Novel natural polymer coatings with self-renewable antimicrobial properties

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Microbial infectious diseases, occurring uponthe contamination of surfaces by a plethora of pathogens,constitute a growing threat to human health, with major risks in food packaging and storage, water filtration-purification, household sanitation and the biomedical field. Bacterial biofilm formationhas been identified as the profound event leading tomicrobial contaminated surfaces. This emerging threat has triggered researchtowards the development of effective,long-lasting and environmentally friendly bacteria elimination methods.

The aim of this work is to develop novel, biodegradable polymeric coatingsbased on modified natural polymers bearing environmentally and toxicologically friendly biocidal groups, able to self-polish and regenerate their antimicrobial activity upon repetitive bacterial fouling. Antibacterial quaternized chitosan (QCS) was prepared by modification of theprimary amine groups of the chitosan chains with a quaternary ammonium alkyl halide to enhance the water solubility andbiocidal action of the natural polymer. Polymer films were deposited and cross-linked, usinga water solubleand acid degradable cross-linker, in order to retain the film structureon silicon and glass substrates.The successful modification of chitosan was verified by proton nuclear magnetic resonance spectroscopy, whereas the thickness, wettability and morphology of the polymer films were assessed by ellipsometry, water contact angle measurements and scanning electron microscopy, respectively.The antimicrobial action of the polymer films was evaluated using two representative gram-positive and gram-negative bacteria strains. The controlled self-polishing and regeneration of the antimicrobial activity of the films wereinvestigated upon the gradual degradation of the cross-links by local pH changes induced by the bacterial cell death.

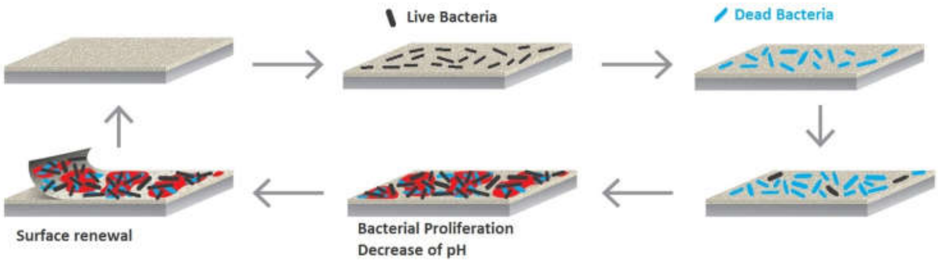

Figure 1: Schematic illustration of the bacterial death upon contact with the surface, the subsequent attachment of viable microbes and the regeneration of the biocidal surface.

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