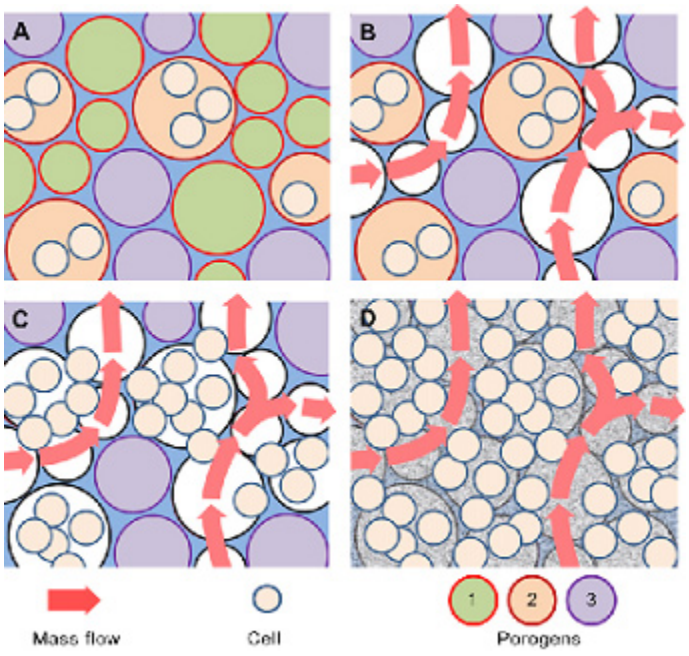
Docket #: S12-148

Tissue engineering scaffold with controllable macropore-formation

Researchers in Dr. Fan Yang's lab have developed 3D tissue engineering scaffolds with dynamic, temporally and spatially controllable macropore formation. Macropores within tissue engineering scaffolds are important structures that promote tissue formation by facilitating diffusion, cell proliferation, migration, and extracellular matrix (ECM) production. Current methods for making macroporous scaffolds are limited in that fabrication conditions are too harsh for cell survival and thus cells can only be seeded onto prefabricated scaffolds. This leads to low seeding efficiency and non-uniform distribution. Current methods also lack step-wise temporally controllable dynamic macropore formation. To overcome these limitations the inventors developed this platform which uses stimuli-responsive porogens to facilitate dynamic formation of macropores in cell-laden scaffolds.



Supporting tissue generation by dynamic pore formation. A) Forming a hydrogel with multiple porogens, which encapsulate the cells; B) Removing porogen 1 to facilitate

the transport of nutrient; C) removing porogen 2 to deliver cells and facilitate cell proliferation; and D) removing porogen 3 to further enhance cell proliferation and formation of ECM.

Stage of Research
The inventors have shown that sequential porogen removal led to significantly enhanced cell proliferation and ECM production compared to scaffolds with fixed macroporosity. Furthermore, they demonstrated that these porogens may also be used as cell-delivery vehicles for temporal cell release in 3D scaffolds.

Applications

- Regenerative Medicine and Tissue Engineering
    - Implant for cell-based plastic surgery
    - Implant for engineering tissues such as skin, muscle, bone, cartilage and cardiovascular tissues
- Distribution vehicle for
    - Therapeutics
    - Cells
- Basic research
    - 3D scaffold for cell culture, expansion and study
    - Cell based drug screening
    - Examine cell responses to dynamic properties such as loss of biochemical or physical cue

Advantages

- Macropore formation can be tuned to comply with pace of cell and tissue growth
- Sequential pore formation enhances cell proliferation and ECM production
- Porogens are made from materials commonly used in tissue engineering and process is non-toxic.
- 3D cell culture more closely mimics *in vivo* cellular behavior.
- Direct cell encapsulation provides:
    - Cell protection
    - Control of cell distribution in 3D

- More homogeneous cell distribution

Publications

- Published US Patent Application US 2014061843
- Hammer J, Han LH, Tong X, Yang F. A Facile Method to Fabricate Hydrogels with Microchannel-Like Porosity for Tissue Engineering. Tissue Eng Part C Methods. 2013 Jun; 20(2):1-8. doi: 10.1089/ten.tec.2013.0176. Epub 2013 Jun 7.
- Han LH, Lai J, Yu S, Yang F. Dynamic Tissue Engineering Scaffolds with Stimuli-Responsive Macroporosity Formation. Biomaterials. 2013 Jun;34(17):4251-8. doi: 10.1016/j.biomaterials.2013.02.051. Epub 2013 Mar 13.

Patents

- Published Application: 20140161843

Innovators

- Li-Hsin Han
- Fan Yang

Licensing Contact

Luis Mejia

Senior Licensing Manager, Physical Sciences

Email