FibrePrint: width-controlled 3D bioprinting of thin and homogeneous biomimetic fibres

The Challenge

One of the challenges faced by current 3D bioprinting research and technological development is being able to provide a **3D bioprinting method of individual fibres** that:

- allows to carefully **control the thickness** of the bioprinted constructs in the micro-meter range,
- obtains **individual fibres that are not fused** with each other, improving the biomimicry of the organizational structure of, e.g., skeletal muscle tissue, and enhancing the cell viability in the inner parts of the constructs due to an enriched nutrient and oxygen diffusion,
- is **universal** enough to include different types of hydrogels and different crosslinking strategies.

These requirements are especially important to **skeletal muscle tissue**, where thin, individual myofibers are assembled in muscle fibres, which are organised in fascicles that receive nutrients through small capillaries, and this structure is itself organised in thicker bundles that constitute the muscle itself.

The Market

The technology is interesting for companies that commercialise 3D bioprinters, materials and methods to fabricate different types of tissues. It allows **expansion of the portfolio of engineered tissue types by including bioprinting and bioink kits for skeletal muscle**. This is one of the most interesting applications for tissue engineering research, as recreation of skeletal muscle tissue models is crucial for muscle diseases studies related to skeletal muscle loss, including skeletal myopathies (e.g., muscular dystrophy, spinal muscular atrophy) or traumatic injuries. Due to the **universality of the method**, derived compositions for different tissues could be designed and offered using the same method.

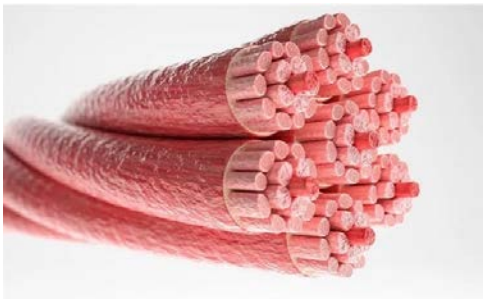
The Asset

IBEC researchers have developed a universal method for the fabrication of **thin, homogeneous, and width-controlled free-form fibres** that can be used with a **wide variety of cell-laden hydrogels.** The method inventively separates the fixation process of the 3D-printed fibre structure from the hydrogel polymer cross-linking step. In particular, the method of the invention enables the fabrication of multi-layer tissue constructs without significant fusion of adjacent fibres, based on a co-axial method with a biocompatible sacrificial polymer that protects the individual fibres until they are crosslinked, with **high versatility in terms of hydrogel composition and cross-linking processes**. Moreover, this method does not to rely on the use of sodium alginate, as most co-axial approaches do, being an agent that is not well received by certain tissues like skeletal muscle.

The asset value

- Good **mimicking of highly structured skeletal muscle tissue**:
  - Individual fibres are printed with a controlled width
  - There is no significant fusion of adjacent fibres
- The system is **versatile**, it allows bioprinting with a wide variety of cell-laden hydrogels.
- The solution is based on **co-axial nozzles that could be used with different 3D printing systems**.

A co-axial bioprinting method to better mimic the high-level structure of skeletal muscle tissue



Potential product:

- Bio-printing kit (Coaxial extrusion nozzle, bioink, protocol), especially designed for muscle application

Scientific Project Leader

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Stage of development

- TRL 4
- Full validation for skeletal muscle tissue, demonstrating improved cell differentiation and larger force outputs.
- Characterization of different protocols to obtain high quality fibres with a wide combination of materials.

Intellectual Property Status

PCT application filed in July 2021
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Exploitation plan

Patent available for licensing with technical cooperation / Technical co-development

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