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Chemical and topographical modification of polydimethylsiloxane surfaces synergistically influence mesenchymal stem cell fate

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The interactive influence of chemical and topographic microenvironments in the immediate vicinity of anchorage dependent cells such as the mesenchymal stem cells (MSCs) has been a central theme of many studies involving stem cell based tissue regeneration. In this regard, the optimal adhesion of mammalian cells is critical in determining the cell viability and proliferation on substrate surfaces to facilitate long term *in vitro* studies on cell behavior and regenerative mechanisms. PDMS based microsystems have been greatly used for such in-vitro studies at both cellular and tissue level architectures. However, due to the inherent high hydrophobicity of a polydimethylsiloxane (PDMS) surfaces, cell culture on these surfaces is unfavorable, causing cells to eventually dislodge from the surface. Although physically adsorbed matrix proteins can promote initial cell adhesion, this effect is usually short-lived. To address this issue, a surface chemical modification of PDMS was performed for covalent immobilization of ECM proteins through (3-aminopropyl)triethoxy silane (APTES) and cross-linker glutaraldehyde (GA) cross-linking chemistry. Further, PDMS surfaces developed with micro-pillar and hole (H: 30 μm and D: 30 μm) based topographical features with grooved and non-grooved features obtained by photolithography were included in this study to study the combinatorial substratum effects on MSCs. The hydrophobicity of the native PDMS decreased significantly with the mentioned surface functionalization with a higher anchorage of ECM proteins. Both, surface chemical and topographical features resulted in an enhanced adhesion, proliferation and differentiation of mesenchymal stem cells into osteogenic lineage. We believe that these strategies could also be applied to several other substrate materials by appropriate combinations of self-assembled monolayers (SAMs), ECM proteins and substrate topography to obtain a realistic understanding of cell-microenvironment interactions which influence critical cell behaviors in the realm of cell based regenerative therapies.

Biography

Shreyas Kuddannaya is currently a PhD student at Nanyang Technological University. He has completed his Master's degree from the Delft University of Technology in Netherlands. His PhD research is focused on studying the surface-chemical and micro/nano mechanical environments on mammalian cell behavior in the context of tissue regeneration. He has published in several reputed peer reviewed journals and has presented his research in reputed platforms in bioengineering.

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