

Antimicrobial Chitosan-PVA Cryogels with Tailored Nanosilver for Treating Infected Wounds

Maria Samara^{1,2}, Reshma V. Ramachandran^{1,2}, Jennifer Geara³, Georgios A. Sotiriou^{1,2} and Ning Xu Landén³

¹Department of Chemistry, Stockholm University, Sweden
²Department of Microbiology, Tumor and Cell Biology, Karolinska Institutet, Sweden
³Unit of Dermatology, Department of Medicine, Karolinska Institutet, Sweden



Background

Chronic wounds

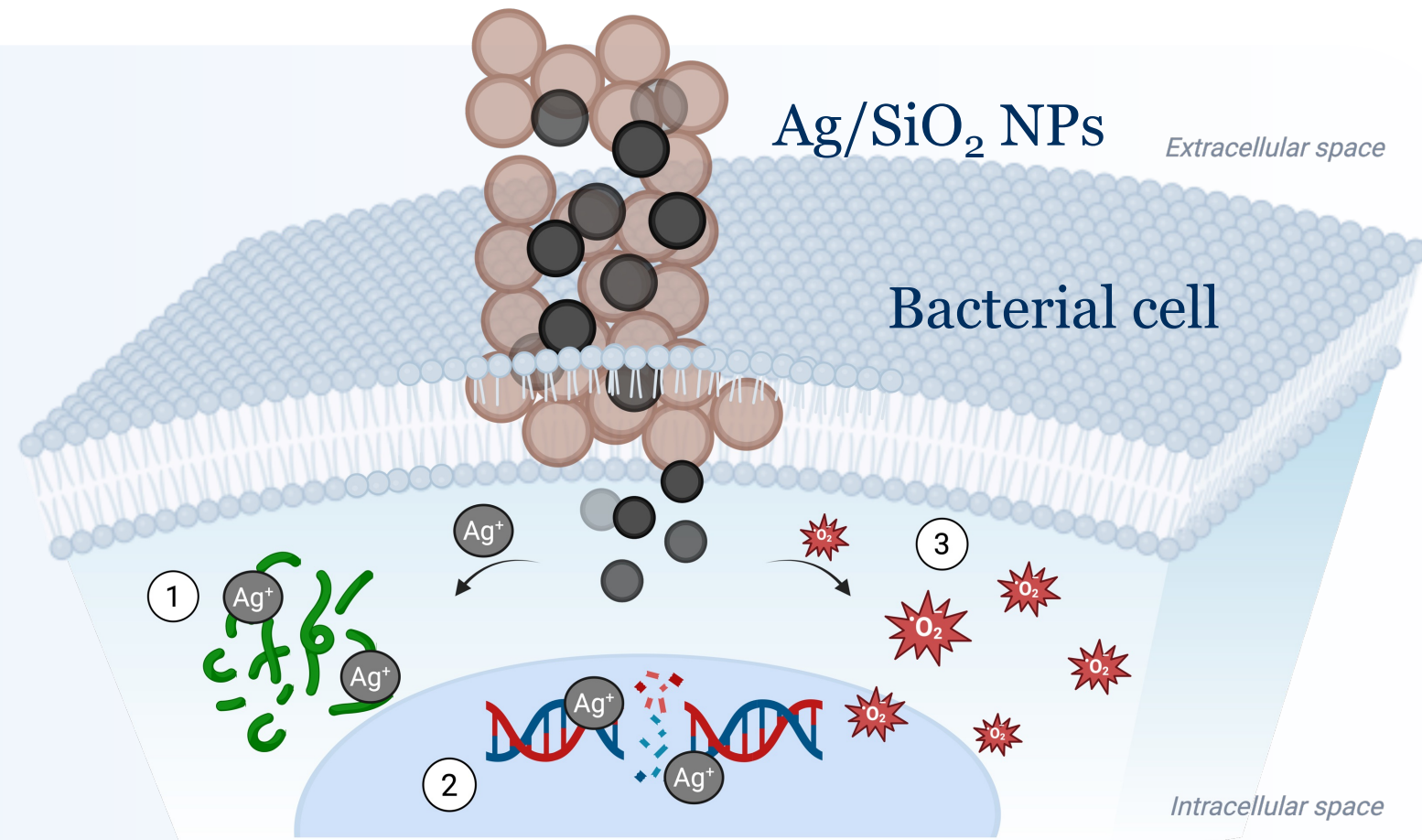
- 40M+ people globally¹
- 20% of diabetic patients
- Risks: Infection, amputation, death²
- Huge economic burden (billions annually)²

Clinical Challenges³

- Biofilms hard to combat
- Frequent dressing changes disrupt tissue regeneration
- Antibiotic resistance

Nanoparticle antibacterial mechanism⁴

1. Protein degradation
2. DNA damage
3. ROS generation

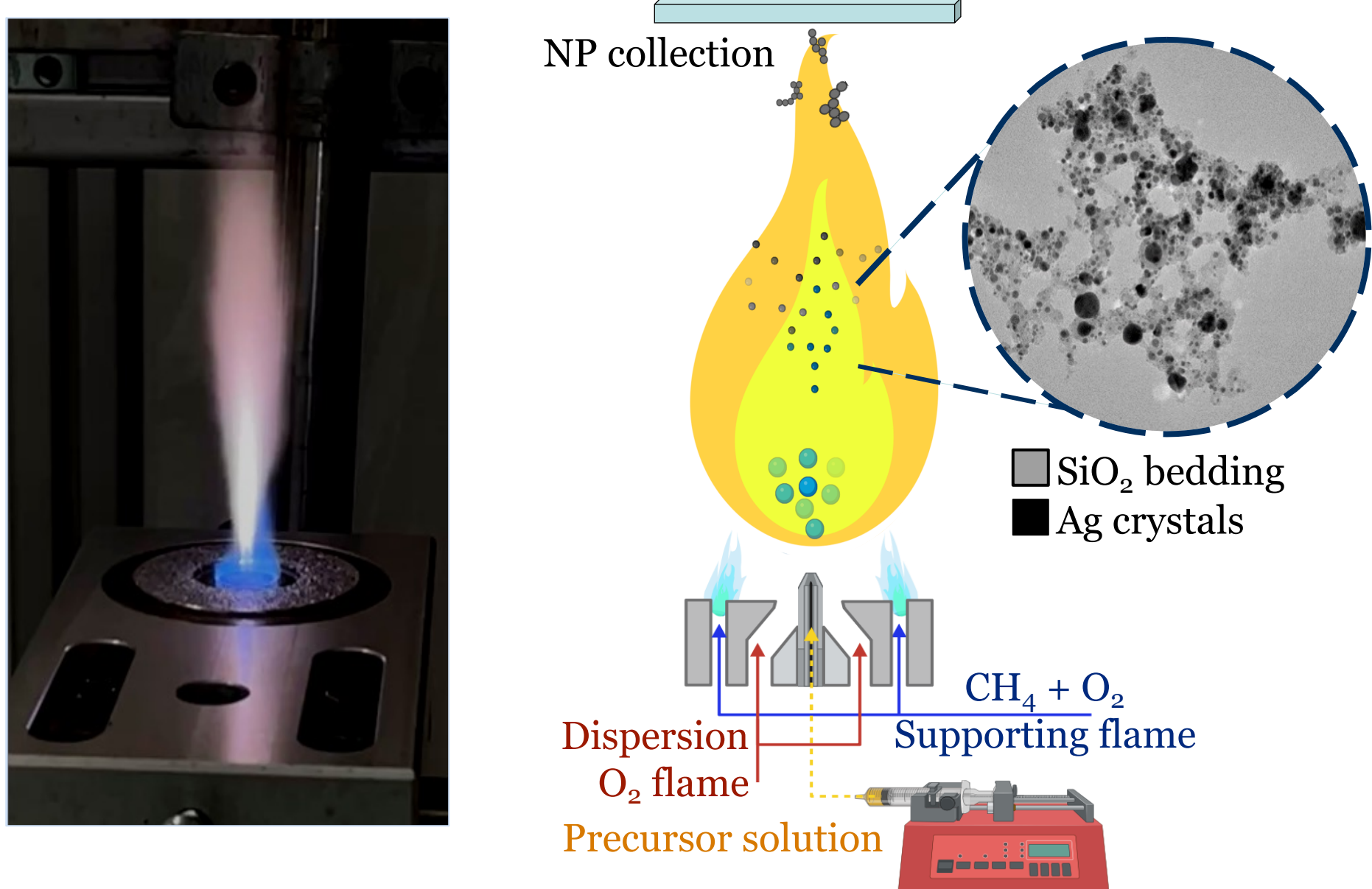


Materials and Methods

Ag/SiO₂ Nanoparticle synthesis: Flame spray pyrolysis

- ✓ Scalable
- ✓ Fast and efficient
- ✓ Highly reproducible
- ✓ Tailored particle properties

Fractal-like Ag/SiO₂ nanoparticles synthesized in a one-step-process:

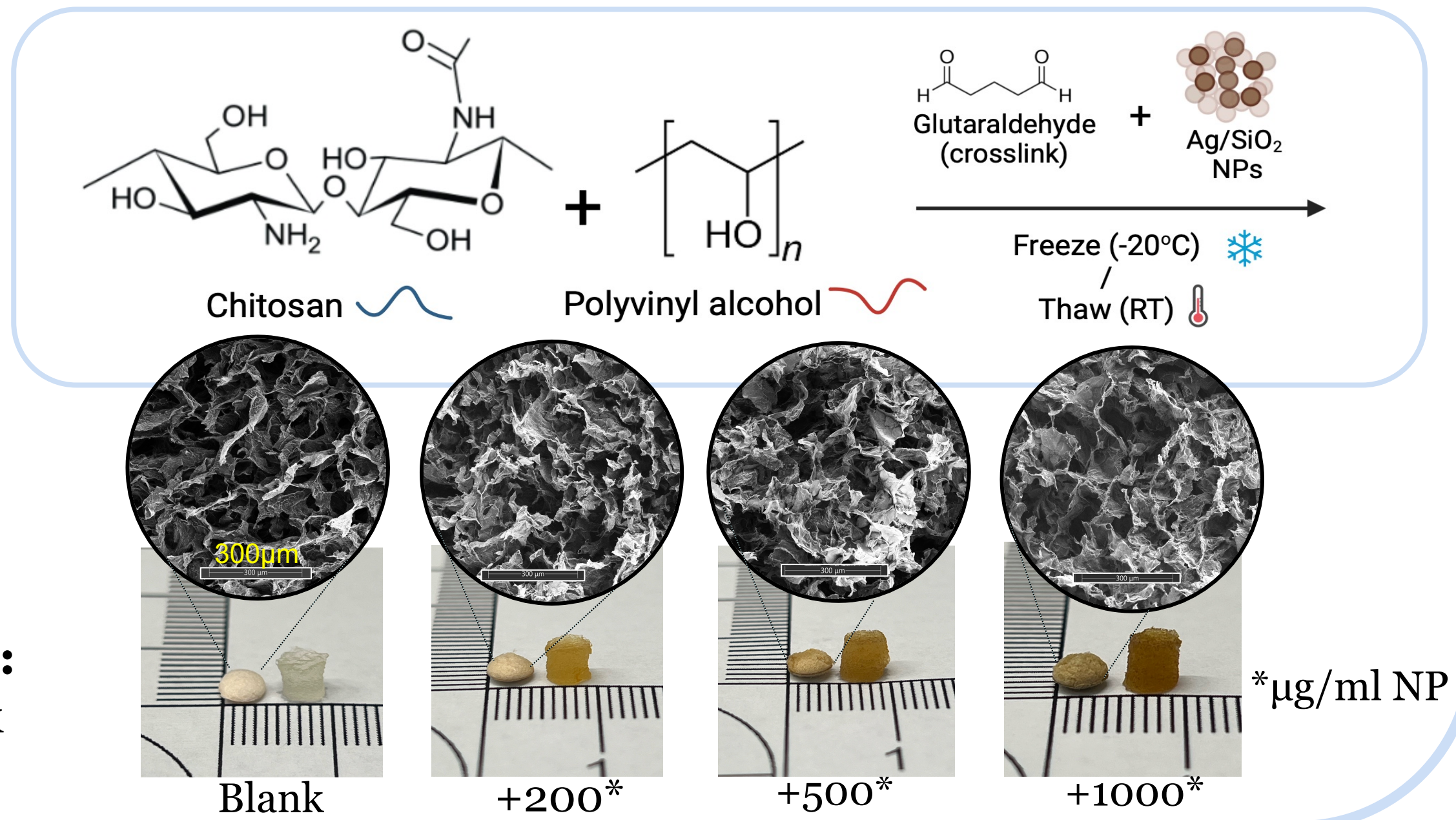


Chitosan/Polyvinyl alcohol Nanoparticle-cryogels

Chitosan (CS): antimicrobial properties

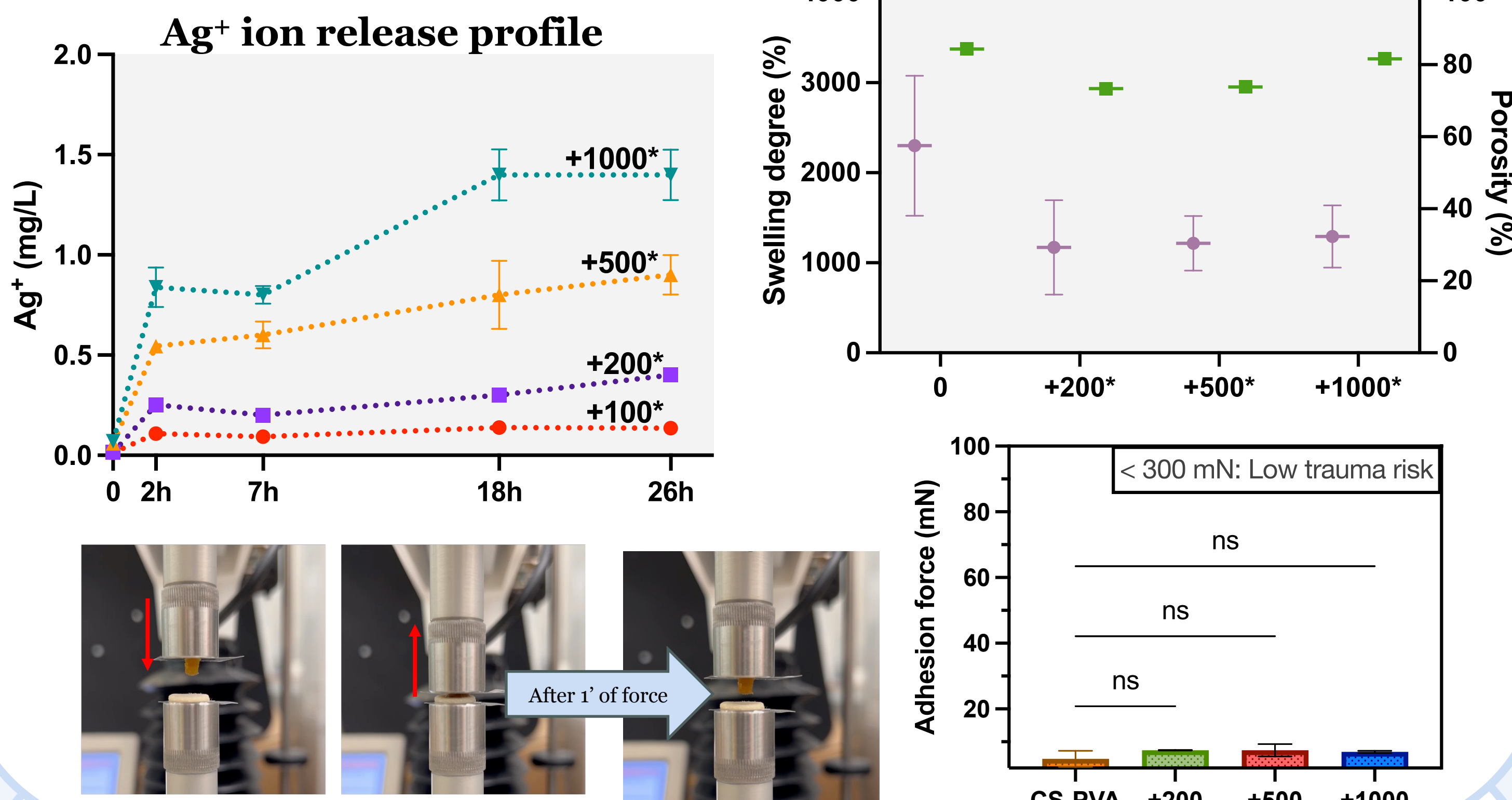
Polyvinyl Alcohol(PVA): mechanical stability and flexibility

Freeze-thaw cycles: macroporous network

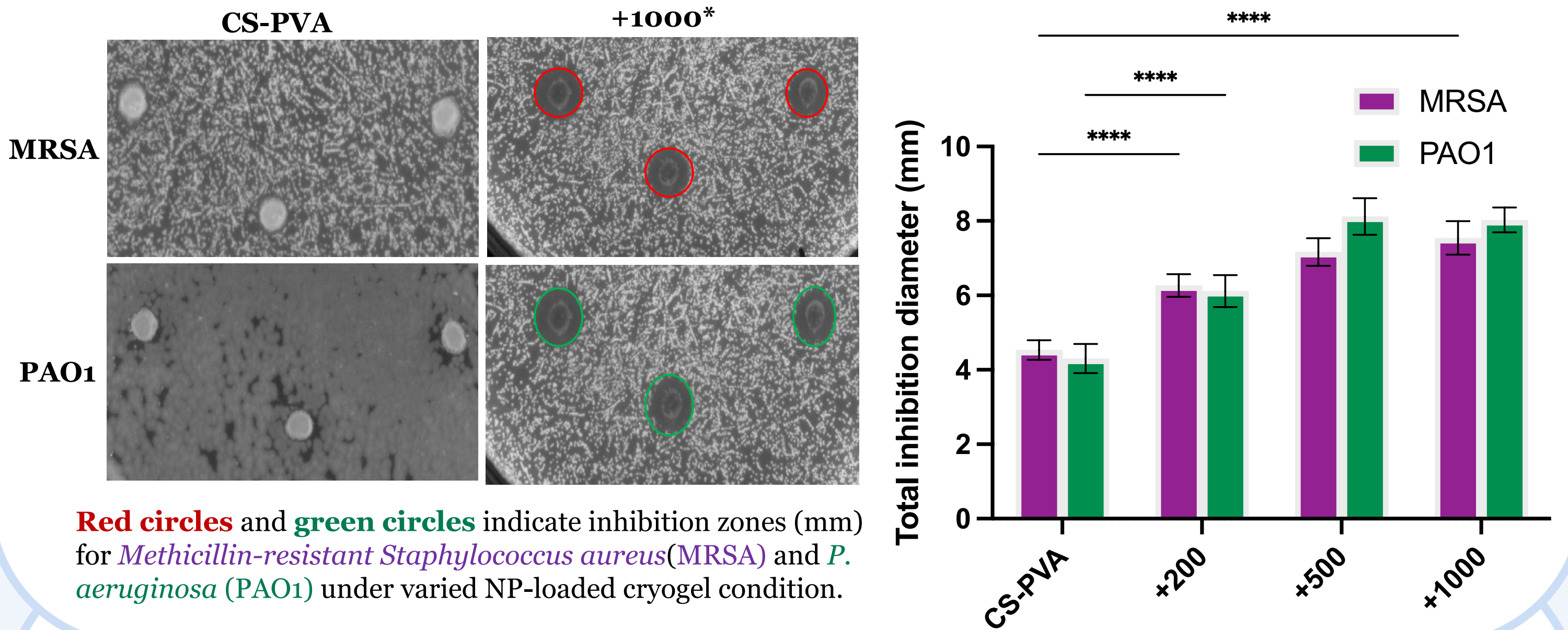


Results

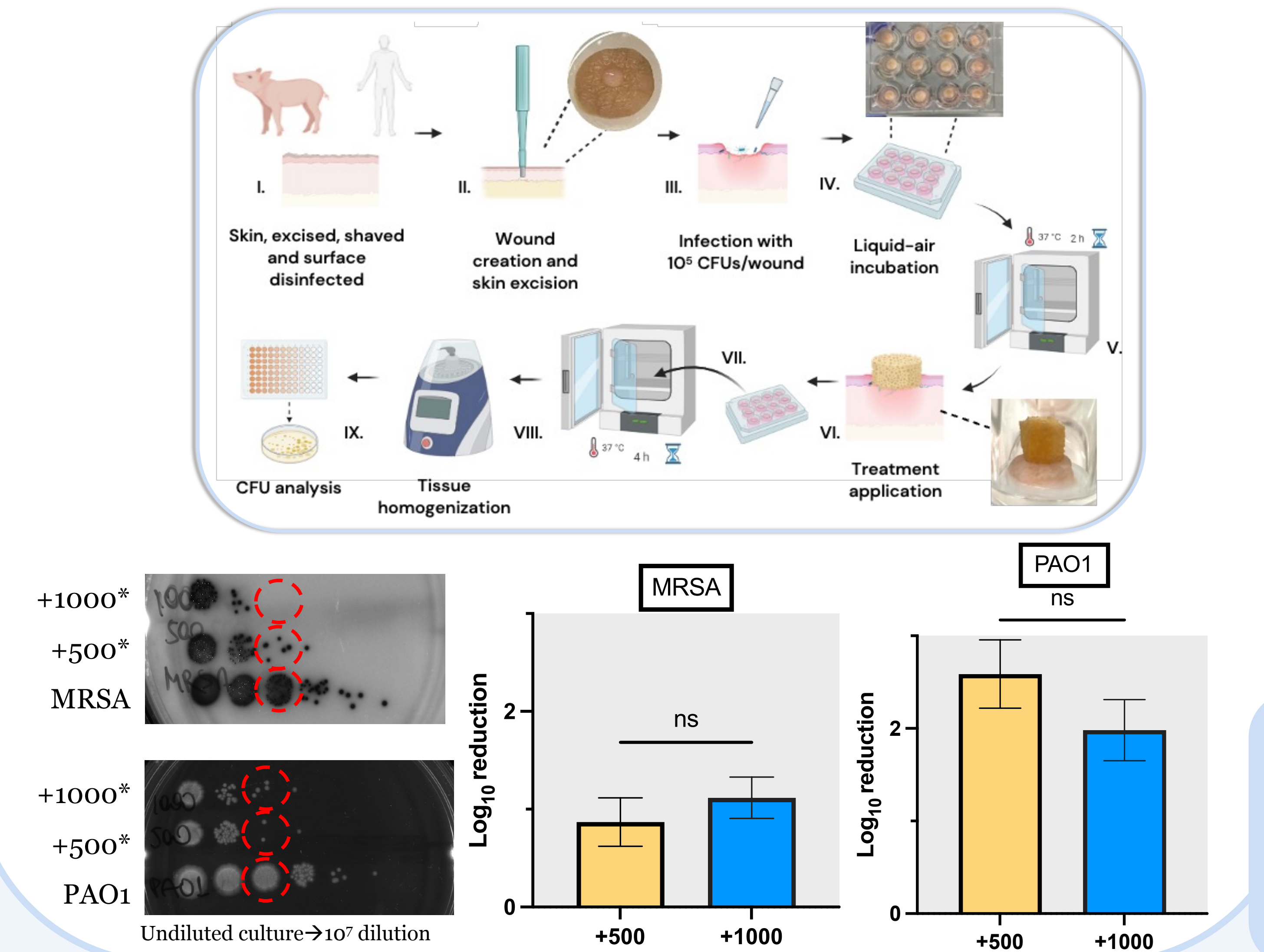
Mechanical properties



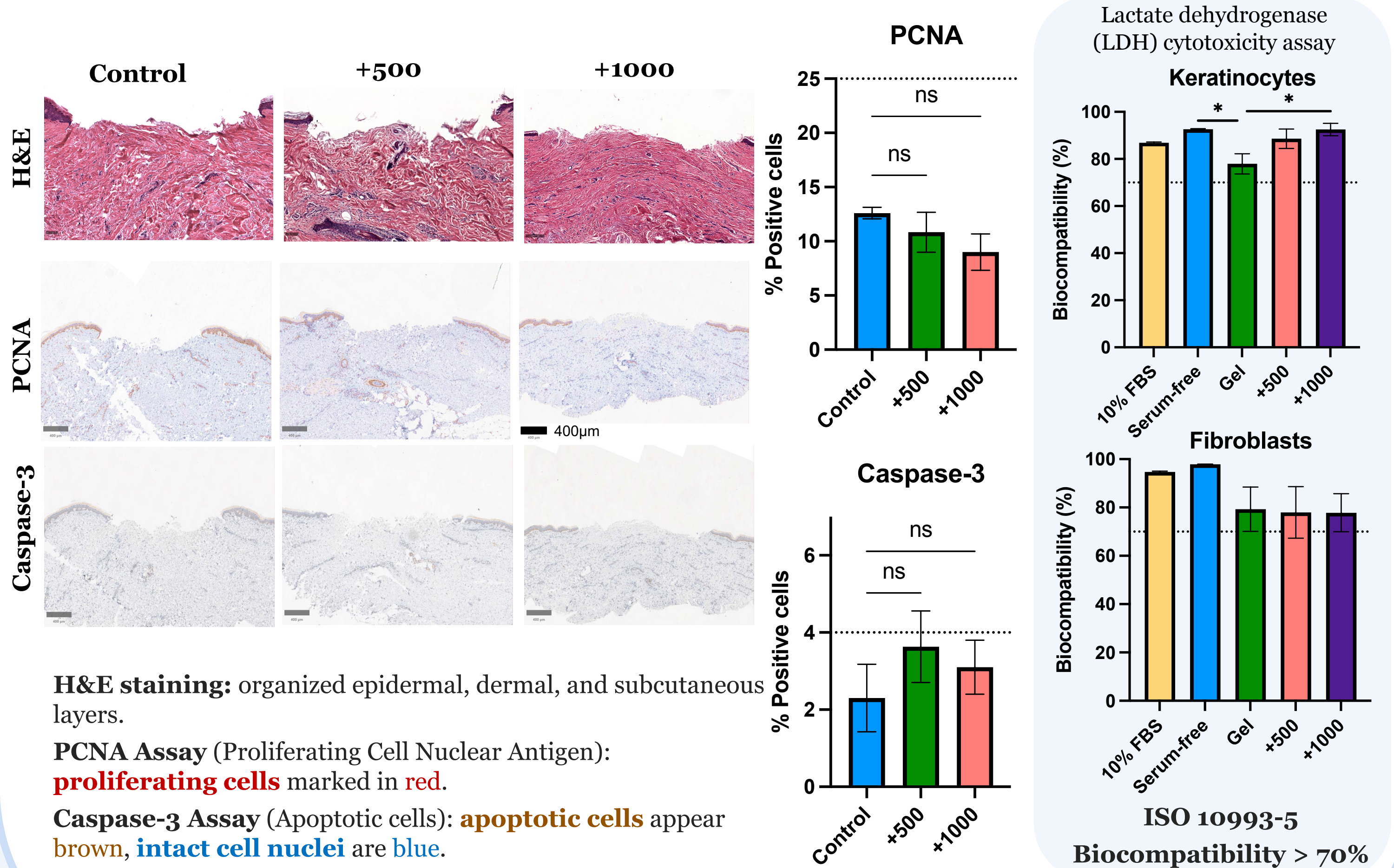
In vitro cryogels' antibacterial action against MRSA and PAO1



Ex vivo treatment against antibiotic resistant pathogens



Biocompatibility and cytotoxicity evaluation



Conclusions

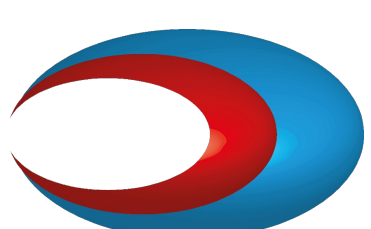
- ❖ A **scalable, reproducible** method for producing **high amounts** of Ag/SiO₂ nanoparticles
- ❖ **Biocompatible** wound dressing: **non-invasive, highly antimicrobial** treatment for infected wounds

References

- ¹K. L. Heras, M. Igarua, E. Santos-Vizcaino, R. M. Hernandez, Journal of Controlled Release, 328, 532-550 (2020).
- ²S. Patel, S. Srivastava, M. R. Singh, D. Singh, Biomedicine & Pharmacotherapy, 112 (2019).
- ³C. Attinger, R. Wolcott, Advances in Wound Care, 1, 127-132 (2012).
- ⁴T. Bruna, F. Maldonado-Bravo, P. Jara, N. Caro, International Journal of Molecular Sciences, 22, 7202 (2022).

Acknowledgments

Acknowledgements: Funding from the Swedish Foundation for Strategic Research (SSF) (FFL18-0043) and the Swedish Research Council (2023-03057) is kindly acknowledged.



maria.samara@su.se

LinkedIn

