Biocidal quaternized chitosan for self-polishing coating applications

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Antimicrobial surfaces that prevent biofouling from any type of microorganism are attractive in inhibiting the spread of microbial infections. Such surfaces either repel microbes, so they cannot attach to the surface, or kill microbes in the vicinity of the surface. Such contact-active antimicrobial surfaces can be realized by tethering antimicrobial polymers onto a surface. Biocidal surfaces are continuously being developed for a plethora of applications spanning from biomedical tools, packaging, marine technology and navigation.
In this work, we have developed novel, biodegradable polymeric coatings based on modified chitosan bearing environmentally and toxicologically friendly biocidal groups. These coatings are able to self-polish and regenerate their antimicrobial activity upon repetitive bacterial fouling. The primary amine contained in the chitosan monomeric unit was modified with a quaternary ammonium alkyl halide in order to introduce biocidal units. Furthermore, this modification enhancing the solubility of the chitosan in water. Modified chitosan, along with an acid-labile acetal-based bifunctional alkyl halide, were deposited in glass and silicon 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 were investigated.

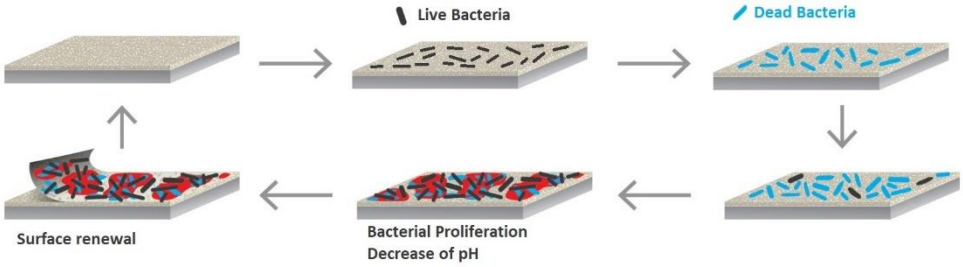

Figure 1: Schematic illustration of the bacterial death upon contact with the surface, the subsequent attachment of viable microbes and the regeneration of the biocidal surface.

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