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Plasma Engineered Nanorough Substrates for Stem Cells in vitro Culture

Authors : Melanie Macgregor-Ramiasa, Isabel Hopp, Patricia Murray, Krasimir Vasilev

Abstract : Stem cells based therapies are one of the greatest promises of new-age medicine due to their potential to help curing most dreaded conditions such as cancer, diabetes and even auto-immune disease. However, establishing suitable in vitro culture materials allowing to control the fate of stem cells remain a challenge. Amongst the factor influencing stem cell behavior, substrate chemistry and nanotopogaphy are particularly critical. In this work, we used plasma assisted surface modification methods to produce model substrates with tailored nanotopography and controlled chemistry. Three different sizes of gold nanoparticles were bound to amine rich plasma polymer layers to produce homogeneous and gradient surface nanotopographies. The outer chemistry of the substrate was kept constant for all substrates by depositing a thin layer of our patented biocompatible polyoxazoline plasma polymer on top of the nanofeatures. For the first time, protein adsorption and stem cell behaviour (mouse kidney stem cells and mesenchymal stem cells) were evaluated on nanorough plasma deposited polyoxazoline thin films. Compared to other nitrogen rich coatings, polyoxazoline plasma polymer supports the covalent binding of proteins. Moderate surface nanoroughness, in both size and density, triggers cell proliferation. In association with polyoxazoline coating, cell proliferation is further enhanced on nanorough substrates. Results are discussed in term of substrates wetting properties. These findings provide valuable insights on the mechanisms governing the interactions between stem cells and their growth support.

Keywords : nanotopography, stem cells, differentiation, plasma polymer, oxazoline, gold nanoparticles
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