

## Hydrogel Tubes and Coaxial Fibers from Custom 3D Printed Nozzles

**This technology offers a fabrication process for coaxial fibers and hollow tubes with hydrogel compositions. Custom nozzles extrude and cure the hydrogel during the printing process and shows potential in in vitro models.**

### What is the Problem?

Tubular structures are abundant in nature where they function broadly as conduits for the bulk transport of fluids. These tubular structures include the airways and blood vessels of vertebrates. Fabrication of perfusable structures using biofunctional materials and compatible manufacturing processes is of great interest in the areas of bioengineering and regenerative medicine. While tubes are geometrically simple, their fabrication from soft materials is an existing challenge in the field. Existing approaches exhibit limited utility when it comes to the fabrication of tubes with small luminal diameters. Improved methods for fabricating polymeric tubes and associated biomimetics are needed.

### What is the Solution?

The solution is a novel process for fabricating coaxial fibers and hollow tubes with hydrogel compositions. This is enabled by the development of custom nozzles for extrusion-based printing, which is coupled with hydrogel inks which can be modified to tune the physical and chemical properties of the corresponding hydrogel. The nozzle assembly extrudes a hydrogel solution, which is cured during the extrusion process, forming hollow tubes or filaments. The hydrogel tubes have potential for use as artificial blood vessels, in vitro lung models, or other applications related to cell culturing or tissue engineering.

### What Differentiates it from Solutions Available Today?

Common existing strategies involve casting or rolling a synthetic or natural polymeric material around a mandrel, wherein the diameter of the mandrel determines the tube's luminal diameter. Mandrel-based approaches can yield tubes with properties comparable to those of human blood vessels. However, the utility of these approaches is limited when it comes to the fabrication of tubes with small luminal diameters (<0.5 mm). 3D printing will allow for tunable and consistent hydrogel tubes that exhibit biomimetic properties. This allows for wide applicability, as the mechanical properties can be tuned for specific use cases.

### Patent Information:

### Technology ID

BDP 8692

### Category

Materials/Polymers  
Selection of Available  
Technologies

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### Learn more



## References

1. S Cem Millik, Ashley M Dostie, Dylan G Karis, Patrick T Smith, Michael McKenna, Nathan Chan, Chad D Curtis, Elizabeth Nance, Ashleigh B Theberge, Alshakim Nelson(43647) , <https://pubmed.ncbi.nlm.nih.gov/31220824/>, Biofabrication