Phase II

A hybrid 3D-nanofabrication technology for the development of 3D-scaffolds, hydrogels, and implants for research and medical applications

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What is the problem?

To date, there is no effective treatment for nerve and spinal cord damage. A promising new approach involves introducing artificial scaffolds combined with stem cell has shown promising results. However, this approach has technical limitations related to the customization of the scaffolding matrix and availability of suitable biomaterial for the development of 3D-biological implants and tissue grafts. The modern 3D-lithography offers control over scaffold architecture, but it is slow, size-limiting and introduces non-biodegradable materials. While electrospinning is a much faster and lower-cost manufacturing alternative: a personalized scaffold can be produced within hours as opposed to days using conventional lithographic techniques, which has a huge impact on the patient's prognosis. However, scaffolds fabricated by conventional electrospinning tend to be mostly 2-dimensional, doesn't allow any customization of scaffolding parameters (such as geometry, thickness, fibers alignment) and not sufficiently conductive to be suitable for neural tissue applications.

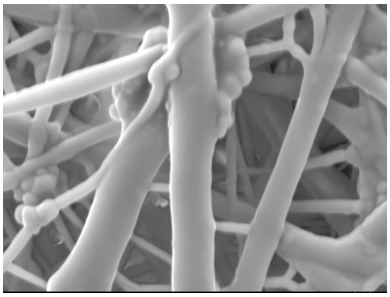


Figure 1. High resolution SEM image of nanofiber mesh of biomaterial we developed.

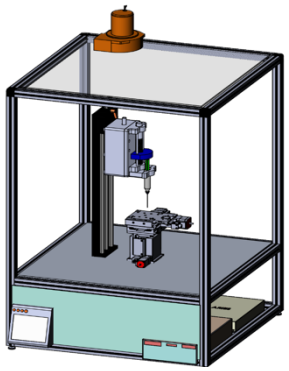


Figure 2. 3D-CAD design of hybrid fabrication technology

What is your solution?

We have developed a novel composite biomaterial and developing a high-precision hybrid fabrication technology has features of both electrospinning and 3D-bioprinter for the rapid fabrication of patient specific 3D-fibrous scaffolds and 3D-neural grafts (based on stem cells) which are precisely tailored to fit the site of injury. This is a ground-breaking step towards the development of low-cost, personalized regenerative treatments for spinal cord damage.

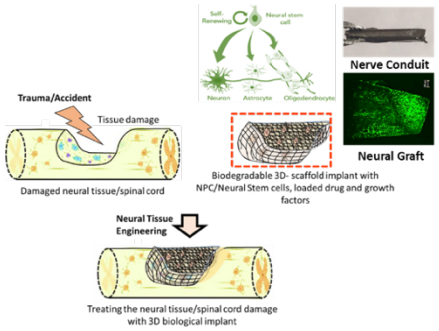
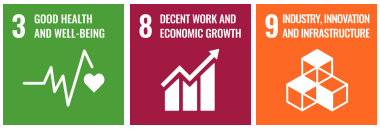


Figure 3. Graphical Illustration of neural tissue engineering. Nerve conduit or stem cell graft tailored according to the patient requirements to fit at the lesion site

Other resources

- Patent information
- Publication list
- Unit website
- Podcast

Contribution to SDGs



Keywords: Spinal Cord Injury, Neural Tissue Engineering, Electrospinning, 3D-bioprinting, Neural Grafts, Nerve Conduits.

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