Opto-electronically active materials for infection control

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This talk will present how our merger of organic bioelectronics and bacterial infection biology has opened exciting, new opportunities for infection control.[1,2] Our approach takes advantage of the electro-catalytical properties of conductive polymers for mutual communication between bioactive surfaces and bacterial cells growing in liquid culture and biofilm. Biofilm forms when free-living planktonic bacteria undergo a phenotypic transition, producing dense bacterial aggregates embedded in extracellular matrix. We take advantage of the dual organic-conductive nature of electrically conducting oligomers and polymers to develop novel materials and strategies to control biofilm formation and diagnose infections. Based on the conducting polymer poly(3,4-ethylenedioxythiophene (PEDOT), we show how PEDOT can be used for rapid and sensitive potentiometric sensing of bacteria in liquid cultures via their secreted redox active compounds.[3] We also show that PEDOT can act as an electron mediator for bacterial metabolism, demonstrating how growth of *Salmonella* biofilm can be modulated by the electrochemical state of the polymer.[4] By functionalizing PEDOT with biocide agents, the material showed efficient antimicrobial activity as a surface coating.[5] This was illustrated in PEDOT functionalized with silver nanoparticles (AgNP), where a synergistic effect of AgNP and the electrical input nearly completely prevented growth of *Staphylococcus aureus*. To overcome the lack of methods for specific reporting of the biofilm life style, we developed methods for specific detection of extracellular matrix components. Utilising the opto-electronic nature of conjugated oligothiophenes, we established 'optotracing' as a non-toxic, fluorescence-based method for identification of ECM components, such as amyloid curli fibers and cellulose both in liquid cultures as well as at the air-solid interface in real-time.[6] Optotracing for cellulose was further applied in a culture-independent diagnostic assay for biofilm-related urinary tract infection caused by uropathogenic *E. coli*.[7] Currently, we are extending the applicability of optotracing technology for automated biofilm diagnostics and point-of-care bacteria identification.

References

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