# Antibacterial hydrogel particle surface-modified poly(dimethylsiloxane) for biomedical applications

A. Stepulane[1,2], A. K Rajasekharan[2], M. Andersson[1,2]

[1] *Department of Chemistry and Chemical Engineering, Chalmers University of Technology, Gothenburg, SE,* [2] *Amferia AB, AZ BioVentureHub, Mölndal, SE*

**INTRODUCTION:** Due to its excellent mechanical properties and biocompatibility poly(dimethysiloxane) (PDMS) elastomer is an indispensable tool in production of medical devices. However, PDMS is prone to protein adsorption, bacterial attachment, and infection formation exacerbating medical device associated infection risks. Consequently, antibacterial surface modifications of PDMS are long sought after. Here, PDMS surface modification with amphiphilic hydrogel microparticles in combination with covalently immobilized antibacterial peptides (AMP) is introduced [1]. The study demonstrates the use of AMPs, broad-spectrum antibacterial agents, in coating formulation as an alternative to conventional antibiotics to prevent biomaterial-associated infections.

**METHODS:** Amphiphilic hydrogel microparticles were prepared by top-down methods from self-assembled lyotropic liquid crystal hydrogels, based on polymerizable versions of triblock Pluronic F127 copolymers. The intrinsic amphiphilicity facilitated the particle immobilization onto solid PDMS substrates via dip-coating the substrates in PDMS prepolymer, followed by subsequent particle deposition and heat curing. The formed particle coatings were rehydrated in aqueous media, followed by covalent AMP attachment to the hydrogel network via carbodiimide crosslinker chemistry and peptide bond formation. The antibacterial activity of the formed coatings was evaluated against gram-positive *S. epidermidis and S. aureus* bacteria species. Coating properties were characterized with water contact angle measurements (WCA), x-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM) and Raman spectroscopy.

**RESULTS:** Coating characterization with WCA displayed contact angle reduction from 99.5 ± 3.4° of pristine PDMS to 30.3 ± 11.6° of hydrogel particle coated PDMS, resulting in surface wetting. XPS surface scans of AMP modified coatings exhibited presence of nitrogen (1s) when compared to AMP-free coatings, indicating peptide integration. Raman displayed AMP presence in the AMP particle coating. Microbiological assessment resulted in bacteria colony forming unit (CFU) count reduction on AMP modified surfaces, by 99.6 % and 94.5 % for *S. epidermidis* and *S. aureus*, respectively in comparison to control (AMP-free) coatings.

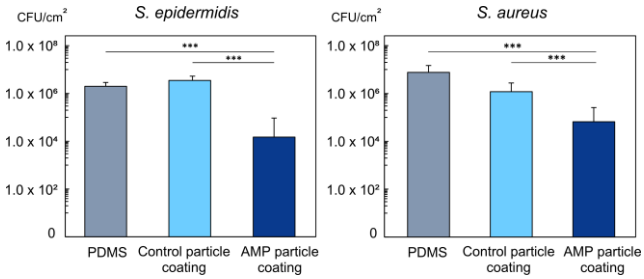


*Fig. 1: Antibacterial activity against S. epidermidis and S. aureus, of the AMP particle coating, control particle coating and pristine PDMS. *** indicates $p \leq 0.001$.*

**DISCUSSION & CONCLUSIONS:** Successful PDMS surface modification with AMP functionalized hydrogel microparticle coating is demonstrated, proving highly efficient against gram-positive *S. epidermidis* and *S. aureus* bacteria species with potential material applicability in antibacterial elastomer production for medical devices.

**ACKNOWLEDGEMENTS:** The authors would like to thank the Wallenberg Foundation and the Chalmers Area of Advance "Materials Science" for funding.

**REFERENCES:** [1] A. Stepulane, A. K. Rajasekharan, M. Andersson. "Multifunctional Surface Modification of PDMS for Antibacterial Contact Killing and Drug-Delivery of Polar, Nonpolar, and Amphiphilic Drugs," *ACS Applied Bio Materials*, 2022.