Effectiveness and Stability of OptiChem® Poly (ethylene glycol) - Coatings Against Bacterial Adhesion

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Statement of Purpose: OptiChem® (Accelr8 Technology Corporation. Denver, USA), is a poly (ethylene glycol) based polymer coating, developed to inhibit non-specific biomolecular adsorption and cell binding. OptiChem® is composed of three core coating components all mixed into one carrier solvent. Therefore, it can be easily applied with conventional industrial processing techniques in a single step and is compatible with diverse substrates, including glass, metals (indium tin oxide), plastics (tissue culture polystyrene dishes), and silicone, making it an interesting coating for surface modification to reduce bacterial adhesion. The aim of this study was to determine the effectiveness of OptiChem® coatings against adhesion of different clinically isolated bacterial strains involved in biomaterial centered infections. Furthermore, stability of OptiChem® in physiological fluids at different time intervals was investigated.

Methods: Effectiveness of OptiChem® coating against adhesion of *Staphylococcus epidermidis* 3399, *Staphylococcus epidermidis* HBH 276, *Streptococcus salivarius* GB24/9, *Escherichia coli* O2K2 and *Pseudomonas aeruginosa* # 3 was determined in a parallel plate flow chamber under the influence of different shear rates: 70, 16, 5 and $2s^{-1}$. To assess the strength of bacterial adhesion, an air bubble was passed through the chamber at the end of an experiment, which caused a detachment force on adhering micron-sized particles. All adhesion data on OptiChem® coated glass were compared for each bacterial strain with its adhesion to bare glass. Experiments were carried out at least three times with separately grown microorganisms and new OptiChem® coated glass slides. Stability of the coating was assessed by evaluating the adhesion of *S. epidermidis* 3399 (as described above) after the coating was exposed to human saliva, human urine, human blood plasma and PBS for 24, 48 or 168 hours at 25°C. Chemical changes occurring during exposure to the different physiological fluids were determined using XPS. Stability experiments were carried out in single fold.

Results/discussion: Adhesion experiments in PBS buffer showed that bacterial adhesion on OptiChem® was less than adhesion on glass (Fig 1). This indicates that OptiChem® is effective against the adhesion of these specific strains. Additionally, OptiChem® contributed to a reduction of more than 80% in bacterial attachment in relation to glass after the passage of the air bubble. The numbers of organisms present before and after the passage of a liquid-air interface can be determined as a measure of the strength of microbial adhesion (Busscher H.J, Van der Mei H.C. Clin Microbiol Rev. 2006; 19:127–141). Most bacteria adhered to OptiChem® were removed, whereas on glass only minor detachment of bacteria was seen. Therefore, these results suggest that as far as adhesion of the strains used in this study on OptiChem® was found, this adhesion can be considered weak since removal of bacteria after the bubble passage was remarkably high in relation to glass. However, one exception was observed with *E. coli* O2K2. Although this strain adhered more to glass than to OptiChem®, *E.coli* O2K2 detached more easily from glass than from OptiChem® indicating a strong adhesion on the polymer coating.

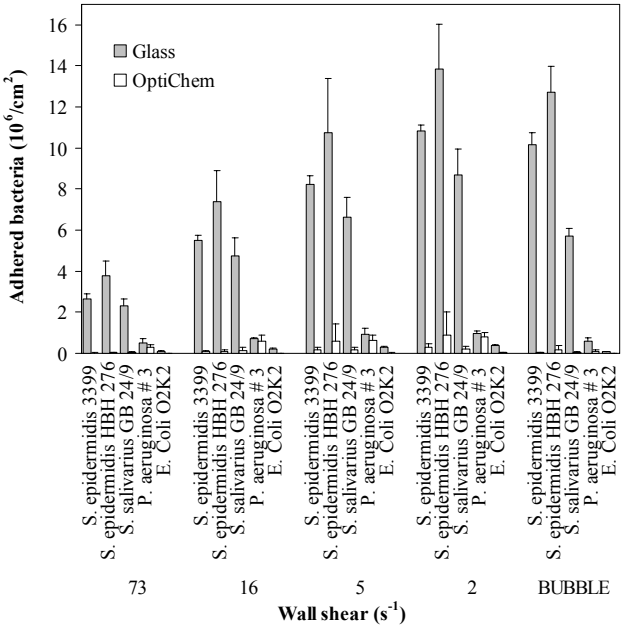

Figure 1. Bacterial adhesion on OptiChem® and on glass

Effectiveness of OptiChem® after exposure for 24, 48 and 168 hours in PBS and urine was demonstrated, however it was significantly reduced when exposed to saliva and blood plasma, probably this occurred due to accumulation of proteins on the surface which reduced the antimicrobial effect of OptiChem®. Stability of OptiChem® in all physiological fluids was determined with XPS experiments. Results showed that the composition of the samples at different times intervals remained relatively constant, indicating that OptiChem® did not degrade.

Conclusions: Our findings suggest that OptiChem® coating may be beneficial for the prevention of bacterial adhesion and therefore the prevention of biomaterial centered infections. However, the effects of physiological environments on the coating require more investigation.