MONTANA STATE UNIVERSITY
Norm Asbjornson College of Engineering

Improving Transport in Hydrogels for 3D Bioprinting Applications by Reha Abbasi

PhD Defense
Department of Chemical & Biological Engineering
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3:00pm to 4:00pm

Department of Chemical & Biological Engineering

Meeting link: https://montana-student.webex.com/montana-student/j.php?MTID=mfc1ca55d55171bf4121d48aefc00e811
Meeting number: 120 072 2277
Password: TbA3fP37unZ

ABSTRACT
Hydrogels are soft, water-based gels with widespread applications in medicine, tissue engineering, and biotechnology. Many applications require structuring hydrogels into complex three-dimensional shapes. For these applications, light-based 3D bioprinting methods offer exquisite control over 3D structure. However, the use of these methods for structuring hydrogels is underdeveloped, limiting transport of nutrients, waste, and other materials through the hydrogel. For example, the limited transport of nutrients through 3D printed tissue constructs leads to low cell viability. Here, we describe three experimental research studies focused on improving material transport in 3D-printed hydrogels. In the first part of this talk, we describe a generalizable method for light-based 3D printing of hydrogels containing open, well-defined, submillimeter-scale channels with any orientation. These submillimeter channels allow for bulk liquid flow through the hydrogel to improve nutrient and oxygen transport. In the second part of the talk, we describe a simple, reversible, plug-based connector designed to couple tubing to a hydrogel-based fluidic device to allow for pressurized liquid flow through the system. The resulting connection can withstand liquid pressures significantly greater than traditional, connector-free approaches, enabling long-term flow through 3D-printed hydrogels. In the third part of the talk, we characterize the printability of photopolymerizable resins containing particles that slowly dissolve to release oxygen and thereby improve cell viability. The light-based 3D bioprinting technologies we describe in this dissertation work will improve transport through 3D printed hydrogels and enable a wide variety of applications in 3D bioprinting and hydrogel fluidics.

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Publications related to this thesis:

1. A. D. Benjamin*, **R. Abbasi***, M. Owens, R. J. Olsen, T. B. LeFevre, J. N. Wilking, Light-Based 3D Printing of Hydrogels with High-Resolution Channels, *Biomed. Phys. Eng. Express* (5) 025035 (2019). (*co-first author)
2. **R. Abbasi,** T. B. LeFevre, A. D. Benjamin, I. J. Thornton, J. N. Wilking, Coupling Fluid Flow to Hydrogel Fluidic Devices with Reversible "Pop-it" Connections, *Lab on a Chip*.
3. **R. Abbasi,** Z. Mahdieh, G. Yiyen, R. Walker, J. N. Wilking, Light-Based 3D Bioprinting of Hydrogels Containing Colloidal Calcium Peroxide, *Bioprinting*. (in prep.)