Synthetic Surfaces for Advanced Cell Culture

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This presentation will provide an overview of a materials science approach for the development of novel vessels and surfaces for advanced cell culture applications. Two specific applications will be discussed: i) high density cell culture vessels; and ii) synthetic surfaces for the expansion and differentiation of human stem cells.

Thin, gas permeable polymer films have been utilized to create high density cell culture vessels. Rather than containing a headspace for gas exchange within the culture vessel, the gas permeable vessels have air spaces (referred to as "tracheal" spaces) beneath each culture chamber. This compact design permits stacking and manifolding of cell growth chambers to increase efficiency with regard to cell growth surface area per unit volume. Ten of these cell growth chambers have been assembled into the same footprint as a standard T-175 flask. The technology has been expanded in size for use in the cell therapy and vaccine production markets. The performance of these vessels relative to traditional culture vessels will be highlighted.

A combinatorial chemical design and screening approach was used to identify and develop synthetic surfaces that support the growth and differentiation of stem cells. In our work, we screened over 6000 unique copolymers in a 96-well microplate format. Selected surfaces were also functionalized with peptide epitopes. Surfaces were characterized with a variety of analytical techniques including optical microscopy, infrared spectroscopy, atomic force microscopy, confocal Raman imaging, water contact angle, zeta potential, and dye staining. A biological screening method was used to select the best performing surfaces. The performance of one of these surfaces was evaluated for the long term expansion (> 20 passages) and differentiation of human embryonic stem cells and human mesenchymal stem cells in defined, xeno-free medium.