Hydrogel Surfaces for Modulation of Cell Secretory Activity

Compositions of hydrogel matrices to serve as cell culture surfaces for modulating cell secretory activity, maintaining cell health, and allowing cell growth in low serum/serum-free growth conditions

Georgia Tech inventors have created compositions of hydrogel matrices to serve as cell culture surfaces for modulating cell secretory activity. In addition, the hydrogel matrices can be used for sequestering proteins near the cell-hydrogel interface for localized paracrine signaling, and for serum-free or low serum culture of cells. The hydrogel culture surfaces also reduce cell senescence over multiple cell population doublings indicating these surfaces may improve cell health and expansion compared to standard culture surfaces. The main objective of this technology is to establish new hydrogel-based cell culture substrates to amplify therapeutic paracrine signals and improve cell health. The hydrogels can be formed as flat surfaces or three-dimensional carriers in bioreactor systems for cell expansion or culture to prime cells before they are used for a specific application or during a specific application as cell carriers.

Summary Bullets

- **Multiple formulations** – set of hydrogel formulations to control the secretory behavior of cells
- **Customizable** – hydrogels can be tailored to exhibit a range of mechanical and biochemical properties:
    - Mechanical properties controlled by length and concentration of polymers, concentration of free radical initiators, curing time
    - Biochemical properties include what peptide, lipid, carbohydrate or other moieties are incorporated into the hydrogel network.
    - Can be formed as flat surfaces or three dimensional matrices

Solution Advantages

- **Multiple formulations** – set of hydrogel formulations to control the secretory behavior of cells
- **Customizable** – hydrogels can be tailored to exhibit a range of mechanical and biochemical properties:
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Potential Commercial Applications

- Cell culture (manufacturing)
    - Reduction of serum factors
    - Improve cell health (reduced senescence)
- Cell adhesion
- Regenerative Medicine
    - Pro-regenerative priming for cell therapy
    - Cell delivery vehicle that can alter secretome

Background and More Information

Mesenchymal stem cells (MSCs) have been used in clinical trials to treat multiple diseases. They are an ideal therapeutic cell due to their ability to secrete a number of immunomodulatory and chemotactic factors to promote tissue healing. Strategies to modify the profile of these secreted factors could further improve their therapeutic capacity and potentially reduce the number of cells needed per therapeutic dose.

Production of MSCs for cell therapy involves the in vitro culture expansion of MSCs. Standard tissue culture plastic surfaces cause a progressive increase in cell senescence (a non-proliferative state) with extended culture; therefore, culture substrates that reduce senescence could improve the ability to expand MSCs ex vivo for cell therapy manufacturing. Culture of MSCs also requires the addition of growth factors and nutrient sources that are traditionally derived from xenogenic serum and represent a large cost in cell manufacturing. A culture system that reduces the need for exogenous growth factors has the potential to reduce culture cost as well as cell exposure to undefined xenogenic serum proteins.

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Publications

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