New Micro- and Nanostructured Biomaterial Surfaces based on Colloidal Crystals

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Abstract

Complex colloidal crystals are a promising material that is attracting interest in the areas of photonic band gap devices, electronics, displays, chemical sensors and biosensors, and biomaterials and tissue engineering. One of the challenges with decorating surfaces with colloidal crystals is to create ordered structures over large surface areas (cm^2). This presentation will discuss how using controlled solvent evaporation it is possible to surface engineer new types of patterns and structures on surfaces with a range of colloids of different size, chemistry and shape. Precise spatial control of chemistry on surfaces provides an essential platform for the directed attachment of bioactive molecules and control over cell and bacterial attachment and growth. In addition, the crystal layers can be used as masks against deposition of plasma polymers and/or metals such as gold to create complex patterns of dimensions ranging from μms to sub 100 nms and are useful for post-modification with different chemistries for site-specific immobilisation of biomolecules. This includes using chemistries for preventing non-specific adsorption of proteins and attachment of cells, including new ways of generating high graft density polymer brushes. Also we demonstrate that the colloidal crystals can be sued to selectively graft cell adhesive or antimicrobial peptides that enhance the growth of mammalian cells or kill bacteria respectively. In terms of mammalian cells we are targeting using colloidal crystals to direct stem cell fate in specific cell types and even using them the generate induced pluripotent stem cells (iPSCs) from somatic cells such as fibroblasts. The presentation will also demonstrate the importance of using surface sensitive analytical tools to prove the presence of the different surface chemistries. These include x-ray photoelectron spectroscopy (XPS), SEM, and high resolution time-of-flight secondary mass spectrometry (ToF-SIMS) imaging. Finally, the presentation will provide details

of cell and bacterial attachment results to polymers and biopolymer surfaces where the properties have a profound effect on the responses. The potential of these new materials in biointerface science is discussed.