

Cellular Attachment and Protein Adsorption onto Chemically Patterned Polymer Surfaces.

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Introduction. It is well established that the interaction between biomaterial surfaces and the biological environment is critically important in determining the acceptance or rejection of biomedical devices and in optimizing tissue culture techniques. Modification of biomaterial surface properties, in particular chemistry, is one method for controlling the behaviour of this bio-interface in terms of protein adsorptivity and cellular attachment. Chemically functionalised (polar) surfaces are known to be generally superior to unfunctionalised (non-polar) surfaces in terms of *in vitro* cell attachment, rates of attachment and subsequent growth [1,2] whilst surface chemical patterning can be used to control the spatial position of cell attachment [3,4].

Methods. In the work reported, ultraviolet/ozone oxidation and plasma polymerisation technique have been used to produce polystyrene surfaces with either increasing levels of oxygen functionalities or micropatterned oxygen functionality. These materials have been characterized using XPS, AFM and water contact angle measurement and then used to study the effects of varying surface oxygen chemistry (polarity) on the adsorption of albumin and fibronectin and on the attachment behaviour of a wide range of cells in the presence of serum proteins.

Results. For all of the cells studied, surface oxidation promotes attachment relative to attachment to unoxidised PS. Where oxidised (polar) and unoxidised (non-polar) domains are present adjacently, initial cell attachment is observed to occur at the polar domains and the cell attachment pattern corresponds to that of the chemical pattern. In some instances the chemical pattern

dimensions are observed to influence the attached cell geometry and orientation. Over longer culture periods attachment also occurs at non-polar domains and the previously observed cell pattern becomes random. The results clearly show that the presence of polar domains can facilitate subsequent attachment at adjacent non-polar areas which would not normally support attachment. Some insight into the attachment mechanisms at the two surface types is given by the results from albumin adsorption experiments which indicate that relatively high concentrations of strongly bound protein are adsorbed at non-polar hydrophobic PS surfaces where attachment would be expected to occur primarily by dispersion interaction. For oxidised surfaces, albumin adsorption appears to occur by polar interactions resulting in a weaker attachment (possibly by formation of a hydrated interface) and a different conformation, the latter being nearer to that expected in aqueous solution. The substrate chemistry driven differences in protein adsorption, and particularly the differing energies of attachment will be discussed in terms of possible cell adhesion mechanisms.

References

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