ENHANCED ANTI-BIOFILM AND ANTI-PROTEIN ADSORPTION PROPERTIES OF LIQUID-INFUSED SILVER-POLYTETRAFLUOROETHYLENE COATINGS

Ruolan, Chen.[1], Xiao,Teng. [2], Coin P. McCoy.[3], Shuai, Zhang.[4]
[1] School of Pharmacy, Queen's University Belfast, BT9 7BL Belfast, UK
email: shuai.zhang@qub.ac.uk

INTRODUCTION

Medical device-associated infections (MDIs) remain a major concern globally. As a basic survival strategy, microorganisms tend to colonise and grow on surfaces, in the form of biofilms. Current strategies to prevent MDIs mainly include antimicrobial, anti-adhesive, and combinatorial approaches. However, their long-term use in biomedical applications and the emergence of silver/antibiotic-resistant pathogenic bacteria remain to be addressed. On exposure to a complex physiological environment, proteins may rapidly adsorb onto device surfaces and redefine the surface properties, acting as a conditioning film and affecting bacterial adhesion.

METHODS

A slippery liquid-infused silver-polytetrafluoroethylene (AgFP) coating was fabricated via a spontaneous polycondensation of 1H,1H,2H,2H-perfluorooctyltriethoxysilane (PFOTES) onto an electroless AgF sublayer. The anti-biofouling properties were investigated by adsorption of Escherichia coli, Staphylococcus aureus, fibrinogen, and bovine serum albumin.

RESULTS

As evident after 24 h of co-culture with E. coli or S. aureus, the Ag and AgF surfaces still demonstrated extensive bacterial adhesion (Fig. 1). The incorporation of PTFE particles altered the anti-adhesion efficacy after and minimum bacterial adhesion was observed when the PTFE concentration reached 10 mL/L (AgF-2), reducing 60.6% and 30.3% of E. coli adhesion, 51.9% and 22.1% of S. aureus adhesion, respectively, when compared with SS and Ag coating. Notably, a further ~70% reduction in CFU was observed on the AgFP coating regardless of its weakest anti-bacterial activity. The results suggest that the liquid-like AgFP surface could effectively reduce bacterial accumulation and inhibit biofilm formation.

To mimic the complexities of the biological environment, the antibiofilm performance of the coatings was challenged with a protein-bacteria co-deposition model. The AgF-2 coating with verified best anti-adhesion performance (Fig. 1) was used as a reference. After introducing proteins into the media, all the surfaces experienced a dramatic increase in biofilm coverage (Fig. 2).

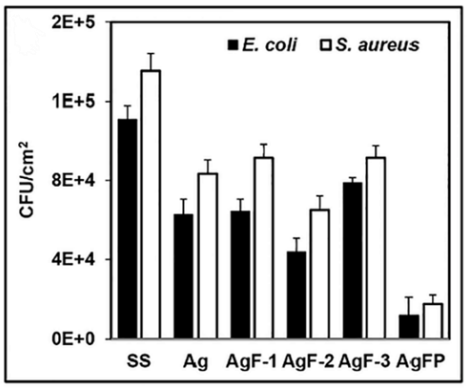

Figure 1 Quantitative counts of viable bacterial cells adhering to different surfaces after 24 h of incubation.

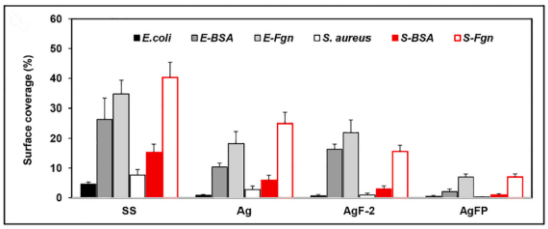

Figure 2 comparison of surface coverage of biofilm on different coatings after 24 h (n = 6, bars represent standard deviation of the mean).

CONCLUSION

In summary, compared with traditional Ag and AgF coatings, the AgFP coating showed ultralow adhesion for both bacteria and proteins. Protein-bacteria co-deposition experiments showed that the AgFP coating was able to significantly inhibit biofilm formation in near-real conditions.

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