Docket #: S19-254

3D Bioprinting using Stiffened Polymer Bioinks and Bioorthogonal Crosslinkers

The Heilshorn group has developed a platform for 3D bioprinting which stiffens the structure post-printing using chemistry that is completely bioorthogonal. This two-part system utilizes a family of UNIversal Orthogonal Network (UNION) bioinks and diffusive small molecule crosslinker support baths. UNION bioinks are functionalized hydrogel backbones (such as PEG, collagen, dextran, and hyaluronic acid, etc.) with variable levels of crosslinking moieties to tune stiffness. The 3D structure is bioprinted into the diffusive support bath which contains the complementary multifunctional crosslinker. These molecules diffuse into the printed structure and spontaneously crosslink the bioink, rendering the final structure. This platform enables the printing of two or more bioinks into a composite structure with a cohesive, stable interface. Notably, this printing method uses chemistry that is biorthogonal to other printing methods and cellular functions, making it an ideal system for tissue engineering or other applications requiring live cells, including stem cells and organoids.

Stage of Research

- Proof of concept

Applications

- **Personalized medicine**
- Printed tissue engineering
- Tissue or vasculature models for drug discovery

Advantages

- **Universal crosslinking moieties are broadly applicable to various hydrogel backbones**
- Bioink mechanical properties are independent from post-printing stiffening
- Cytocompatible for cell-laden 3D constructs
- Bioink hydration and printed structure immobilization using the diffusive support bath

Publications

- Hull et al. Advanced Functional Materials (2020) "3D Bioprinting using UNIversal Orthogonal Network (UNION) Bioinks"

Patents

- Published Application: WO2021041372
- Published Application: 20220305718
- Issued: 12,397,495 (USA)

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