Engineering Biomaterials for the Investigation of Factors that Influence Stem Cell Fate

by

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ABSTRACT

The past few decades have witnessed an explosion in the advances in stem cell technology. These advances give rise to the hope of treating once believed to be incurable diseases with *in vivo* cell replacement, gene therapies, or *ex vivo* tissue regeneration followed by implantation. Before stem cell therapies can become a mainstream medical treatment, the precise factors which control stem cell fate must not only be elucidated but also controlled to ensure the desired stem cell fate.

The aim of this thesis is to engineer biomaterials to investigate both genetic factors and factors of the cellular microenvironment that influence stem cell fate. We have engineered micropatterned surfaces using soft lithographic techniques, and developed a novel chemistry to immobilize bioactive molecules to an inert surface for control of stem cell adhesion and cell-ligand interactions respectively. To investigate genetic sequences that influence stem cell fate, we have developed clonal microarrays that can be used to screen large genomic libraries within the space of a few culture plates and within a two week time period. We also developed three-dimensional stem cell scaffolds based on degradable alginate hydrogels for investigating factors of the cellular microenvironment that influence stem cell fate. Lastly, we are developing biomaterials that can instruct stem cell differentiation and synthesizing temperature responsive clonal microarrays.