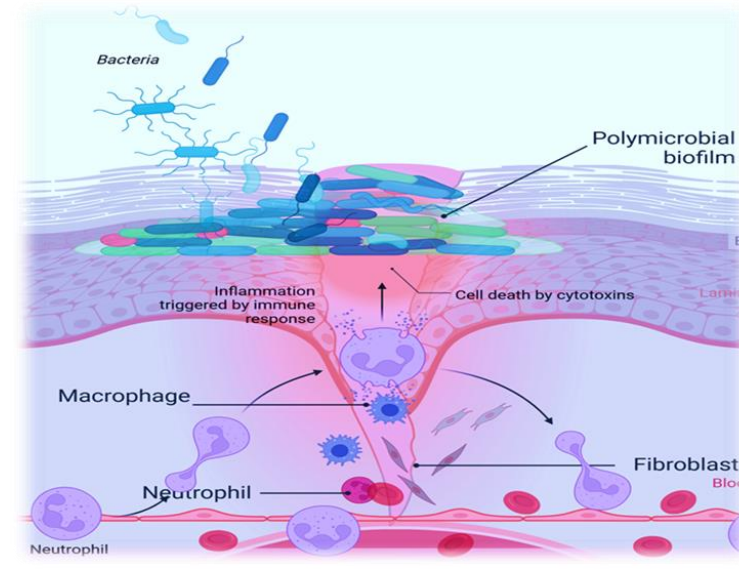


BACKGROUND

- Infections:** Polymicrobial communities in biofilms: impenetrable to host immunity and antimicrobials^[1-2]
- Infections in chronic wounds** prevent healing^[2-4]
 - ~6.5 million affected in the US
 - 3 in every 1000 globally
 - Pain and disability for patients and caregivers
 - Cost >90 billion USD to treat annually



Current Treatment Options

Debridement Negative Pressure Wound Therapy (NPWT) Dressing e.g., chitosan, hyaluronic acid, and collagen

	Debridement	Negative Pressure Wound Therapy (NPWT)	Dressing e.g., chitosan, hyaluronic acid, and collagen
Comfort	X	X	✓
Low cost	✓	X	✓
Biofilm Removal	✓	✓	X
Infection surveillance	X	X	X

Current treatments do not address biofilms

Current Surveillance Options

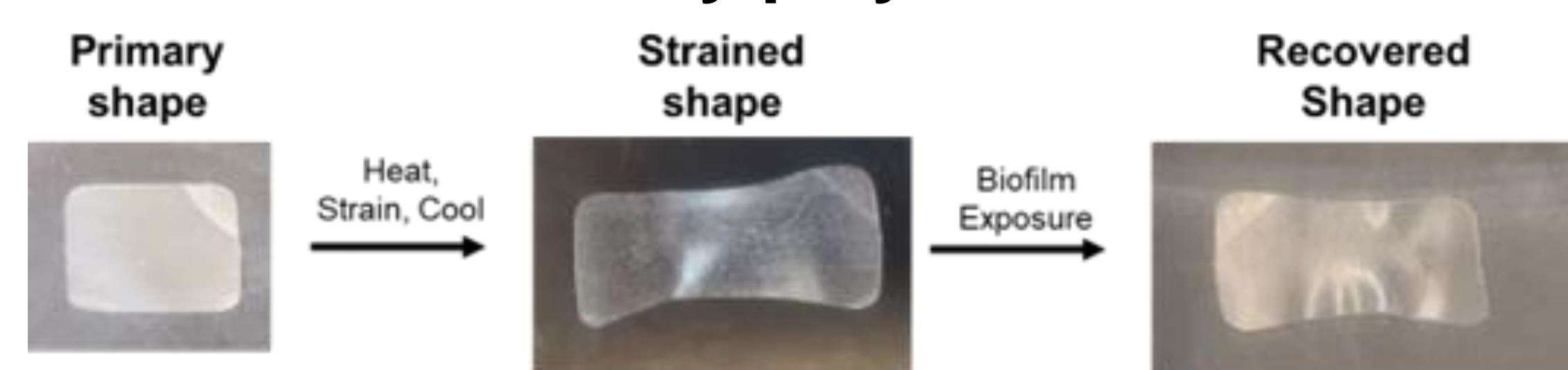
- Swab culture
 - Needle aspiration
 - Tissue biopsy
- Surveillance methods require time, are painful, and/or inhibit healing

Clinical need:

Innovative biomaterials that can simultaneously prevent formation of biofilms and indicate when infections are present in chronic wounds

APPROACH

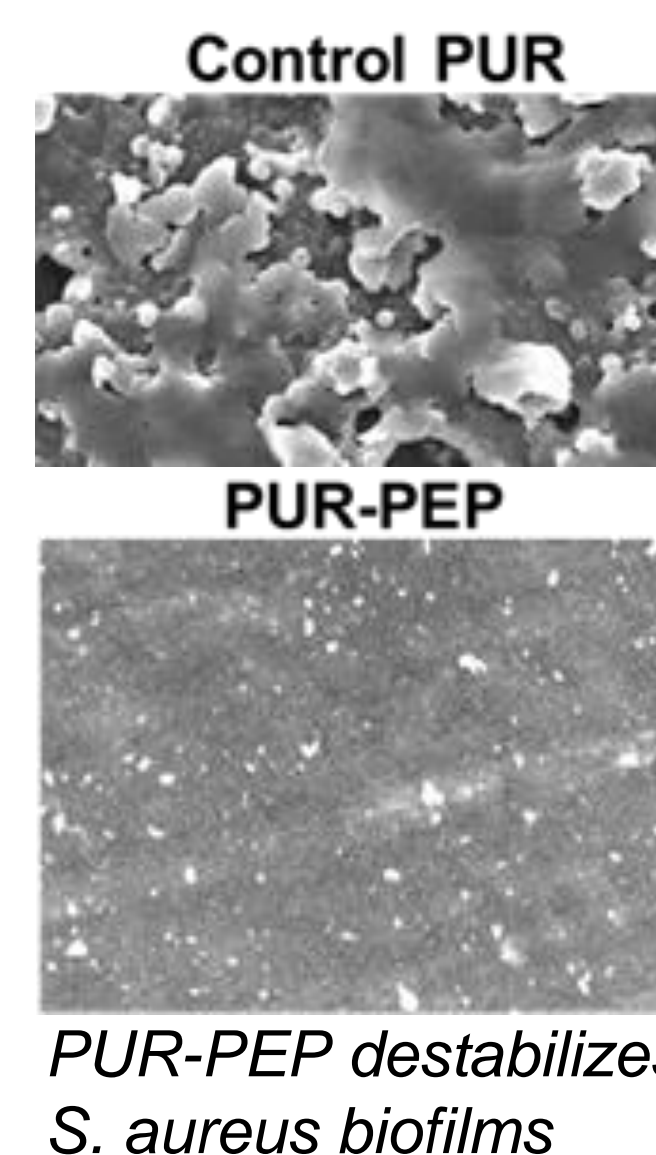
Bacteria-responsive polyurethane (PUR) shape memory polymer^[5]



PUR with peptide (PUR-PEP) changes shape in response to bacterial proteases during infection

→ Shape change inhibits biofilm formation

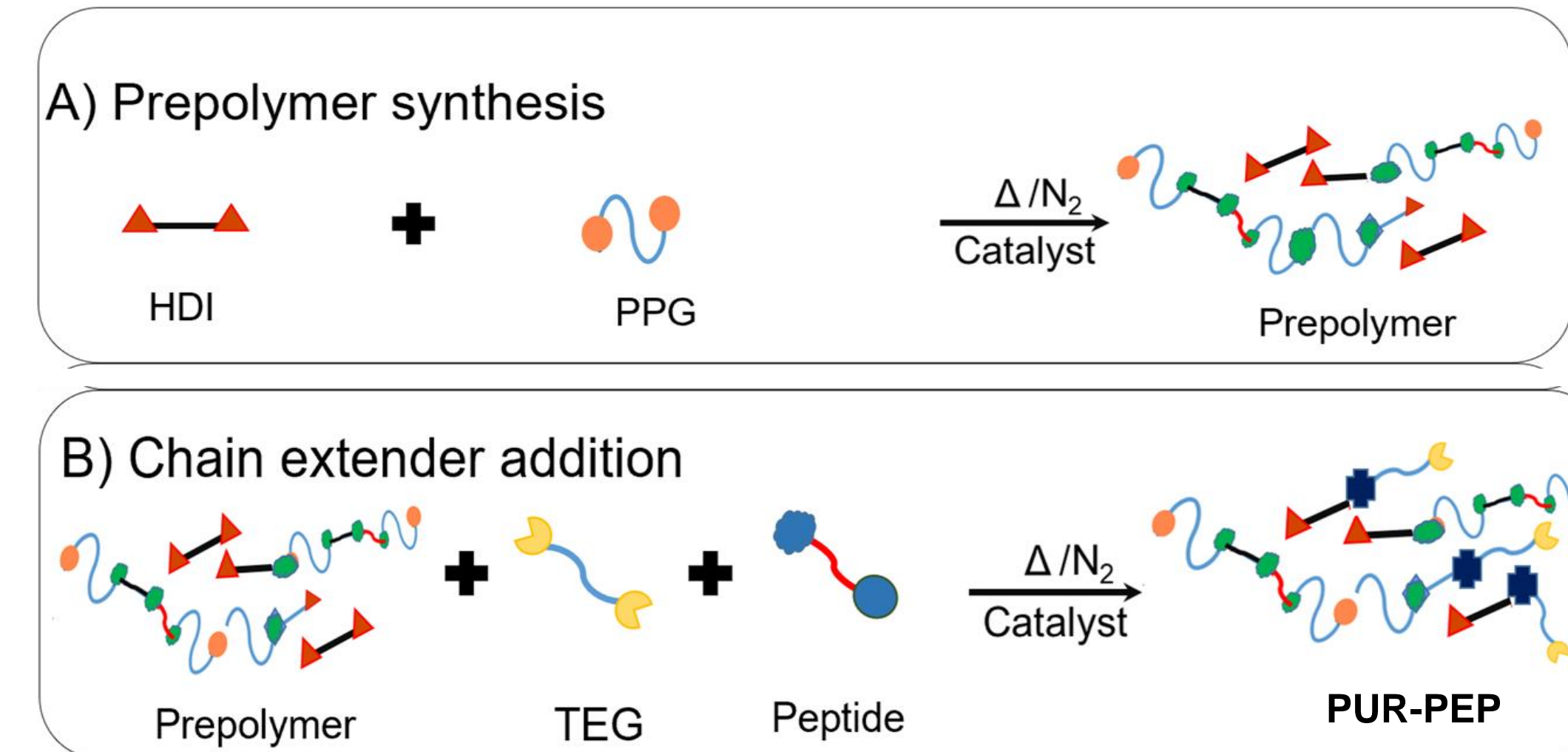
→ Shape change provides visual cue for infection surveillance



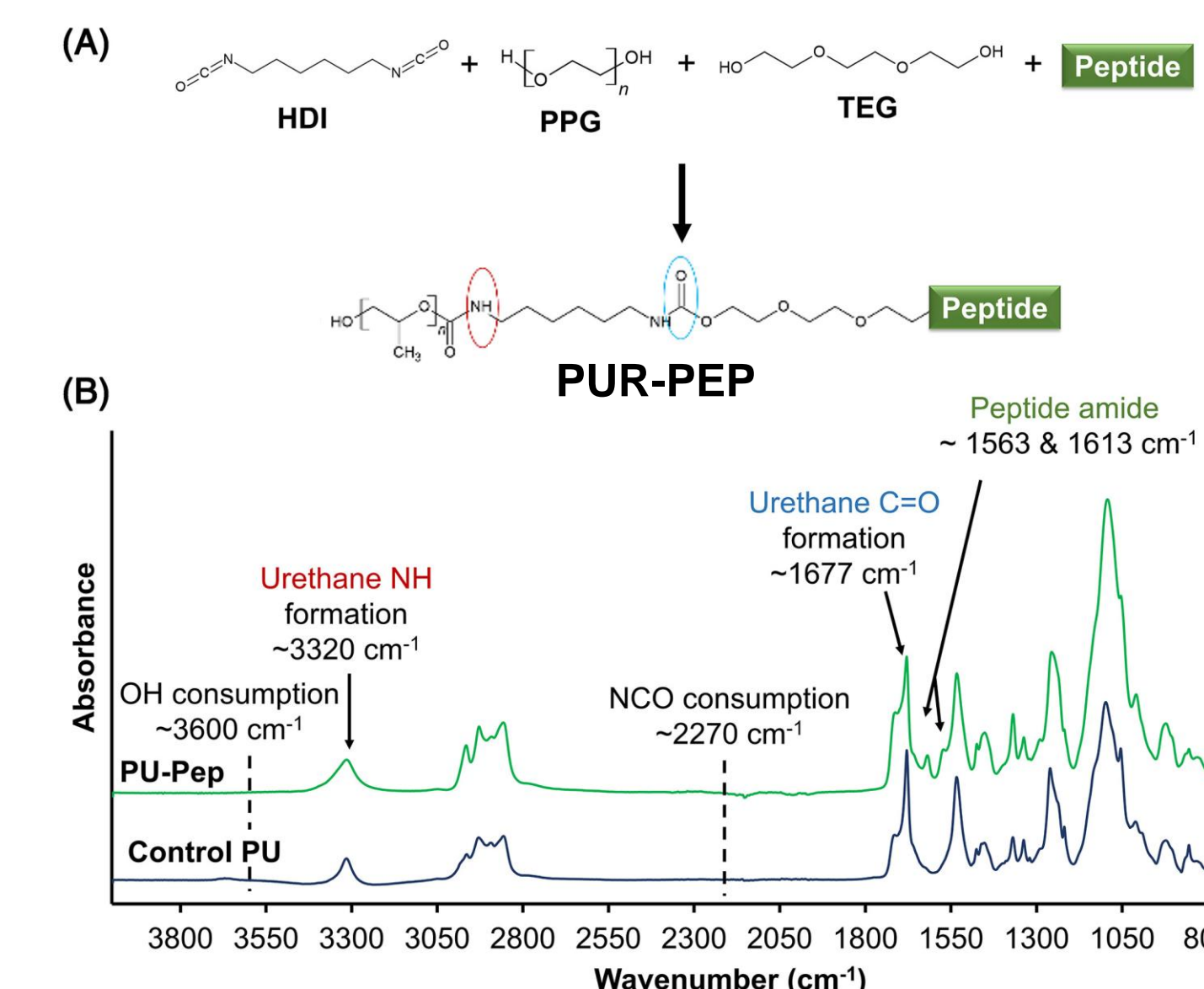
RESEARCH GOAL

Design a wound dressing that changes shape and color to indicate infections in chronic wounds while preventing biofilm formation

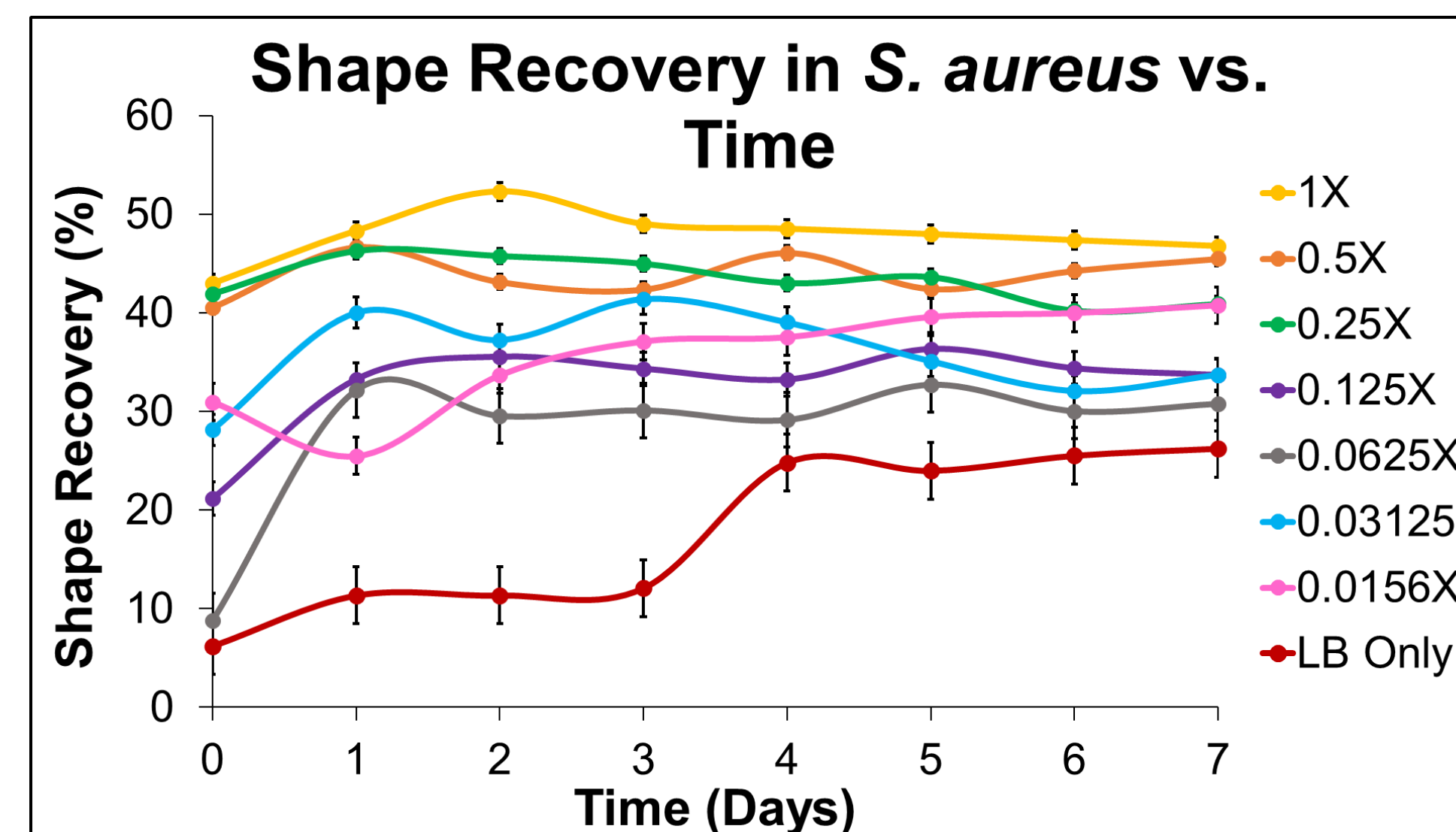
SYNTHESIS OF BACTERIA-RESPONSIVE POLYURETHANE



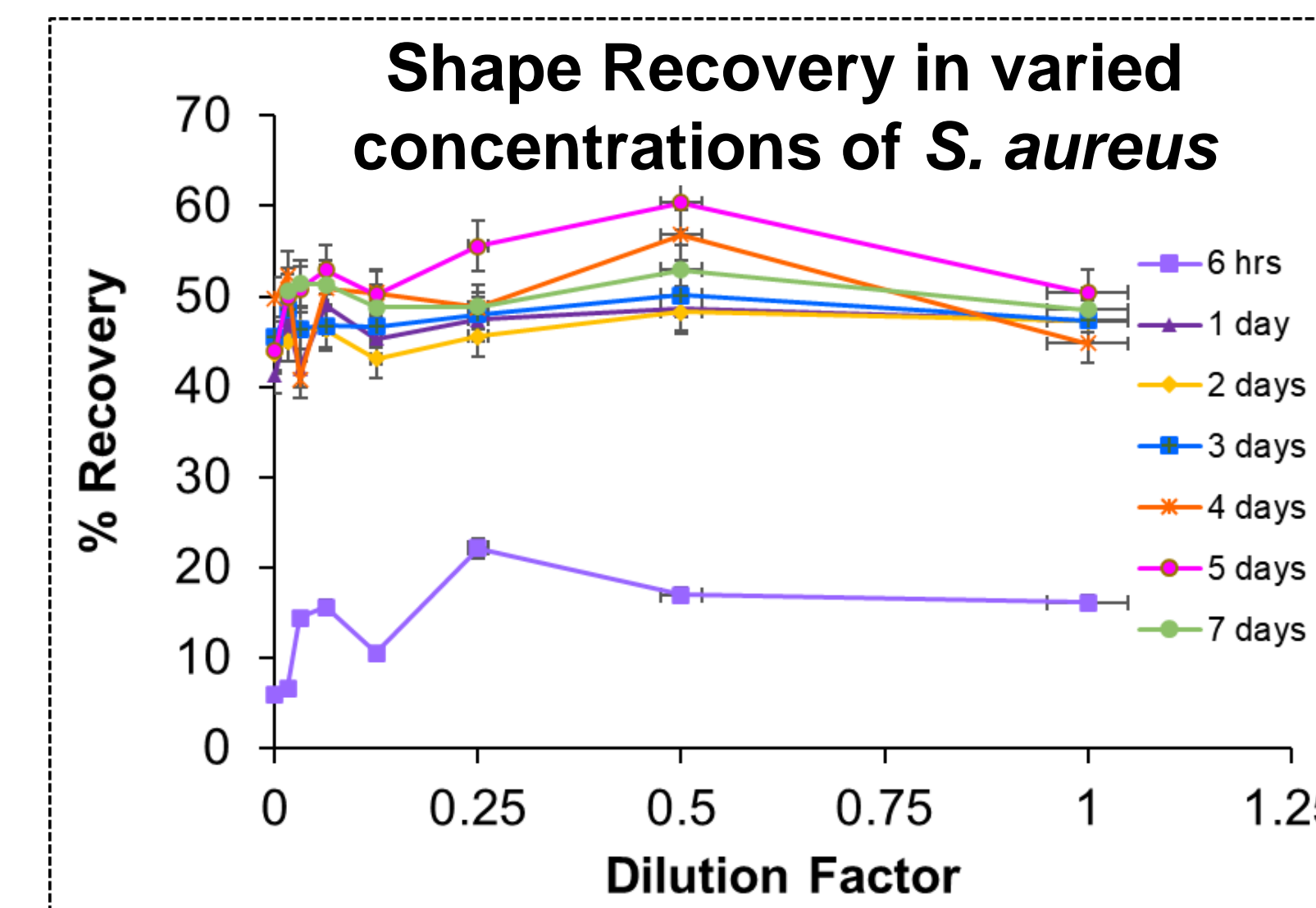
Hexamethylene diisocyanate (HDI) Polypropylene glycol (PPG) Triethylene glycol (TEG) Peptide



SENSITIVITY TO S. AUREUS



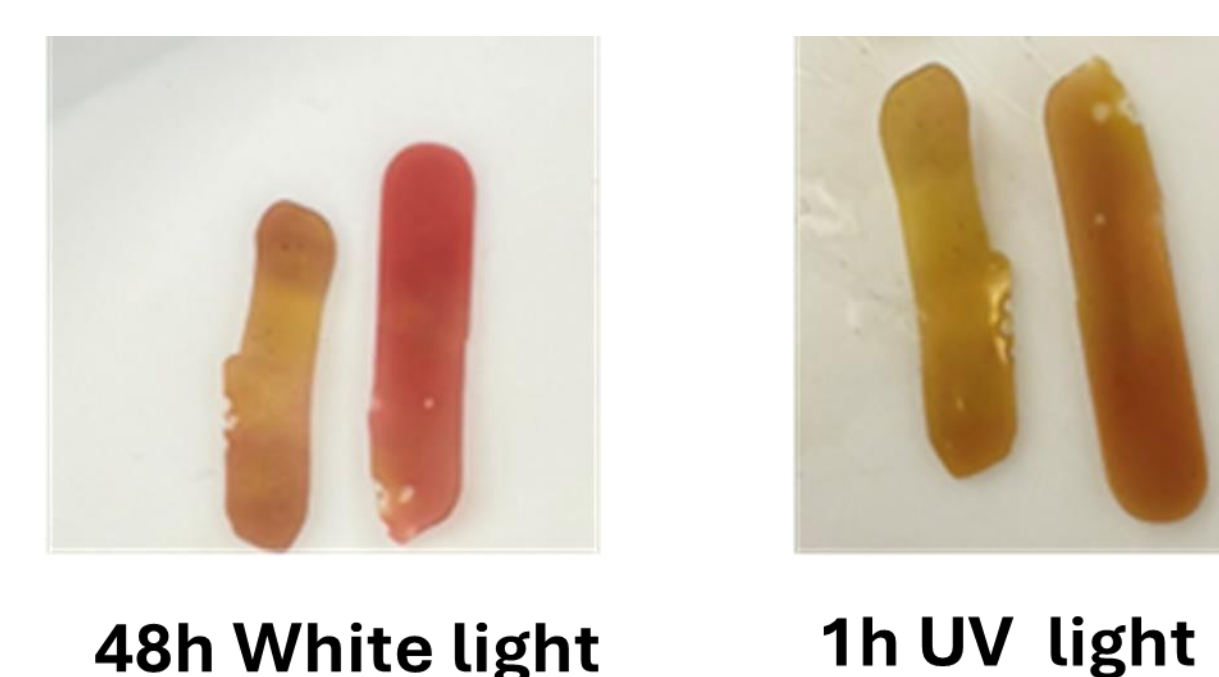
Majority of shape recovery occurs within first 24 hours



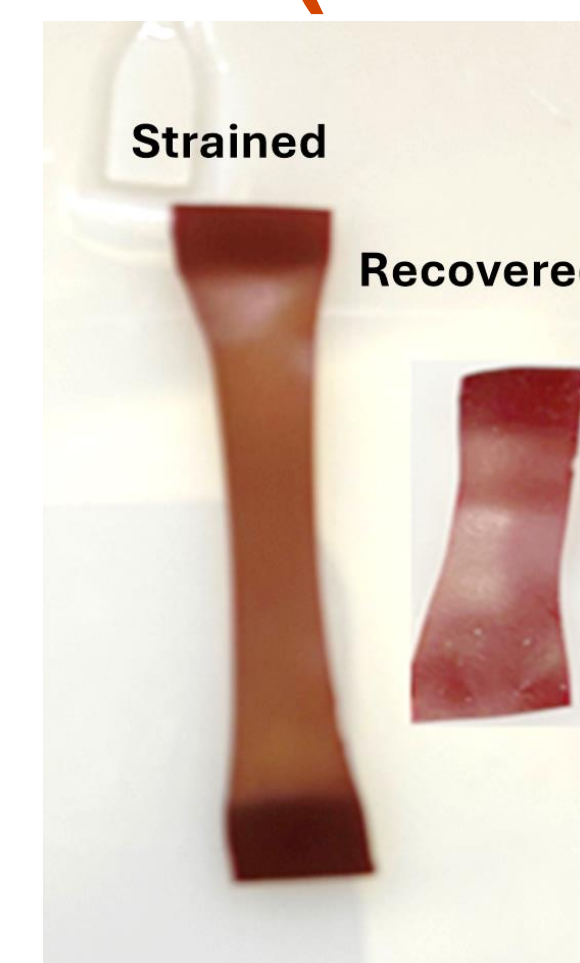
Similar shape recovery at all tested S. aureus concentrations

PUR-PEP is sensitive to high and low concentrations of bacteria → Could be used to detect infections early

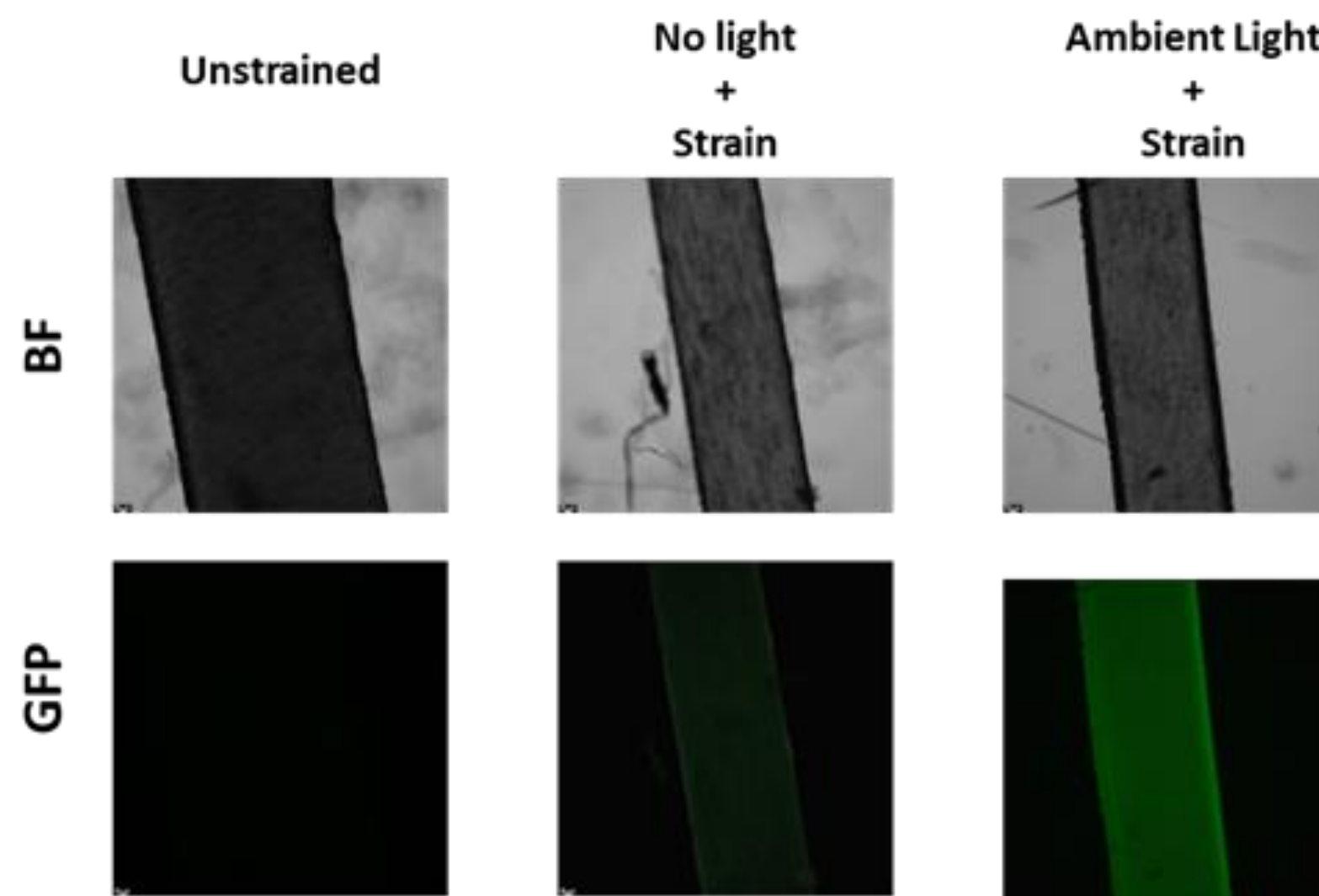
MECHANOCROMIC POLYURETHANE (PUR/SP)



PUR/SP films turn red when exposed to visible light and back to yellow-brown when exposed to UV light



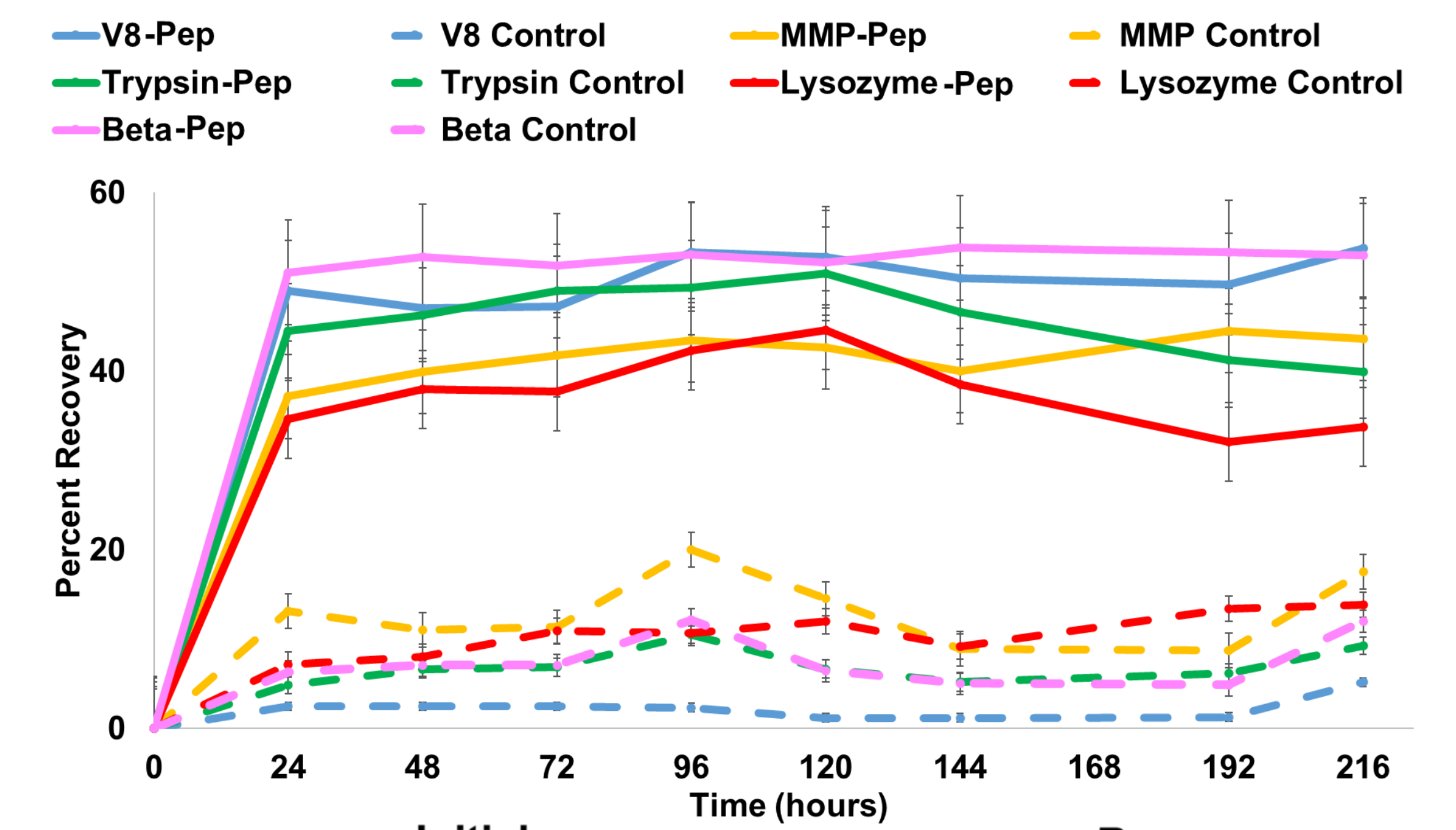
Strained PUR/SP films turn from brown to red upon shape recovery



Strained PUR/SP samples show increased green fluorescence compared to unstrained samples

SP-containing PUR could provide a color-based surveillance of infection in chronic wounds

PUR-PEP SPECIFICITY TO BACTERIAL PROTEASES



Sample	Initial Length	Strained Length	Recovery after 216 hrs.
V8 PU-Control	Initial	132% Strain	5% Recovery
V8 PU-Pep	21.23 mm	28.23 mm	27.90 mm
V8 PU-Pep	Initial	144% Strain	60% Recovery
V8 PU-Pep	21.29 mm	30.80 mm	25.04 mm
Trypsin PU-Pep	Initial	131% Strain	51% Recovery
Trypsin PU-Pep	21.56 mm	28.24 mm	24.82 mm

PUR-PEP samples undergo visible shape recovery (~55% in 24 hr) in all tested enzymes. Control PU stable (<10% recovery) in all tested enzymes.

PUR-PEP shape recovery is not specific to bacterial proteases

CONCLUSIONS & FUTURE WORK

PUR-PEP has high sensitivity to S. aureus protease

- Potential for detection of low-grade infections in chronic wounds

Incorporation of mechanophore enables simultaneous color and shape change

- Potential for enhanced infection surveillance

Shape recovery in mammalian enzymes indicates low specificity

- Requires tuning chemistry to ensure stability in non-infected wounds

Current and Future Work:

- Improve specificity of peptide to bacterial proteases
- Incorporate SP into PUR-PEP

ACKNOWLEDGEMENTS

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