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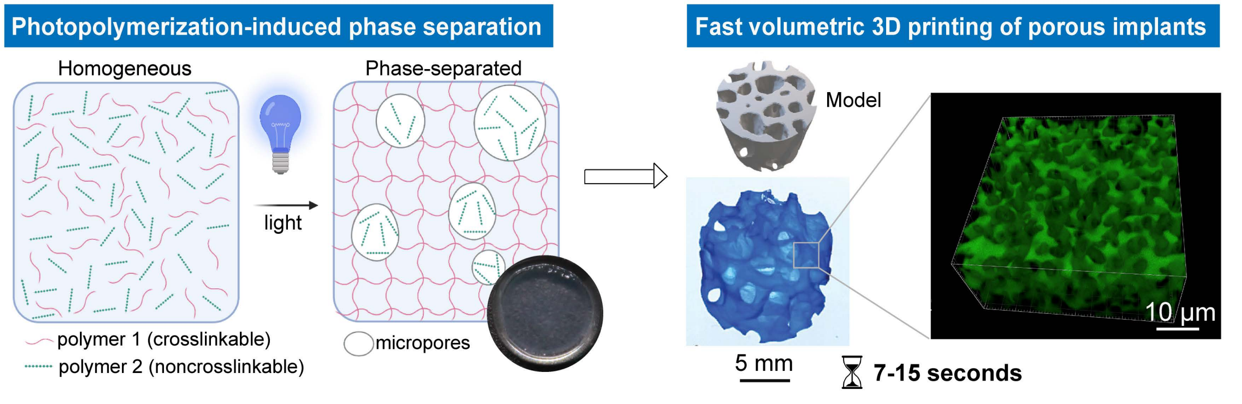
Licensing Opportunity

Photoclick hydrogels for 3D-printed porous implants



Left: New water-soluble, biocompatible photopolymer resins rapidly form microporous hydrogels via photopolymerization-induced phase separation. Right: 3D-printed bone-like construct with hierachical porosity by volumetric printing in seconds.

Application

This 3D-printable hydrogel has diverse applications in dental implants, bone regeneration, and wound healing. In dental care, custom-fit implants, jawbone regrowth, and delivery of antimicrobial agents are supported. In bone regeneration and wound healing, this scaffolding hydrogel mimics the extracellular matrix, release growth factors and foster stem cells to repair large defects, thus offering minimally invasive treatment options.

Features & Benefits

- Simple, upscalable photopolymer synthesis
- Fast photocuring at r.t. (< 5-10 seconds)
- Tunable porosity and permeability by light
- Biocompatible and osteoinductive
- Processability via light-assisted 3D-printing

Publication

- "A Synthetic Dynamic PVA Photoresin for Fast Volumetric Bioprinting of Ultrasoft Hydrogels", Adv.Funct.Mater. 2023, 2214393 (10.1002/adfm.202214393)
- Patent pending

transfer

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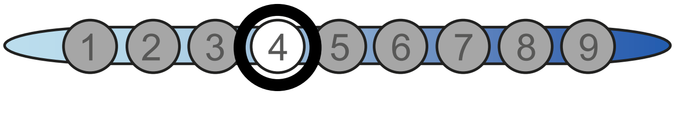
Technology Readiness Level



Background

Traditional covalently crosslinked hydrogels are nanoporous (pore sizes: 5–100 nm) and thus often impede cell spreading and tissue ingrowth, while other types of macroporous scaffolds with larger pores (pore sizes: 100–600 µm) merely provide a 2D cell-to-surface interface. Furthermore, most photolymers used in hydrogel printing rely on low molecular weight polyethylene glycol di-acrylates, which are severely cytotoxic and irritant, thus not applicable for medical implants.

Invention

A composition and a method to generate a microporous hydrogel implant are presented. The composition consists of norbornene-functionalized polyvinyl alcohol, di-thiol crosslinker and dextran sulfate. This resin forms rapidly a hydrogel with interconnected pores by photopolymerization-induced phase separation (PIPS). The preparation method offers tunable pore sizes in the range of 2-40 µm as a function of light intensity, polymer composition and molecular charge. Proof-of-concept experiments show the 3D photoencapsulation of living cells, enhanced cell spreading in microporous hydrogels, and tomographic volumetric bioprinting of cm-scale hydrogel constructs with hierarchical pores within 7-20 seconds. This resin is biocompatible, biodegradable, low-cost and easy-to-make, offering promises for fast photofabrication of cell-compatible implants with complex porous structures.

Summary

3D-printable aqueous photoresins enable complex hydrogel constructs with optimal nutrient/oxygen permeability and favorable 3D cell-material interactions to foster implant-tissue integration and tissue regeneration.