

Antimicrobial Activity of PILs-based Hydrogels and <u>Their Corresponding Monomers</u> <u>A. Jastram<sup>1</sup></u>, J. Claus<sup>1,2</sup>, R. Bucki<sup>3,4</sup>, P. Janmey<sup>5</sup>, U. Kragl<sup>1,2</sup> <sup>1</sup>University of Rostock, Institute of Chemistry, Albert-Einstein-Straße 3A, 18059 Rostock, Germany <sup>2</sup>University of Rostock, Department Life, Light & Matter, Albert-Einstein-Straße 25, 18059 Rostock, Germany <sup>3</sup>Department of Microbiological and Nanobiomedical Engineering, Medical University of Bialystok, ul. Mickiewicza 2C, Bialystok 15-222, Poland

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## Introduction

Nowadays, infections of pathogenic microorganisms are again a concern to patient and food safety as well as public health in general.<sup>[1]</sup> Facing this problem, demands the design and synthesis of novel antibacterial macromolecules. Polymerised ionic liquids (PILs)-based materials have shown interesting potential in this field as they are versatile and able to be adapted to different morphologies, sizes and surface charges.<sup>[2]</sup> Thus, antimicrobial activity of eleven PILs-based hydrogels as well as their corresponding monomers was examined by using the methicillin-resistant *Staphylococcus aureus*, known as MRSA, and *Pseudomonas aeruginosa*. Both are typical representatives of gram-positive and gram-negative bacteria, respectively.<sup>[3]</sup>

## **Results and Discussion**



## Effect on S. aureus

In both cases, A and B, the imidazolium-based hydrogels showed the highest activity (at least 95% killed CFU/mL) against *S. aureus*. Anionic and zwitterionic monomers had just a low effect on the bacterial growth. It is noticeable that the hydrogels generally had a higher antimicrobial activity compared to the monomers.

A - Monomers

## Effect on P. aeruginosa

All tested monomers showed antimicrobial activity against *P. aeruginosa* as a typical gram-negative bacterium. A particularly high efficiency was observed in the use of the cationic monomers. This coincides with the hydrogel results. Here only the cationic representatives showed an effect, whereas anionic, neutral and zwitterionic gels seemed to have no influence. **A - Monomers** 



Fig. 1: Overview of the monomers used within this study.

To scan a wide range of possibly new antimicrobial materials, a variety of cationic, anionic, neutral as well as zwitterionic monomers was chosen (Fig. 1). Generally, hydrogels are built up by 3D-crosslinked polymeric structures, consisting of a monomer and a curing agent. Different types of crosslinking (physically or chemically) are commonly known. In this work, these highly functionalised polymeric materials were easily synthesised via radical polymerisation of a vast selection of monomers and the crosslinker MBis (Fig. 2).







50 µL bacteria stock solution (ca. 105 CFU/mL) with 50 µL monomer; **B** CL/MBis; **C** polymerization reactants ammonium 50 µL bacteria stock solution (ca. 105 CFU/mL) with 50 µL monomer solution; **B** 500  $\mu$ L bacteria stock solution (ca. 105) persulfate (APS) and N,N,N',N'-Tetramethylethane-1,2-diamine monomer solution; **B** 500  $\mu$ L bacteria stock solution (ca. 105) CFU/mL), 100  $\mu$ L washed hydrogel and 400  $\mu$ L PBS1X. CFU/mL), 100  $\mu$ L washed hydrogel and 400  $\mu$ L PBS1X. (TEMED); **D** PILs-based hydrogel. P. aeruginosa Summary S. aureus >>> Five of eleven monomers killed >50% CFU/mL Ten of eleven monomers killed >50% CFU/mL Just three monomers showed nearly no influence ( $\leq 15\%$  CFU/mL)  $\succ$  All cationic species showed antimicrobial activity (killed  $\geq$ 75% CFU/mL) All tested hydrogels killed at least 77% CFU/mL Best results achieved by using imidazolium-based hydrogels References **Acknowledgements:** Scan this for PDF Financial support by the German [1] Z. Zheng, Q. Xu, J. Guo, J. Qin, H. Mao, B. Wang, F. Yan, ACS applied materials & interfaces 2016, **Research Foundation (Deutsche** 8, 12684. Forschungsgemeinschaft, grant [2] A. Muñoz-Bonilla, M. Fernández-García, *European Polymer Journal* 2018, 105, 135. number: 61350094) is gratefully [3] A. Muñoz-Bonilla, M. Fernández-García, Progress in Polymer Science 2012, 37, 281. acknowledged.