SURFACE NANOSTRUCTURES TO CONTROL PROTEINS AND CELLS

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Integrating artificial materials with biological systems requires engineering on molecular and macromolecular length scales. In fields such as biomaterials, tissue engineering, optimized substrates for cell culture and sensing applications there is a push towards the use of nanometer scale structured interfaces to mimic components of biological interfaces. Significant technological and scientific challenges exist to producing synthetic analogues of living systems, functional immobolisation of natural biological components or integrating solid state components and biological molecules into hybrid systems. Self assembling systems combined with lithographically produced patterns represent a promising approach. A number of approaches to immobolise, pattern or study biological macromolecules will be presented. The approaches presented are based on the self assembly of atoms [1], molecules/macromolecules (such as lipids [2], polyelectrolytes, block co-polymers and proteins [3]) and colloidal particles [4] making them suitable for producing macroscopic interfaces. Nanoscale topography, as a result of the potential for large scale production and ease of sterilisation, represents an attractive potential route to controlling biological systems. Non-specific protein binding becomes a significant issue and a number of studies of the influence of nanoscale surface topography on the behaviour of surface bound proteins will be outlined [5]. Examples of the response of cellular systems to surface nanotopography will be described [6]. An alternative approach to controlling cellular systems is through the immobolisation of specific biological molecules at interfaces. Approaches to create nanopatterns of functional proteins over large areas will be described and an AFM based approach to quantification of protein binding outlined. The results of a combined AFM/QCM-D study indicate that the immobolisation of laminin into 120nm patches enhance the functional properties of the protein [7]. Similar control of cellular response can be achieved via interfaces with nanotopography or nanopatterned proteins.

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