MACROMOLECULES AT SOLID-LIQUID INTERFACES

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ABSTRACT

Engineering a surface for desired properties is very important for many industrial and medical applications. The rational design of a surface requires fundamental understanding of the interactions between macromolecules and solid-liquid interfaces. The mechanical properties of an adsorbed layer are important factors for assessing the behavior of surfaces. The goals of the research described here are (i) to develop a new method to study protein cross-linking, and (ii) to control the rheological properties of a surface for use as a biosensor. Increasing the stability of proteins and polypeptides via cross-linking is commonly used to minimize bio-fouling and to increase the life time of enzymes. Determining the extent of cross-linking, using say glutaraldehyde, is often accomplished by noting changes in viscosity that require large amounts of sample at high concentration. Here, we have implemented a highly sensitive quartz crystal microbalance with dissipation (QCM-D) technique to address this limitation. On the other hand, to use a surface for sensor applications, we should be able to control its physico-chemical properties. We have developed a counter-ion responsive-poly(L-lysin) (PLL)-based surface, the viscoelastic properties of which can be reversibly controlled. In principle, this controllable PLL molecule could be used as an ionic gate for drug delivery. Another method to control the physico-chemical properties of a surface is via layer-by-layer (LbL) assembly. We have tailored the LbL assembly of cationic PLL with anionic PSS by monitoring changes in both the rheological properties and the surface charge. This changing surface could, in principle, be used to control stem cell differentiation.

In summary, we have focused our attention on macromolecules at solid-liquid interfaces and measured the protein/polypeptide-surface interactions in order to engineer surfaces with particular properties for specific applications.