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Multi-functional antimicrobial surface coatings

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INTRODUCTION: Antimicrobial surfaces that prevent biofouling from any type of microorganism are attractive in inhibiting the spread of microbial infections. Antibacterial surfaces are continuously being developed for a plethora of applications spanning from biomedical tools, packaging, marine technology and navigation.

METHODS: The primary amine groups along the main chain of chitosan were transformed into biocidal, cationic quaternary ammonium salt moieties upon reaction with alkyl halides. The degree of quaternization of chitosan was determined by proton nuclear magnetic resonance spectroscopy. Furthermore, this modification reaction enhanced the solubility of chitosan in water. Modified chitosan and an acid-labile acetal-based bifunctional alkyl halide, to act as a cross-linker of the polymer, were deposited and reacted on glass and silicon substrates. The thickness, wettability and morphology of the polymer films were assessed by ellipsometry, water contact angle measurements and scanning electron microscopy, respectively.

RESULTS: 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 antimicrobial action of the polymer films was evaluated using two representative gram-positive and gram-negative bacteria strains. The controlled self-polishing behavior and the regeneration of the antimicrobial activity of the polymer films were investigated.

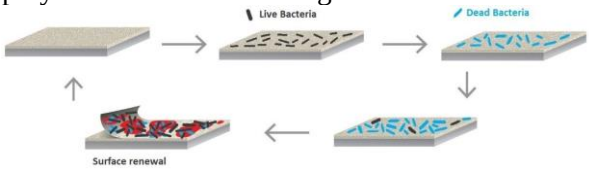

Figure 1: Schematic illustration of the bacterial death upon contact with the surface and the regeneration of the biocidal surface.

DISCUSSION & CONCLUSIONS: Chitosan was modified by reaction with alkyl halides to introduce cationic, biocidal groups along the polymer chain. The modified chitosan films were cross-linked using an acid-degradable acetal-based cross-linker. The antimicrobial activity of the cross-linked chitosan thin films was tested against both Gram-positive and Gram-negative bacteria and their self-polishing behavior was monitored in aqueous media by ellipsometry.

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