Fabrication of polysaccharide-based multilayer films with antibacterial properties

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Nowadays, one of the serious problems in regenerative medicine is implant-related infection originating from pathogenic microorganisms which adhere to the implant surface and form biofilm preventing penetration of antibiotics to the bacterial cells [1]. To solve this problem the surface of implants might be covered by antibacterial coatings [2]. A perspective technique for creation of multilayer films with tailored characteristics is layer-by-layer (LbL) assembly [3].

The aim of this study was to design ultrathin antibacterial coatings based on polysaccharides (pectin, chitosan) and their Ag-containing nanocomposites (pectin-Ag, chitosan-Ag) suitable for implant modification. Multilayer films were fabricated by LbL assembly and the process of their buildup was monitored by quartz crystal microbalance with dissipation [3]. To establish the influence of film compositions and physical-chemical properties on their antibacterial effect, the assembly of the different polycation/polyanion combinations yielded four chemically different multilayer: $(\text{chitosan/pectin})_{10}$, $(\text{chitosan-Ag/pectin})_{10}$, $(\text{chitosan/pectin-Ag})_{10}$, $(\text{chitosan-Ag/pectin-Ag})_{10}$, has been prepared.

The prepared multilayers showed high antibacterial activity against *E. coli* due to the antiadhesive and/or bactericidal behavior. Almost two-fold decrease in the number of the adhered *E. coli* was revealed for pectin-terminated LbL films. We observed a significant enhance in antibacterial activity for pectin-Ag-terminated coatings: the number of adhered *E. coli* was in 3–7 times lower compared with uncovered surface. A lot of damaged *E. coli* cells with irregular shape and cytoplasm leaking (from 47 to 89%) were observed on the surface of LbL films. At the same time, the multilayers showed a mild activity against *S. aureus* predominantly due to the antiadhesive effect. So, the prepared ultrathin LbL films based on chitosan, pectin and their nanocomposites with silver nanoparticles look as perspective materials for covering the surface of medical implants in order to reduce their bacterial contamination.

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References

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