3D Printing: Improving Fiber Deposition Accuracy in Melt Electrowriting

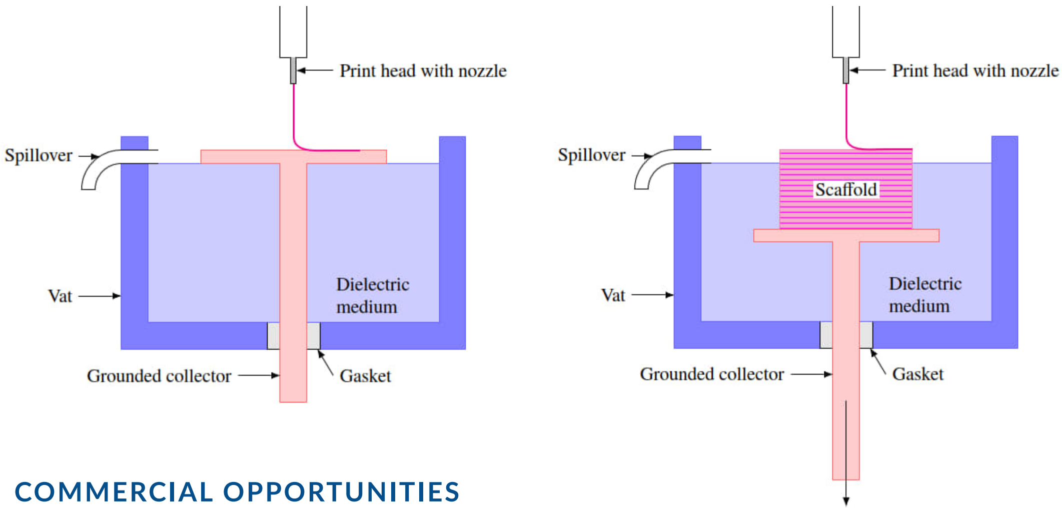
Reference No: B80072

CHALLENGE

Melt electrowriting (MEW) is a high-resolution 3D printing technique that combines elements of electrohydrodynamic fiber formation and polymer melt extrusion. The ability to precisely deposit micro- to nanometer fibers of biocompatible polymers in a layer-by-layer fashion makes MEW a promising scaffold fabrication method for all kinds of tissue engineering applications. The general principle of MEW can be divided into two steps: firstly, the molten material is extruded through a nozzle using air pressure or volumetric dispensing. Secondly, by applying a high voltage electric field between the nozzle and a collector, the extruded polymer droplet transforms into a Taylor Cone from which a fiber jet emerges that travels towards the collector.[1] Accurate scaffolds are formed when the fiber jet is deposited in a direct writing mode layer-by-layer. Maintaining precise fiber placement throughout a print is crucial to obtain clinically relevant scaffolds.
However, with increasing build height a varying nozzle-to-scaffold distance and accumulating residual charges in previously deposited fibers lead to electric field variations that complicate accurate fiber placement resulting in adverse effects such as fiber pulsing[2] or bridging[3].

INNOVATION

The presence of residual charges in previously deposited polymer material bends electric field lines due to a spatially varying dielectric constant and therefore distorts the deposition pattern of subsequent polymer layers. Consequently, this innovation proposes to submerge the collector layer-by-layer into a vat containing a liquid of a specific dielectric constant. The liquid serves to reduce the spatial variation of the relative dielectric constant and may also accept charges from the deposited polymer material. This results in a more uniform electric field enabling accurate fiber deposition even at large build heights.



COMMERCIAL OPPORTUNITIES

The invention is relevant to polymer 3D printing of microscale structures.

DEVELOPMENT STATUS

The invention was tested in first experiments.

REFERENCES:

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