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Role of Biomaterial Surface Nanotopography on Protein Unfolding and Immune Response

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Abstract : The role of biomaterial surface nanotopograhy on fibrinogen adsorption and unfolding, and the subsequent immune response were studied. Inconsistent topography and varying chemical functionalities along with a lack of reproducibility pose a challenge in determining the specific effects of nanotopography or chemistry on proteins and cells. It is important to have a well-defined nanotopography with a homogeneous chemistry to study the real effect of nanotopography on biological systems. Therefore, we developed a technique that can produce well-defined and highly reproducible topography to identify the role of specific roughness, size, height and density with the presence of homogeneous chemical functionality. Using plasma polymerisation of oxazoline monomers and immobilized gold nanoparticles we created surfaces with an equal number density of nanoparticles of different sizes. This surface was used to study the role of surface nanotopography and the interplay of surface chemistry on proteins and immune cells. The effect of nanotopography on fibrinogen adsorption was investigated using Quartz Cristal Microbalance with Dissipation and micro BCA. The mass of fibrinogen adsorbed on the surface increased with increasing size of nano-topography. Protein structural changes up on adsorption to the nano rough surface was studied using circular dichroism spectroscopy. Fibrinogen unfolding varied depending on the specific nanotopography of the surfaces. It was revealed that the in vitro immune response to the nanotopography surfaces changed due to this protein unfolding.

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