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From Fabrication Errors to Tissue Engineering Scaffolds: Leveraging MEW Hierarchical Coiled Architectures

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MEW, tissue Engineering, coiled fibers; hierarchical architectures

Addressing the treatment of critical tissue defects remains a significant challenge in medicine and bioengineering. Tissue engineering (TE) scaffolds, which feature porous architectures conducive to cell growth, offer a promising solution. Recent advancements in additive manufacturing techniques have revolutionized scaffold fabrication, enabling precise control over complex porous structures and anisotropic architectures. One such technique is *melt electro writing* (MEW), which allows for the printing of highly resolved porous structures of controllable architecture.

The phenomenon of *melt electro-written entangled fibers* was examined for the first time in 2011 [1]. Initially, this type of structure was considered a printing error. It was found that characteristic coils are formed due to the buckling of melt jet deposits (Figure 1).

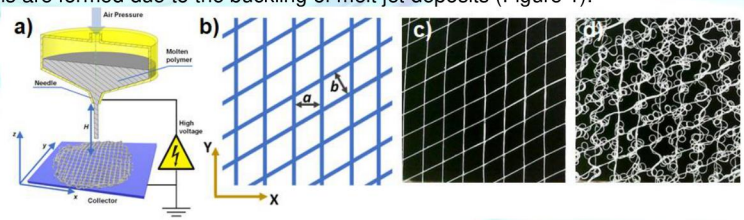

Figure 1. Scaffold fabrication using MEW technique: a) schematic view; H – tip-collector distance; b) selected inter-fiber distances of the primary pattern; c) primary architecture; d) coiled architecture based on the primary pattern [2]

Later, it was demonstrated that MEW structures composed of coiled fibers could serve as hierarchical TE scaffolds. The concept of applying hierarchical porosity in TE is justified by the idea that small pores and surface features can facilitate cell attachment, while larger pores allow for the ingrowth of regenerated tissue.

The ultimate goal of the study was to explore the possibility of fabricating multi-level hierarchically ordered TE scaffolds with entangled fibers through a synergistic combination of MEW and porogen leaching, using polyethylene glycol PEG as a porogen. The research aimed to elucidate the relationships between fabrication parameters and the morphological, mechanical, and functional properties of these scaffolds.

Finally, it was revealed that 3D PCL fibrous scaffold with a coiled morphology, created through a synergistic combination of MEW and porogen leaching using PEG as a porogen, could be an efficient method to produce hierarchical architectures characterized by multi-level hierarchical porosity.

References

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