

External stimulus-responsive biomaterials designed for the culture and differentiation of ES, iPS, and adult stem cells

ABSTRACT

The physical and chemical characteristics of biomaterial surface and hydrogels can be altered by external stimuli, such as light irradiation, temperature changes, pH shifts, shear stress forces, electrical forces, and the addition of small chemical molecules. Such external stimulus-responsive biomaterials represent promising candidates that have been developed for the culture and differentiation of embryonic stem (ES) cells, induced pluripotent stem (iPS) cells, and adult stem cells. Biomaterials that are designed to respond in a reversible manner to specific external signals can be formed on micropatterned or non-micropatterned surface, in hydrogels, or on microcarriers. Stem cells and the cells differentiated from them into specific tissue lineages can be cultured and/or differentiated on dishes with immobilized external stimulus-responsive polymers. Cells can be detached from these dishes without using an enzymatic digestion method or a mechanical method when the appropriate external stimulus is generated on the surface. This review discusses the polymers and polymeric designs employed to produce surface and hydrogels for stem cell culture, differentiation, and/or cell detachment using various external stimuli.

Keyword: Biomaterial; Stem cell; Thixotropic; Photoresponsive; Thermoresponsive; Microcarrier