Biopolymers and their potential application in biomedicine

Understanding interactions of solid biomaterials with living systems or their constituents (proteins, nucleic acids, oligo- and polysaccharide, lipids) is prerequisite for applications in regenerative medicine, as vascular grafts, as biosensors or as low protein fouling layers. In that respect polymeric thin films and coatings are useful for basic investigations of interactions due to their defined character, reproducible preparation and accessibility to modern surface analytical techniques. Among these techniques are atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS), quartz crystal microbalance (QCM-D), surface plasmon resonance (SPR) and fluorescence microscopy. Studying the surface properties of these materials allows for a correlation of the physicochemical composition, morphology and wetting, with polysaccharide, protein or living cells’ adhesion or growth on these materials. Polymeric biomaterials can further be coated on specific substrates or shaped into 3D printed, nano-fibrous or particulate objects useful for mentioned biomedical applications. Those materials can optionally be based on synthetic biodegradable polyesters (e.g. polycaprolactone, PCL), semi-synthetic polysaccharide derivatives bearing charges or hydrophobic moieties, or other naturally occurring polymers. This lecture will give examples on what kind of chemical reactions and surface modifications can be performed with biodegradable or bio-based polymers and how these materials can be processed into various shapes ranging from thin films to 3D printed objects. Besides processing, examples on detailed surface interaction studies will be given that elucidate large differences in the physicochemical characteristics of the materials. These differences are correlated with the response of living cells exposed to and grown on materials modified and processed with the knowledge obtained from basic surface and polymer analytical studies.

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