

Polyelectrolyte films with the „antifouling” properties

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The formation of bacterial slime or biofilms at the surface of biomaterials, e.g. diagnostic devices and a variety of biomedical implants, represents a major medical problem leading, if untreated, to chronic microbial infection. One of the most significant issue is the process of biofouling, i.e. the unwanted adsorption of proteins occurring at surfaces exposed to solutions containing biological material. Therefore, the development of the „antifouling” coatings protecting against non-specific protein adsorption or bacteria and fungi colonization are an important area of research within a broader field of biointerface science. The goal of our work was to develop the method for formation of ultrathin anti-adhesive coatings for biomedical applications. The Layer-by-Layer (LbL) technique of electrostatic self-assembly of charged nanoobjects has been proved to be a versatile technique for the formation of multilayer ultrathin films. The method is based on the sequential adsorption of the oppositely charged species on solid surfaces [1]. The „LbL” method, which is considered as one of the most promising techniques of surface modification, can be used for formation of those coatings.

Immobilization of neutral hydrophilic polymers (e.g. poly(ethylene glycol)) (PEG) at surfaces is one of the promising methods to reduce non-specific adsorption of proteins or microorganisms. Pegylation of polyelectrolyte films is expected to reduce/eliminate the non-specific adsorption of proteins at surface as well as the bacterial colonization of implanted materials. Synthesized copolymers of poly(glutamic acid) or poly(L-lysine) with grafted PEG chains with various grafting ratio and various PEG chain lengths were used for formation of the external pegylated layer of multilayer films. The synthesized copolymers were characterized by NMR method. The biofouling process was investigated by Quartz Crystal Microbalance (QCM) by studying the adsorption of different proteins: HSA, Fibrinogen as well as proteins from Human Serum. We found that pegylated films have antifouling properties decreasing adhesion of microorganism to the ultrathin films.

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[1] G. Decher, J. B. Schlenoff, Multilayer Thin Films Sequential Assembly of Nanocomposite Materials, 2002, ISBN 978-3-527-31648-9 - Wiley-VCH, Weinheim, Germany.