



**QUEEN'S
UNIVERSITY
BELFAST**

Enhanced anti-biofilm and anti-protein adsorption properties of liquid-infused silver-polytetrafluoroethylene coatings

Chen, R., Teng, X., McCoy, C. P., & Zhang, S. (2023). *Enhanced anti-biofilm and anti-protein adsorption properties of liquid-infused silver-polytetrafluoroethylene coatings*. Paper presented at Northern Ireland Biomedical Engineering Society Annual Symposium 2023, Belfast, United Kingdom.

Document Version:

Publisher's PDF, also known as Version of record

Queen's University Belfast - Research Portal:

[Link to publication record in Queen's University Belfast Research Portal](#)

Publisher rights

Copyright 2023 The Authors.

General rights

Copyright for the publications made accessible via the Queen's University Belfast Research Portal is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The Research Portal is Queen's institutional repository that provides access to Queen's research output. Every effort has been made to ensure that content in the Research Portal does not infringe any person's rights, or applicable UK laws. If you discover content in the Research Portal that you believe breaches copyright or violates any law, please contact openaccess@qub.ac.uk.

Open Access

This research has been made openly available by Queen's academics and its Open Research team. We would love to hear how access to this research benefits you. – Share your feedback with us: <http://go.qub.ac.uk/oa-feedback>

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).

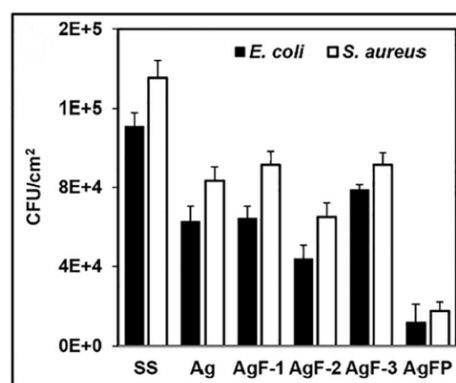


Figure 1 Quantitative counts of viable bacterial cells adhering to different surfaces after 24 h of incubation.

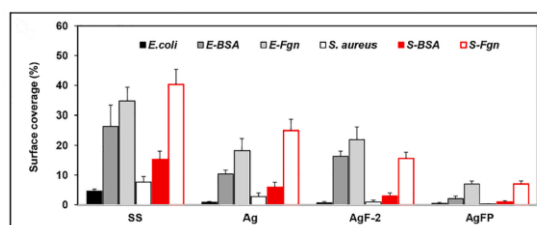


Figure 2 comparison of surface coverage of biofilm on different coatings after 24 h (n = 6, bars represent standard deviation of the mean).

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.

REFERENCES

- Dunne, W. M., Bacterial adhesion: seen any good biofilms lately? Clin. Microbiol. Rev. 15 (2): 155–166, 2002.
- P. Singha (et al.), A review of the recent advances in antimicrobial coatings for urinary catheters, Acta Biomater. 50: 20–40, 2017.
- J. Palmer (et al.), Bacterial cell attachment, the beginning of a biofilm, J. Ind. Microbiol. Biotechnol. 34 (9): 577–588, 2007.