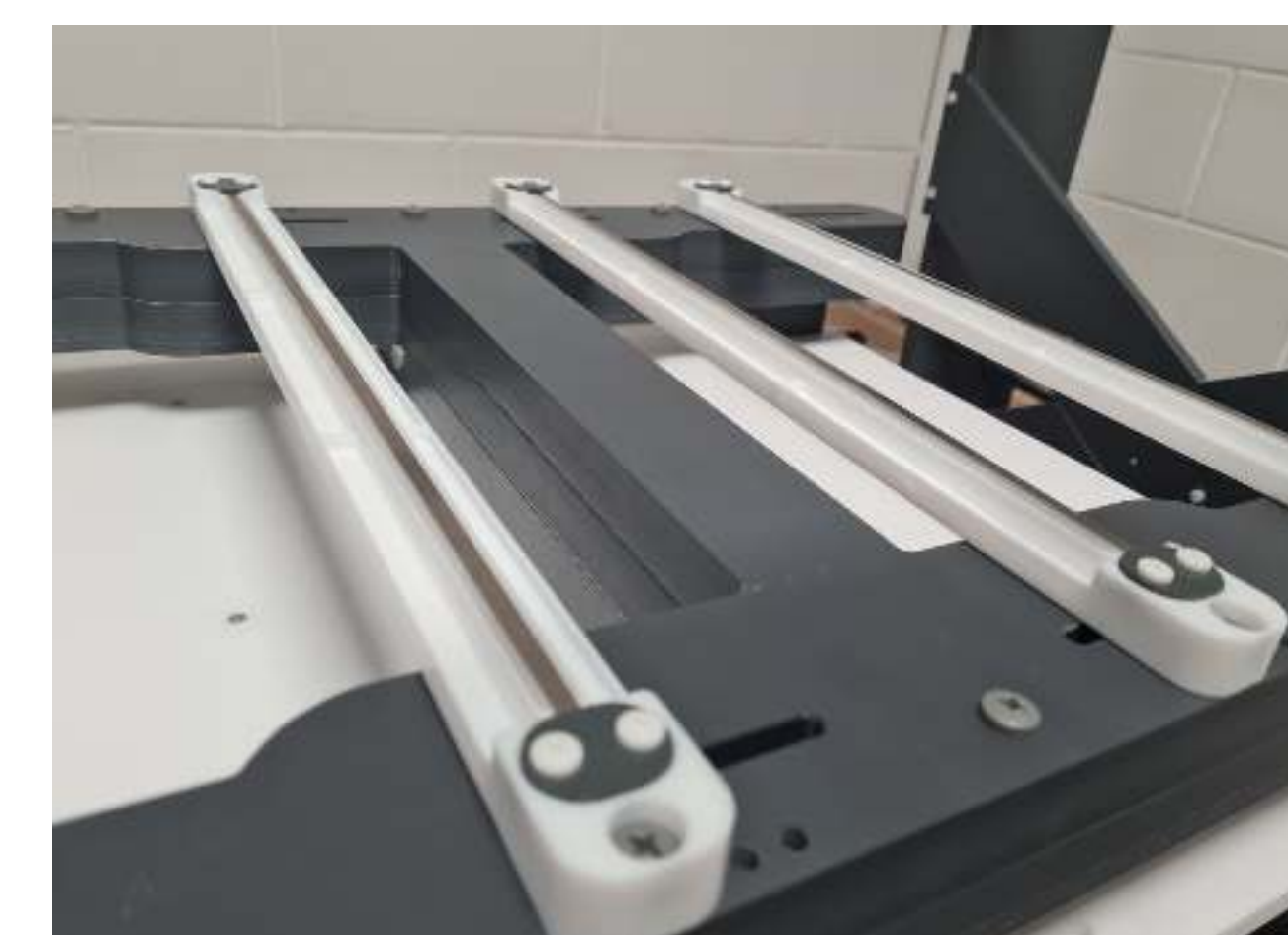
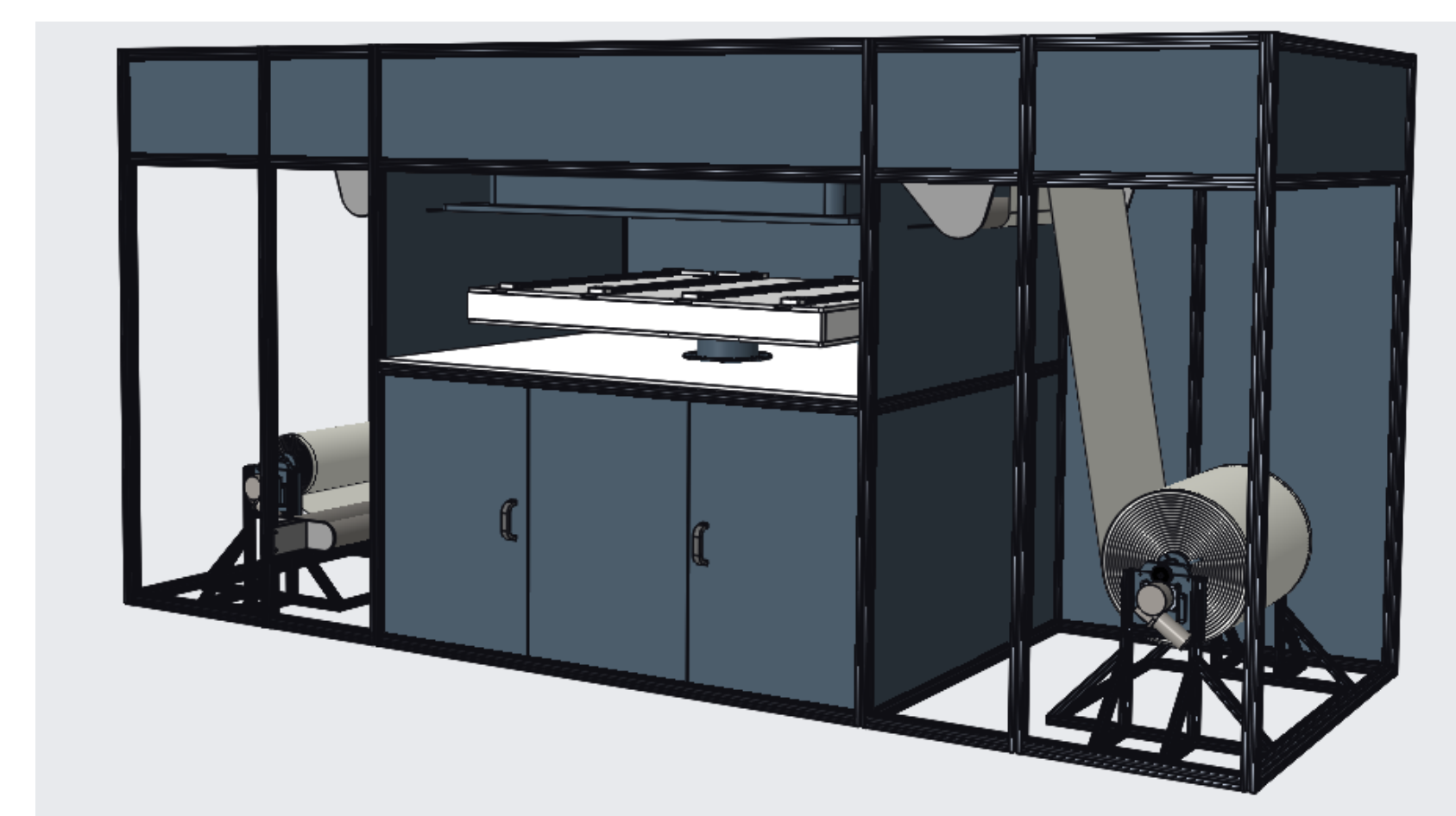
- Needle technology - Basic research - Series EF050 - EF100 - EF300



- Needleless technology - Applied research and Pilot scale - E-Fiber Series EF500

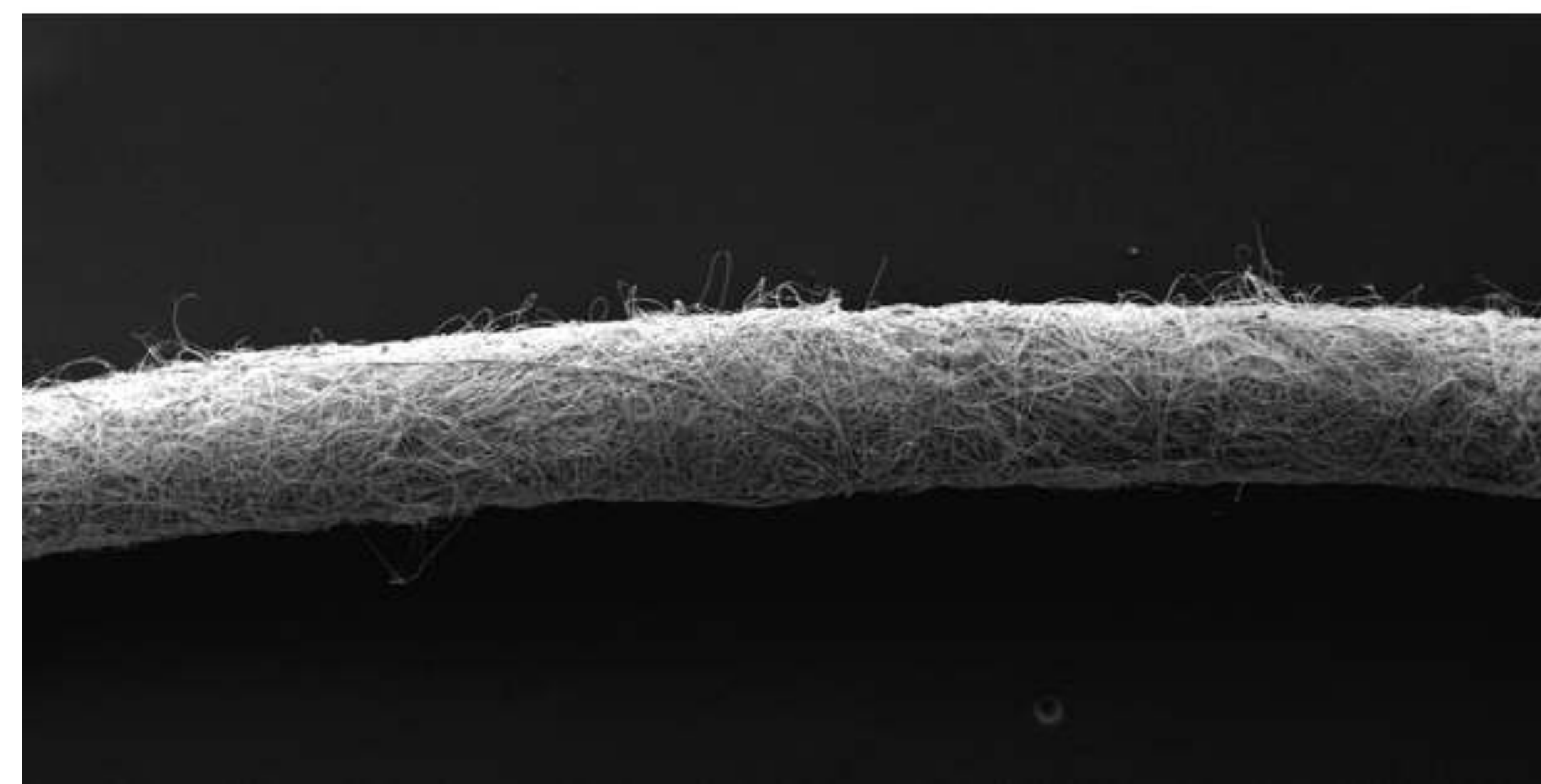


- Needleless technology - Manufacturing and Industrial production - E-Fiber Series EF1000



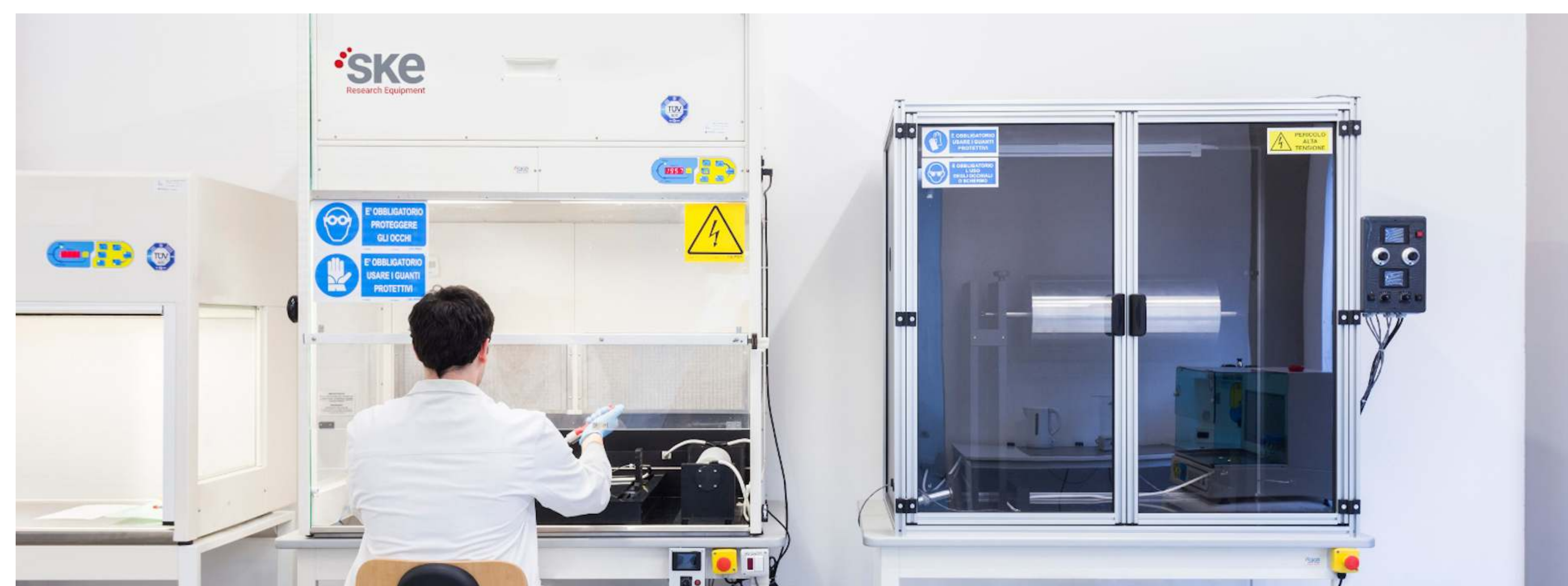
SKE Research Equipment - R&D and Services

- **Contract R&D:** Thanks to our solid experience in the Electrospinning and Life Science fields, we offer feasibility studies according to customer's innovative ideas and requirements, in order to develop performing prototypes that can be translated in commercial products.



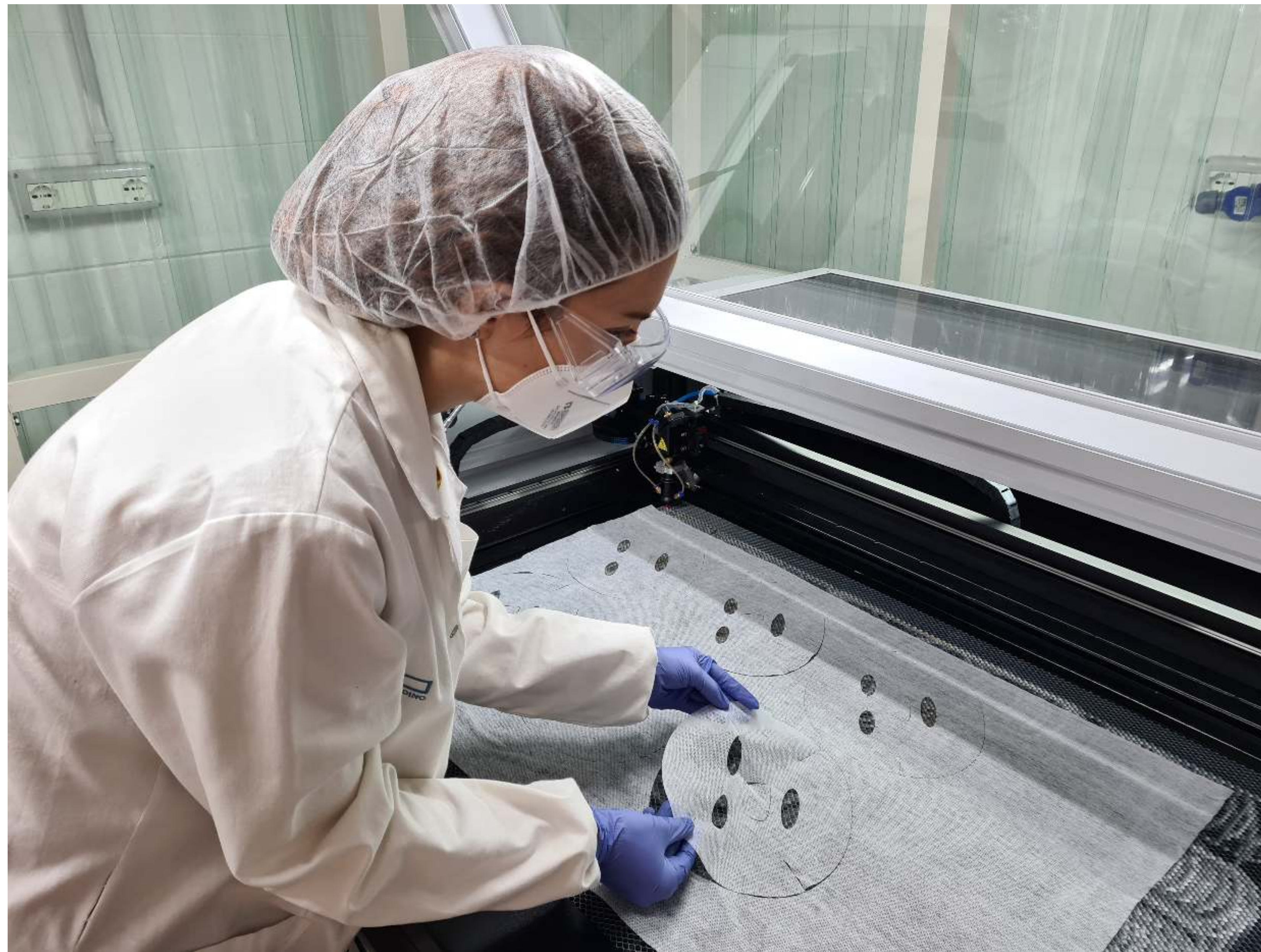
Thread made of nanofibers

- **Contract Manufacturing:** Thanks to our proprietary needleless electrospinning technology, we offer Contract Manufacturing services to produce custom electrospun products for many commercial application fields. SKE has 2 in-house equipment for nanofiber production: a pilot-scale setup for small batches and an industrial roll-to-roll continuous setup for larger volume.

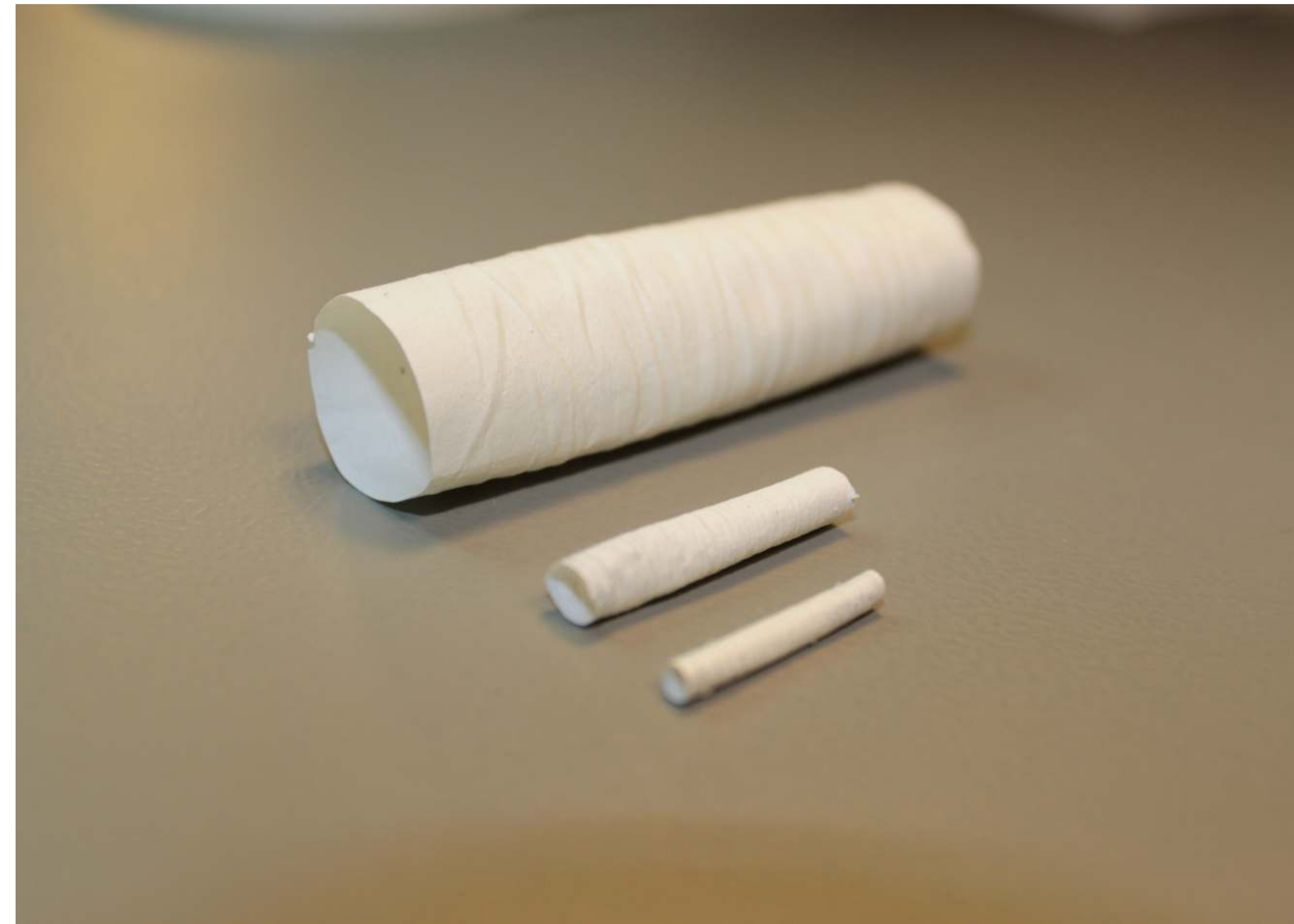


Polymer solubilization process for electrospinning manufacturing

SKE Research Equipment - Manufacturing



Skincare face-mask manufacturing



Tubular Scaffold for 3D cell culturing



Hydrophobic air filtering material



Electrospun advanced wound dressing for chronic wounds

SKE Research Equipment - Our field of applications

	Research	Scale up	Mass production/ commercial products
Medical devices	Since 2014	Since 2017	Since 2019
Cosmetics and skincare	Since 2017	Since 2019	Since 2020
Filtration	Since 2020	Since 2020	Since 2022
Recycling	Since 2021	Since 2021	
Energy	Since 2021	Since 2021	
Technical Textile	Since 2022	Since 2022	
Food Packaging	Since 2022	Since 2022	

SKE Research Equipment - R&D common approach

Research world has a **common approach** to the electrospinning technology:

- Development of a **proof of concept** on a **needle electrospinning** technology platform
- **Validate** their **results**
- Face the **issue** of the **scalability, low throughput** and **manufacturing cost** when scaling not sustainable
- **Moving** the proof of concept on a **needleless technology** platform
- **New development** of all the protocols previously developed
- **Revalidate** their new results (not always possible)

A **needle electrospinning** protocol development **requires new development from scratch** when you have to **scale**, and **this may not lead to the same results** obtained before.

SKE Research Equipment - Needle technology

Advantages of needle electrospinning technology:

- **Easy to use**
- Very **low volume** of solutions for each experiment
- High **versatility** of the equipment
- Wide academic papers and state of the art on the solubilization of most polymers

Disadvantages of needle electrospinning technology:

- Very **low throughput**
- **Small size** of the samples
- Very **low batch-to-batch repeatability**
- **Limited scalability** due to multi needle approach with **too high costs** of the final product
- **Heavy cleaning** procedures and **clogging** of the needles
- Very **high downtime operations** on multi needle equipment (leading to high operative costs)

SKE Research Equipment - Scale-up Needle VS Needleless



ES Needle technology



ES Needleless technology

High throughput	Need to scale up the number of needles to large quantity (at least 100-200)	One needleless spinneret equals to the throughput of ~ 50 needles, so big systems has a maximum of 2 or 3 spinnerets
Homogeneity and repeatability	All the needles are in parallel connection, so flow rate is unbalanced between the needles (1 occlusion is enough to modify the flow rate). Needle technology suffers of solution dropping (due to solvent and occlusions), that creates spots and defect on the final nanofibers	No connection or tubing, one solution reservoir, no occlusion problem. High homogeneity and reproducibility. No solution dropping problems
Cleaning and maintenance	At the end of the process you need to clean up to 200 different needles, so very long and complex cleaning operations	Just one or two reservoir and spinneret to clean
Versatility	Industrial scale-up is complex and does not allow R&D/pilot test with small amount of polymeric solution	You can choose to easily perform R&D/pilot test using the small spinneret that has same features of industrial one, but is just smaller in size (you obtain same results in a smaller width of the fabric), using less amount of polymeric solution

SKE Research Equipment - Our approach: Needleless R&D

Today **nanofiber technology** is **mature**, and **ready for transferring** most innovations to the real world, leading to a **massive diffusion** of the **electrospun products**, reaching directly the **final consumer too**.

Applied and industrial research are replacing the basic research (lasted for the previous 20 years) and **all players** are now **looking for scalable solutions** with a **quick technology transfer process** to the industry world.

R&D main new goal is to develop **products and applications** that are **ready to be scaled and transferred** to the industry.

Our **new approach** allows researcher to create an **already scaled proof of concept**, materials that are **suitable for an immediate and effective transfer** to manufacturing.

SKE Research Equipment - Our Recent Case Histories

NAD Nanofiber Active Dressing: electrospun Silk fibroin nanofibers for chronic wound healing, thanks to the biomimicry of its nanofibers, it creates a favorable environment for tissue regeneration and promotes re-epithelialization in a large variety of wounds, without the use of any drug. Nanofibers structure creates a second skin on the patient derma, inducing a physiological healing



Efficacy of NAD in the treatment of a lower limb vascular ulcer, female patient aged 91 years.



Week 1

Week 2

Week 3

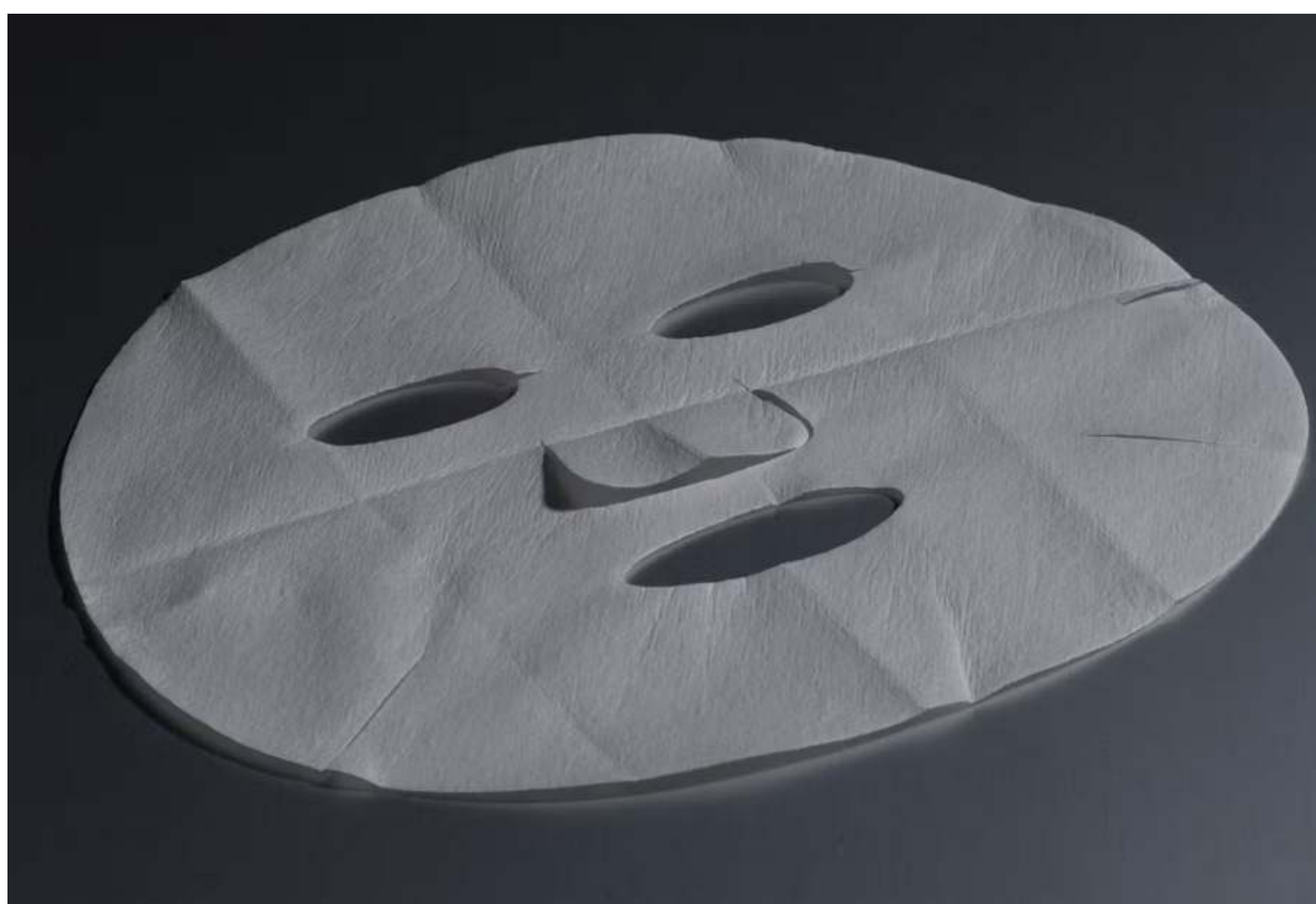
Healing process

TRL #9: Competitive manufacturing, Commercial product since 2019, CE mark medical device manufactured following ISO 13485 QMS, patented technology WO2016059611A1

Manufacturing: SKE needleless electrospinning technology, yearly volume 60.000 m²

SKE Research Equipment - Our Recent Case Histories

Cosmetic skincare face mask: electrospun fibroin nanofibers structure with active ingredients (hyaluronic acid, silk sericin, collagen and encapsulated vitamin-C) on a natural biodegradable substrates of bamboo. This is the first dry mask on the market, allowing a very fast and effective release of the active principle, and the absence of liquid eliminates preservative from the formulation.

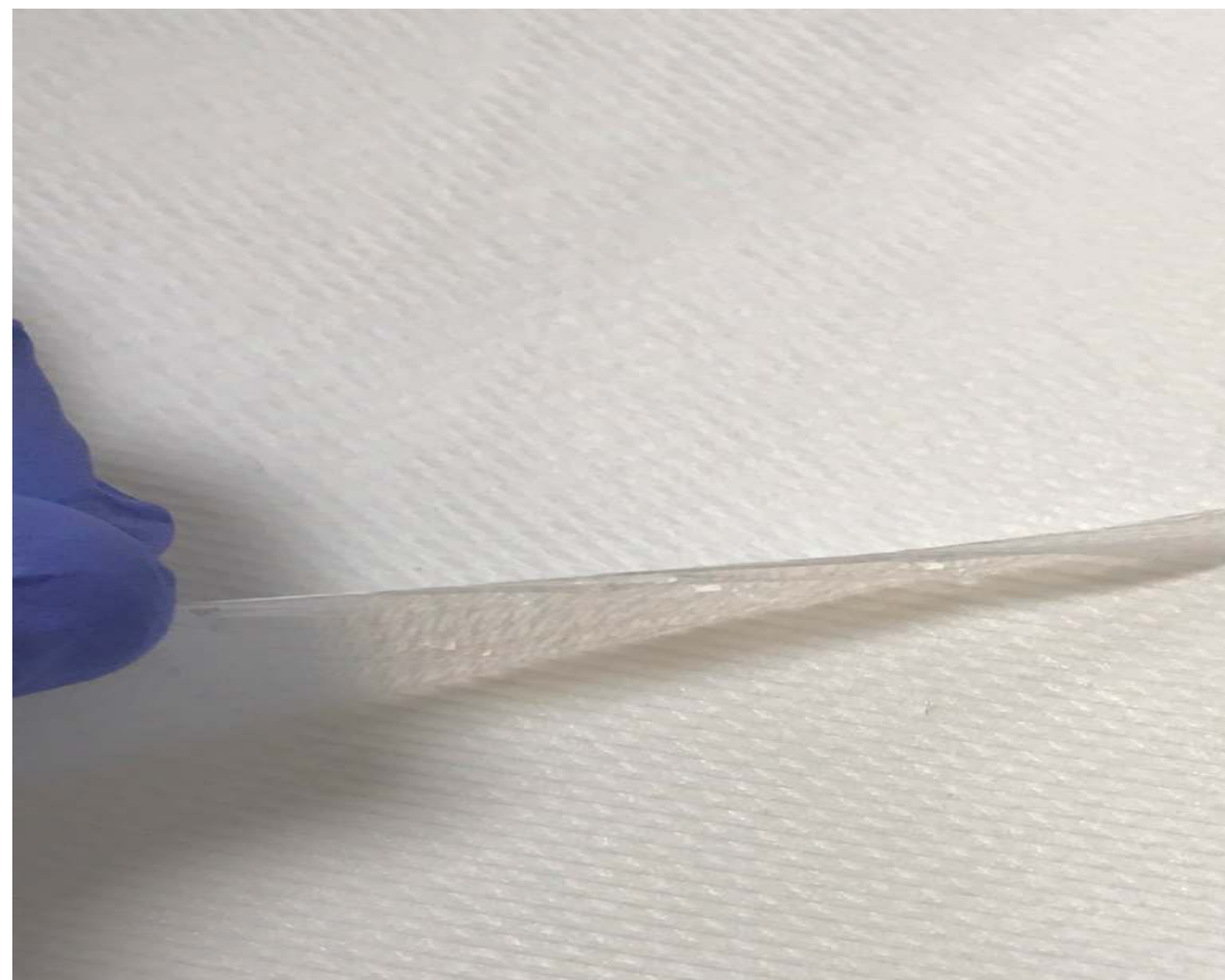


TRL #9: Competitive manufacturing, Commercial product since 2020, certified with european cosmetic rule, manufactured following ISO 13485 QMS, patented tecnology WO2019030661A1

Manufacturing: SKE needleless electrospinning technology, volume 38.000 m²/year

SKE Research Equipment - Our Recent Case Histories

Industrial air filtration material: electrospun PA6 nanofibers on a polyester substrate, with electrospaying middle layer for optimized adhesion. The needleless electrospaying process avoids the use of glue, optimizing and increasing the adhesion homogeneity and performance. Reels of this material are widely used for air filtration on different conditioning systems.



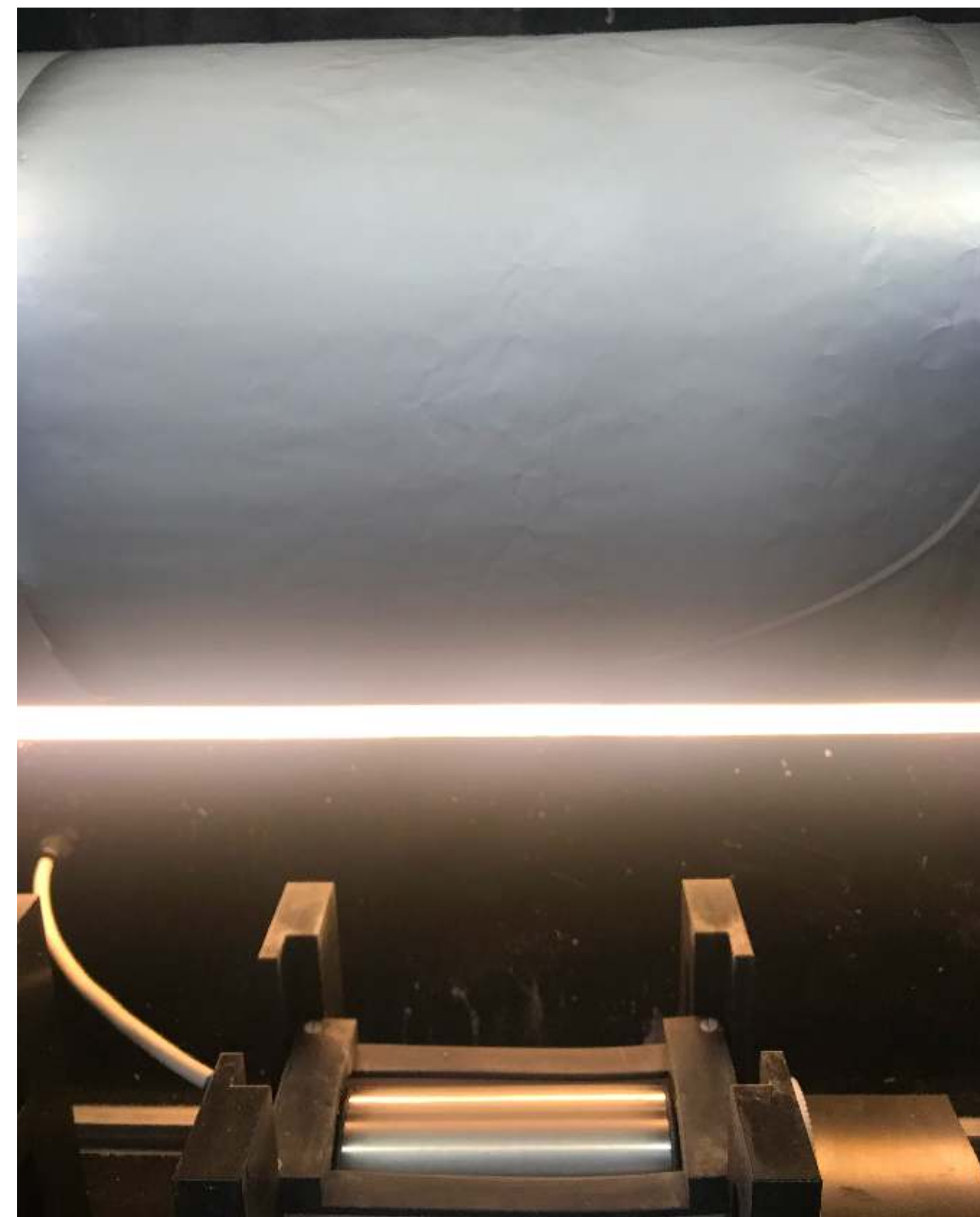
TRL #9: Commercial product since 2022

Manufacturing: SKE needleless electrospinning/electrospaying technology, volume 120.000 m²/year

SKE Research Equipment - Our Recent Case Histories

Food packaging membranes: electrospun biodegradable polymer* on a biodegradable substrate* for food packaging membranes with selective permeability. These membranes enhance food preservation with a controlled permeability to gases and create no impact as the whole resulting material is biodegradable and compostable.

**non disclosable data*



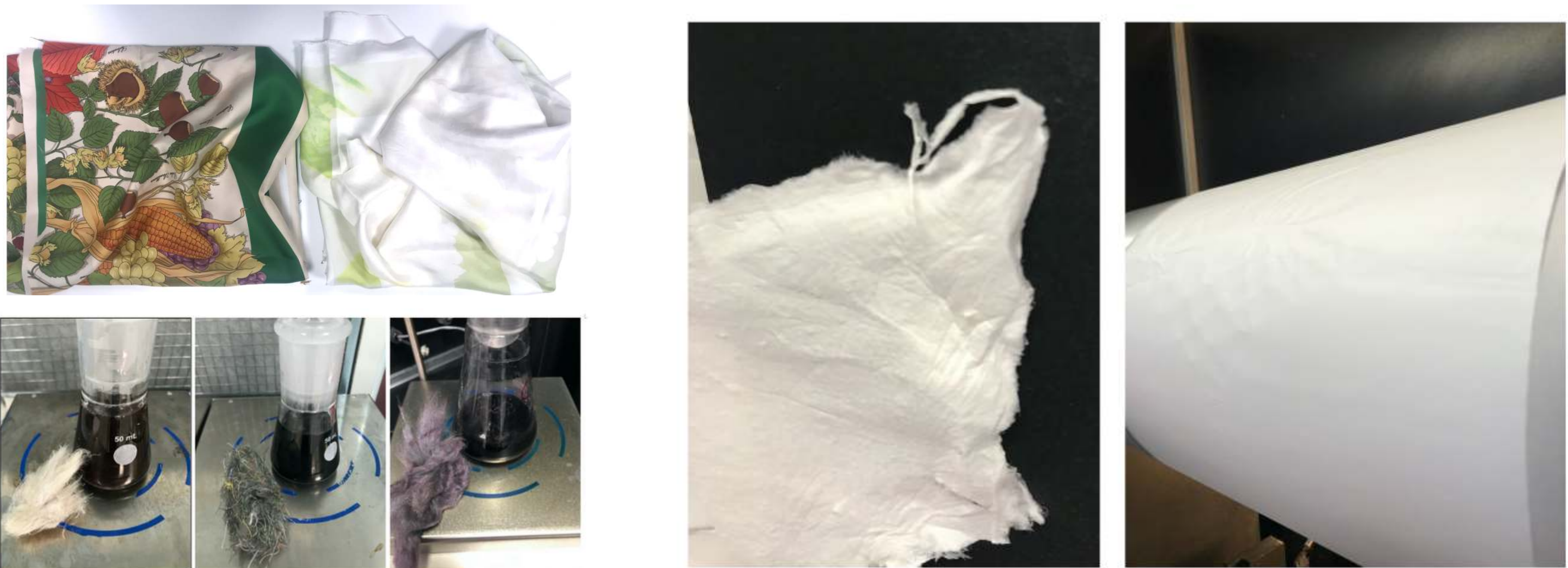
TRL #7: Real Environment demonstration, commercialization forecast end of 2024

Manufacturing: SKE needleless electrospinning/electrospraying technology, pilot volume 1.000 m²/year (estimated manufacturing volume 350.000 m²/year)

SKE Research Equipment - Our Recent Case Histories

Electrospun textile recycling process: regenerating of old textile waste* for hi-tech applications, starting directly from the wasted raw material. Current implementation of the process in a model of circular economy with high efficiency and added value.

**non disclosable data*



TRL #6: Technology demonstration in industrial environment, ready to move to #7, patent pending

Manufacturing: SKE needleless electrospinning technology, pilot volume 1.000 m²/year (estimated manufacturing volume 1.000.000 m²/year)

SKE Research Equipment - Our solution for Needleless R&D

We would like to make **needleless technology possible, reliable, time and money saving, and available** for every lab, so we create a **smart Desktop needleless equipment** which **inherits all the benefits** of a **needle** system, like versatility, low volume and ease of use, with the **power** and the **throughput** of a **needleless** system.



EF100 Needle Electrospinning System

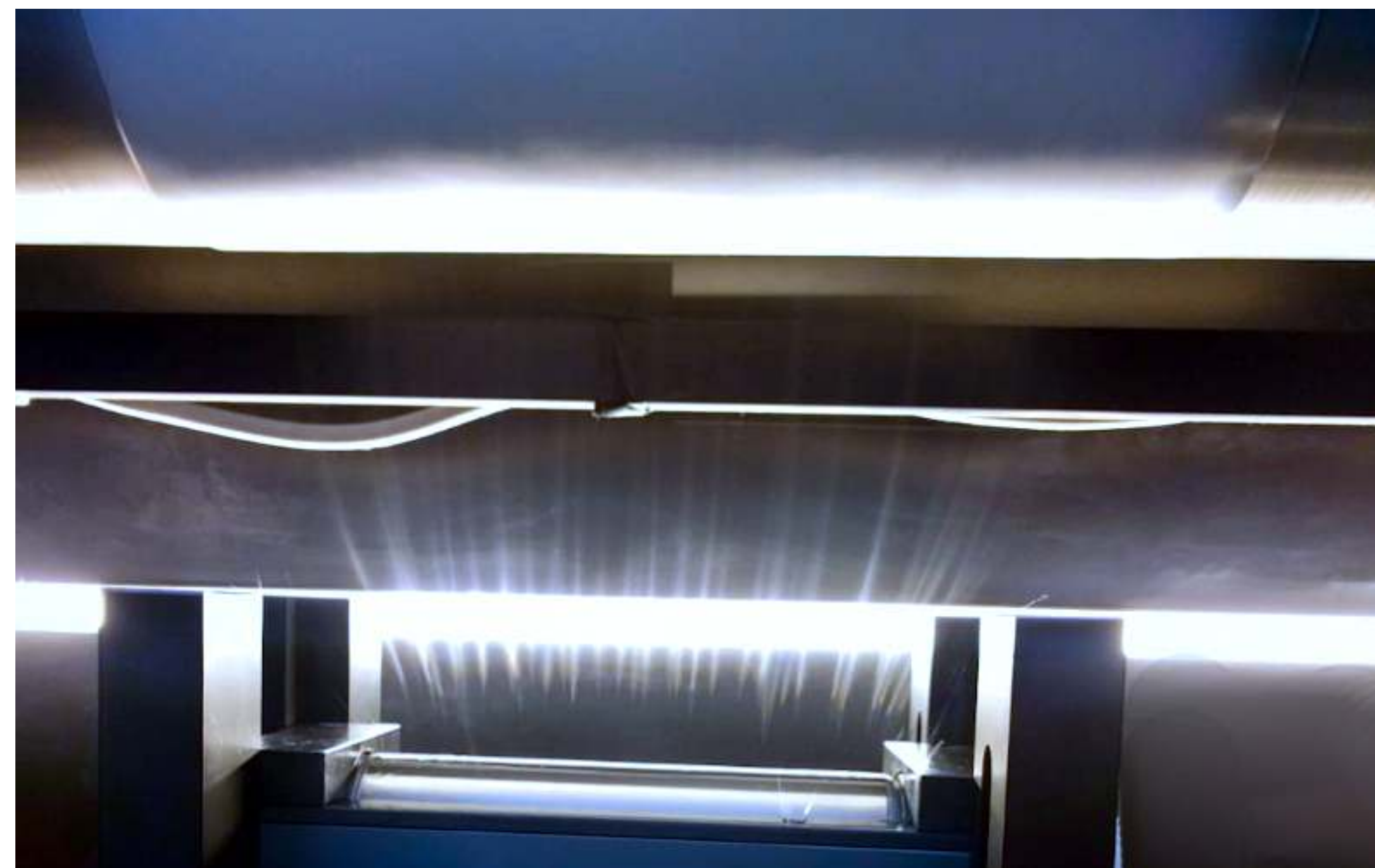


EF500D Needleless Electrospinning System

SKE Research Equipment - Our solution for Needleless R&D

EF500D Main Features:

- Allows same **versatility** of a needle equipment (Drum collector, Roll-to-roll collector, different spinneret heads...)
- Optimized **low volume** with reduced spinneret
- Very **high homogeneity** of the nanofibers
- **Batch-to-batch repeatability**
- **Controlled environmental** parameters (T and RH)
- **Safety** and **ease of use**
- Already **scaled** technology



SKE Research Equipment - Conclusions

Nanomaterials has **changed the world** in the last decade, and we are now approaching to a **revolutionary future**.

Basic research on nanofibers has been replaced by **applied and industrial research**, and the **mindset** has to **change** accordingly.

Electrospinning technology has been widely **proven**, and **innovation** needs now a **fast** and **cost effective transfer** process.

Your research will change the world and we can help you to do it.

THANK YOU



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