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B12-Dependent Photoresponsive Protein Hydrogels for Controlled Cell Release

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Background

Thanks to their marked resemblance to living tissues, hydrogels have huge potential in biomedical fields as well as for 3D and organoid cell culture.

3D cell culture creates an artificial environment that allows cells in vitro to travel in all directions, mimicking the native tissue environment, similar to cells in vivo. Several studies have reported differences in the morphology and gene and protein expression profiles of cells grown in 3D environments, compared with the traditional 2D system. The need for 3D cell models is growing, and researchers are showing increasing interest in their use for biomedical research and development for various pharmaceutical applications. Although the structural and functional properties of genetically engineered protein-based hydrogels can be precisely controlled, the potential cell- and protein-related applications of an entirely recombinant protein-based hydrogel with light-sensing abilities have never been demonstrated.

Technology Overview

This invention provides a B12-dependent light-sensing hydrogel created by covalently stitching together CarHC photoreceptor proteins. The polymeric CarHC proteins self-assemble into an elastic hydrogel in the presence of AdoB12 in the dark and disassemble rapidly into a liquid-like material on exposure to light. This light-dependent liquid to gel transition enables the facile release and recovery of human mesenchymal stem cells from 3D cultures. The CarHC hydrogel is also designed to encapsulate and release bulky globular proteins in a light-dependent manner. The direct assembly of stimuli-responsive proteins into hydrogels represents a versatile strategy for designing “smart” stimuli-responsive biomaterials and opens up enormous opportunities for future material biology.

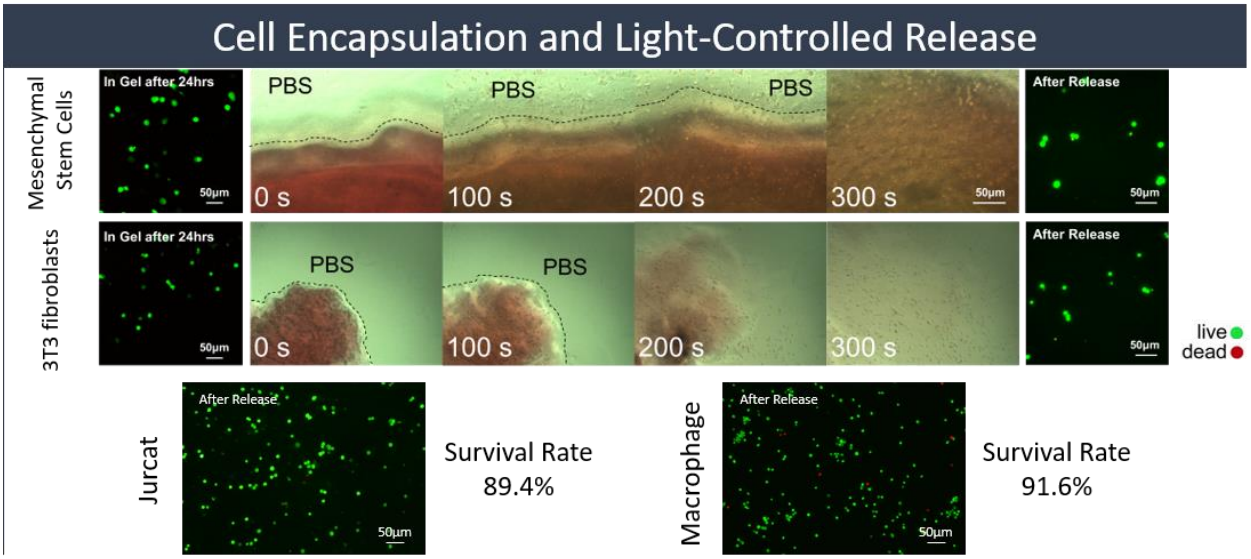
Applications

- 3D cell culture matrix
- Controllable cell delivery vehicle for therapeutic purposes

Patents

- US Patent no.: 15/974927

Figures


Cell Encapsulation and Light-Controlled Release
Mesenchymal Stem Cells
In Gel after 24hrs
PBS
PBS
PBS
0 s
100 s
200 s
300 s
After Release
3T3 fibroblasts
In Gel after 24hrs
PBS
PBS
0 s
100 s
200 s
300 s
After Release
live
dead
Jurcat
After Release
Survival Rate
89.4%
Macrophage
After Release
Survival Rate
91.6%
50µm