Dual-function contact-active antimicrobial polymer coatings

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Antimicrobial surfaces that prevent biofouling are attractive in inhibiting the spread of microbial diseases. Two types of antimicrobial surfaces have been developed. Antifouling surfaces that repel microorganisms, so they cannot attach to the surface, and bactericidal surfaces which kill microbes in the vicinity of the surface [1]. Contact-active antimicrobial surfaces have been realized by tethering antimicrobial polymers onto a substrate and are continuously being developed for a plethora of applications spanning from biomedical tools, packaging materials, marine technology and navigation [2].
The aim of the present work is the development of versatile, multi-functional polymer surfaces exhibiting controllable antimicrobial properties in the solid state. For this purpose, two types of polymeric materials were developed comprising (i) antifouling-bactericidal polymer brushes and (ii) self-polishing-bactericidal polymer films. Semi-fluorinated mixed amphiphilic polymer brushes were grown on silicon substrates by surface-initiated atom transfer radical polymerization (SI-ATRP). In addition, symmetric amphiphilic diblock copolymers comprising a hydrophobic and hydrolysable block and a hydrophilic polyamine block were synthesized by group transfer polymerization (GTP). Several alkyl halides were evaluated for the quaternization of the tertiary amine units of the hydrophilic polymer chains in order to introduce the optimum cationic biocidal groups along the polymer chains. The solvent responsive behavior of the polymer brushes and their bactericidal activity for both Gram-positive and Gram-negative bacteria strains were evaluated. On the other hand, the ability of the quaternized diblock copolymer thin films to form lamellae oriented parallel to the substrate, their bactericidal activity for both bacteria strains and the self-polishing properties of the ordered films were assessed. Overall, these polymer surfaces exhibit profound antifouling-biocidal and biocidal-self-renewal properties, respectively, which prolong their antimicrobial performance.

References

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