Fibrinogen Epitope Mapping on a Nanocomposite Hybrid Biomaterial

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Abstract

The combined properties of chemical nature, charge and topology of a biomaterial surface can influence the structure of proteins adsorbed from blood or plasma. This complex molecular process can be better rationalised by studying, for example, fibrinogen adsorption on different controlled surfaces. Upon adsorption some segments of the protein peptide chains attach to the surface whilst others are exposed to the bulk solution, with the actual conformational orientation being dictated by the balance of all interactions involved. The resultant surface signature of the protein amino acid sequences or *epitopes* dictates subsequent protein and cell interactions.

A hybrid nanocomposite (NC) was synthesised, combining useful properties of both polyurethane and silicon (siloxane) nanocages. An immuno-chemical approach was used to probe the surface adsorbed protein on five different surfaces: model silicon oxide, polyurethane (PU), NC, octadecyltrichlorosilane (C18) and an amine surface. Two monoclonal anti-fibrinogens specific to the alpha and gamma chains were used to bind to the pre-adsorbed fibrinogen on the different surfaces and measured by real time spectroscopic ellipsometry and fluorescence microscopy. AFM provided information on surface topology and protein conformation. The subtle surface peptide-cells (HeLa) interactions were investigated with and without fibrinogen pre-adsorption.

AFM imaging revealed a much rougher terrain on NC compared to polyurethane. Further AFM studies unravelled the coexistence of different surface domains that elicited different fibrinogen conformational structures. Reduced anti-Alpha but increased anti-Gamma binding occurred at the silicon oxide and NC surfaces, but this trend was opposite to that observed at the PU, C18 and amine surfaces. The observation is clearly consistent with the proposition of two mainly different structural conformations of fibrinogen on these surfaces. Subsequent studies of attachment and proliferation of cells on pre-adsorbed fibrinogen surfaces revealed similar trend on both glass and the NC, again confirming the similarity of the interfacial fibrinogen conformations. Improved cell attachment was apparent when availability of gamma chain was higher than the alpha chain. Thus biomaterials such as NC with appropriately surface adsorbed fibrinogen polypeptides can work to improve their surface biocompatibility[1][2].

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