The importance of the surface charge in biomaterials applications

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Resumo:
Surface functional groups determine the charging behaviour of a material surface when the material gets in contact with an aqueous environment. The charging behaviour of material surfaces drives their interaction with solutes that are contained in an aqueous solution. The surface charge is thus significantly contributing to processes such as protein adsorption or biofilm formation. For the analysis of surface charge, the zeta potential at the material-water interface is commonly employed. For macroscopic solids, the zeta potential is determined from the measurement of the streaming potential. We present the application of the zeta potential to assess information about the surface charge of dental implants, such as titanium, stainless steel, or gold. The chemical behaviour of these metal surfaces differs primarily in their ability to form a native oxide layer. Stainless steel and gold are little prone to the formation of an oxide film. The water layer next to the pristine metal surface generates an interfacial charge that vanishes at pH 4. Titanium gets covered with a thin oxide film that introduces an amphoteric behaviour and shifts the isoelectric point to higher pH. In a second example we focus on soft contact lenses. Other than dental implants, soft contact lenses are applied temporarily, externally, and get in contact with tear liquid rather than with human tissue. However, despite of the comparatively short wear period of up to one month, biofilm formation on contact lens surfaces must be suppressed to ensure the comfort of wear. The zeta potential helps in the characterization of the contact lens material, in the analysis of the effect of storage solution, and in the detection of protein adsorption. We conclude with an outlook towards the analyses of other types of biomaterials, such as scaffolds for tissue engineering, the zeta potential analysis under physiological conditions, and the characterisation of protein adsorption and desorption kinetics.