A Self-Healing Acrylic Coating based on Hydrogen Bonding

Maximilian Beach

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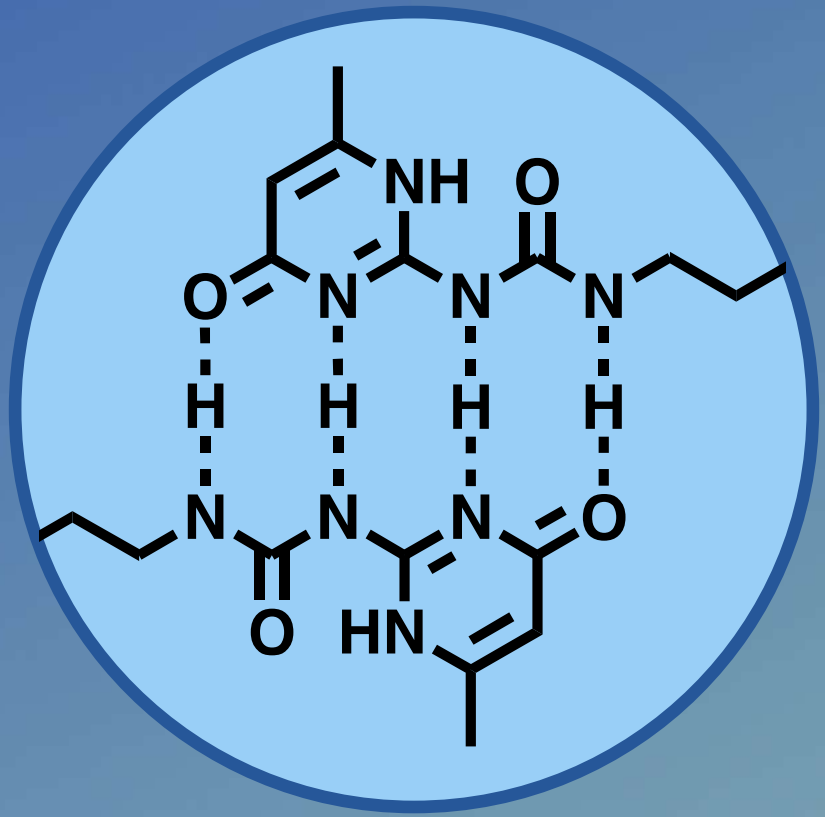

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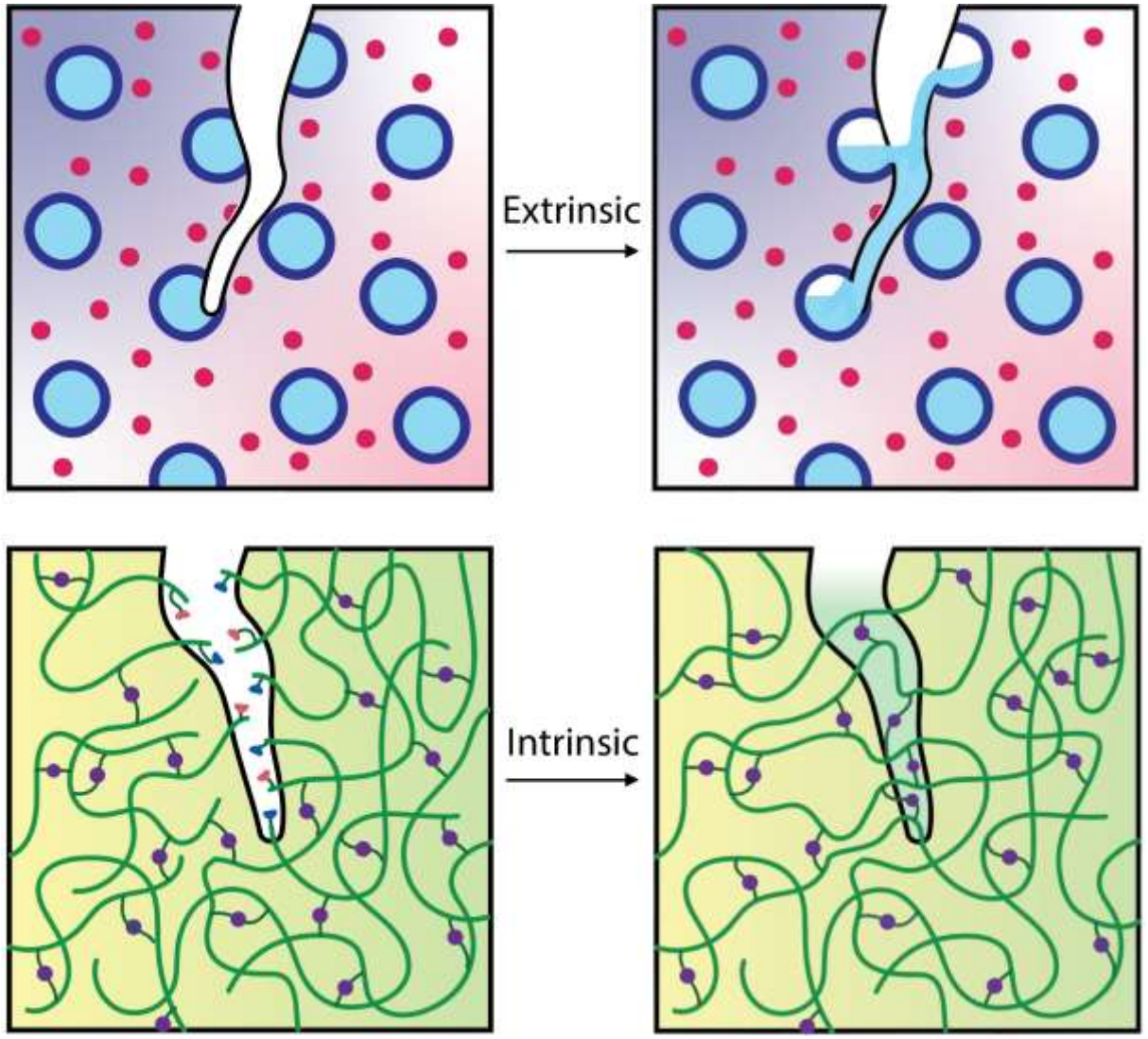
Self-Healing in Materials Science

“Self-healing technology can repair damage spontaneously and without intervention or diagnosis”

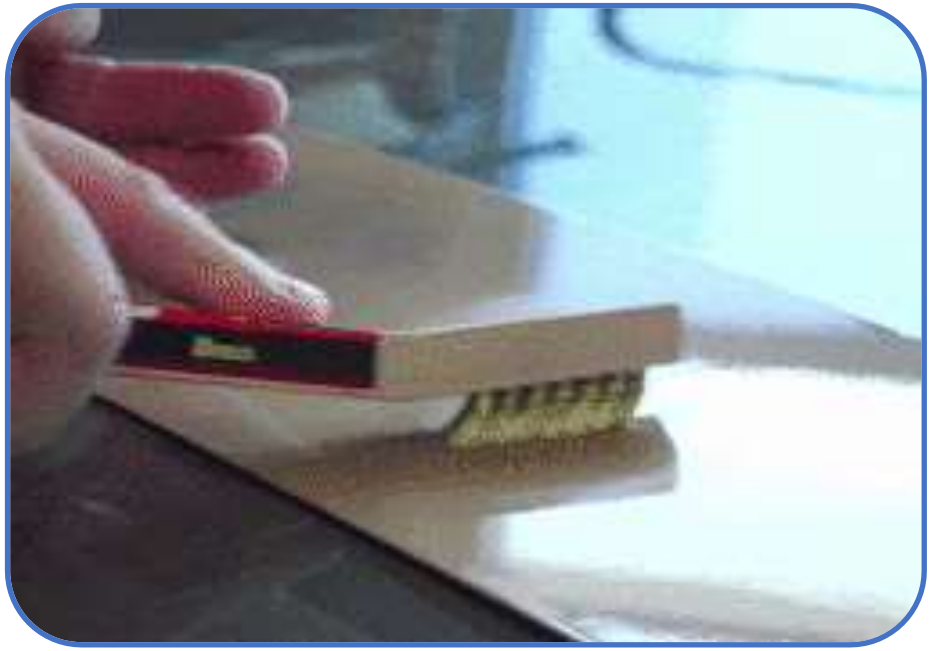


Self-Healing Applications

Applications: Biomedicine, Infrastructure, Aerospace engineering, Energy, Automotive engineering, *Coatings*, and many other materials

Coatings:

- Acrylic (paints) ✗
- Epoxy resins ✓
- Anticorrosive coatings ✓
- Industrial and other ✓



What Healing Technology suits an Acrylic Coating?

Microcapsules

Poor optical qualities

Synthetically complex

Requires catalysts

Can only heal once

Covalent bonds

Forms strong bonds

Requires high temperatures

Repeatable Healing

Supramolecular bonds

Room temperature self-healing

Synthetically accessible

Repeatable healing

Mechanically weak material

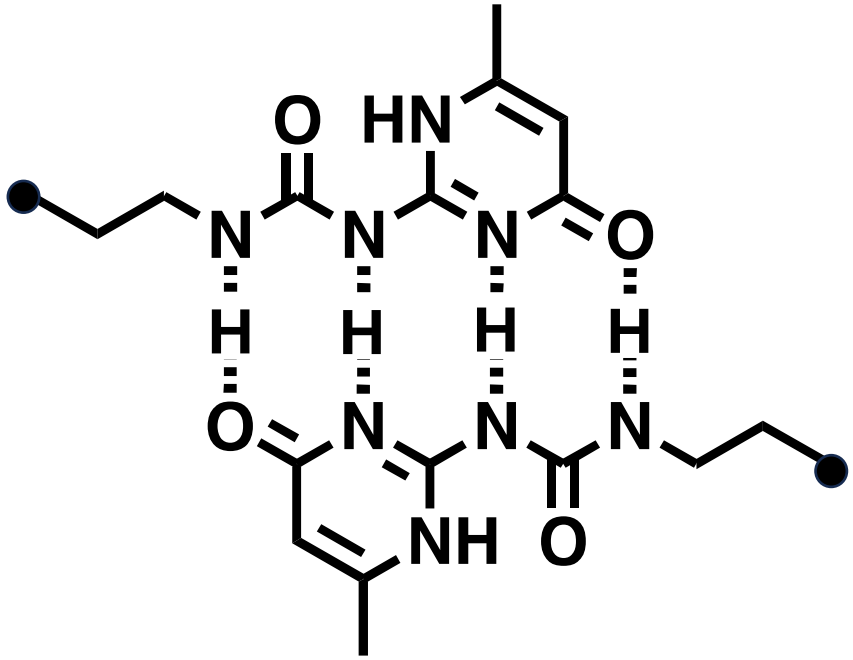
Hydrogen bonding

Benefits

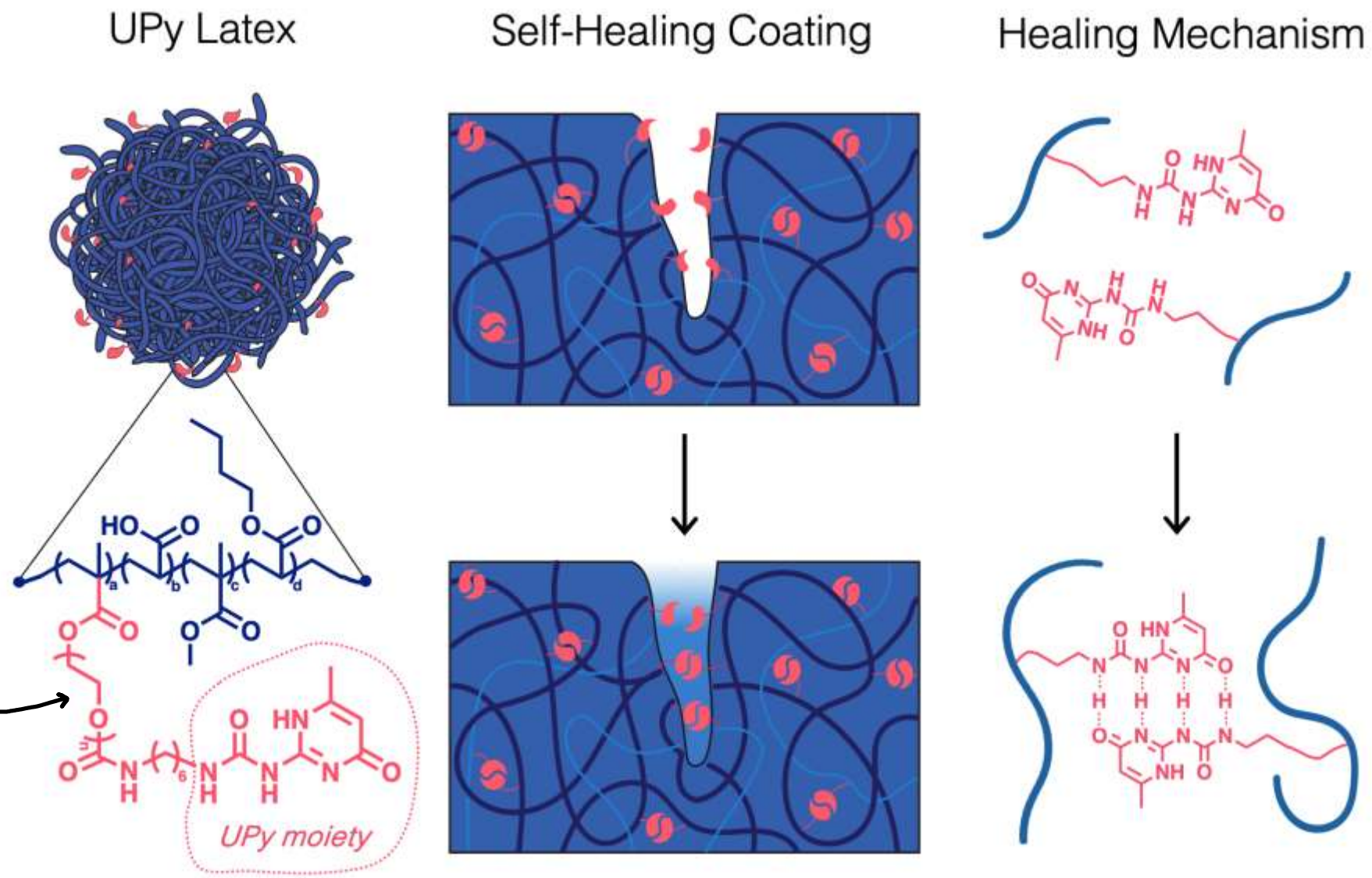
- Ambient self-healing
- Versatile
- Synthetically simple
- Tunable

2-Ureido-4[1H]-Pyrimidinone (UPy)

- Self-complementary
- Extremely strong



UPy-Monomer: Theory



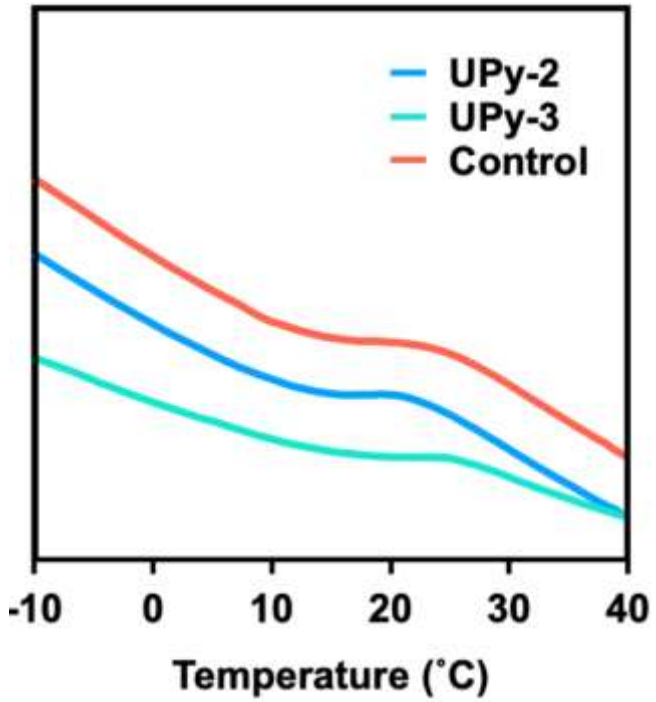
UPy-Monomer: Coating Mechanical Properties

Glass transition temperature (Tg)

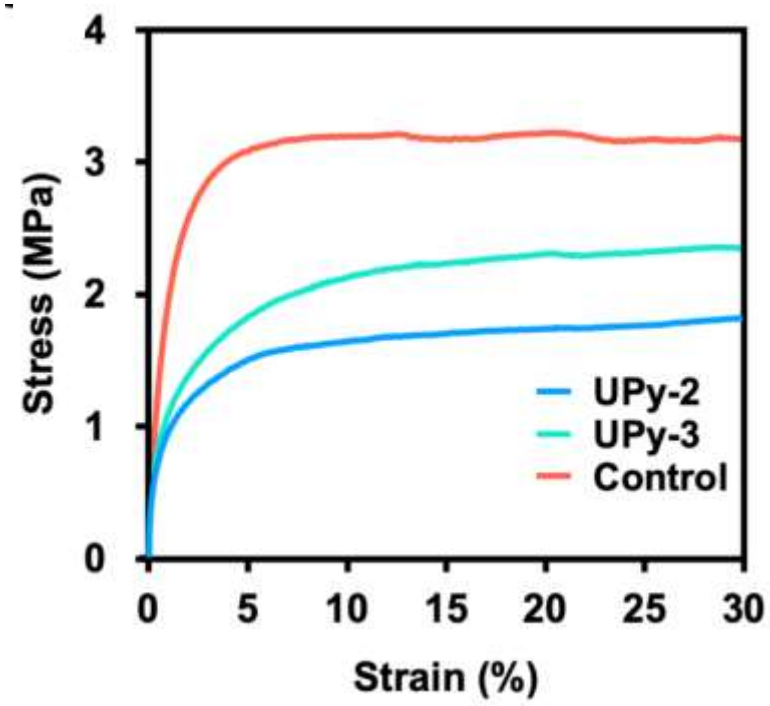
Control: 18˚C

UPy-2: 15˚C

UPy-3: 16˚C



Young's modulus



Control: 0.30 GPa

UPy-2: 0.20 GPa

UPy-3: 0.22 GPa

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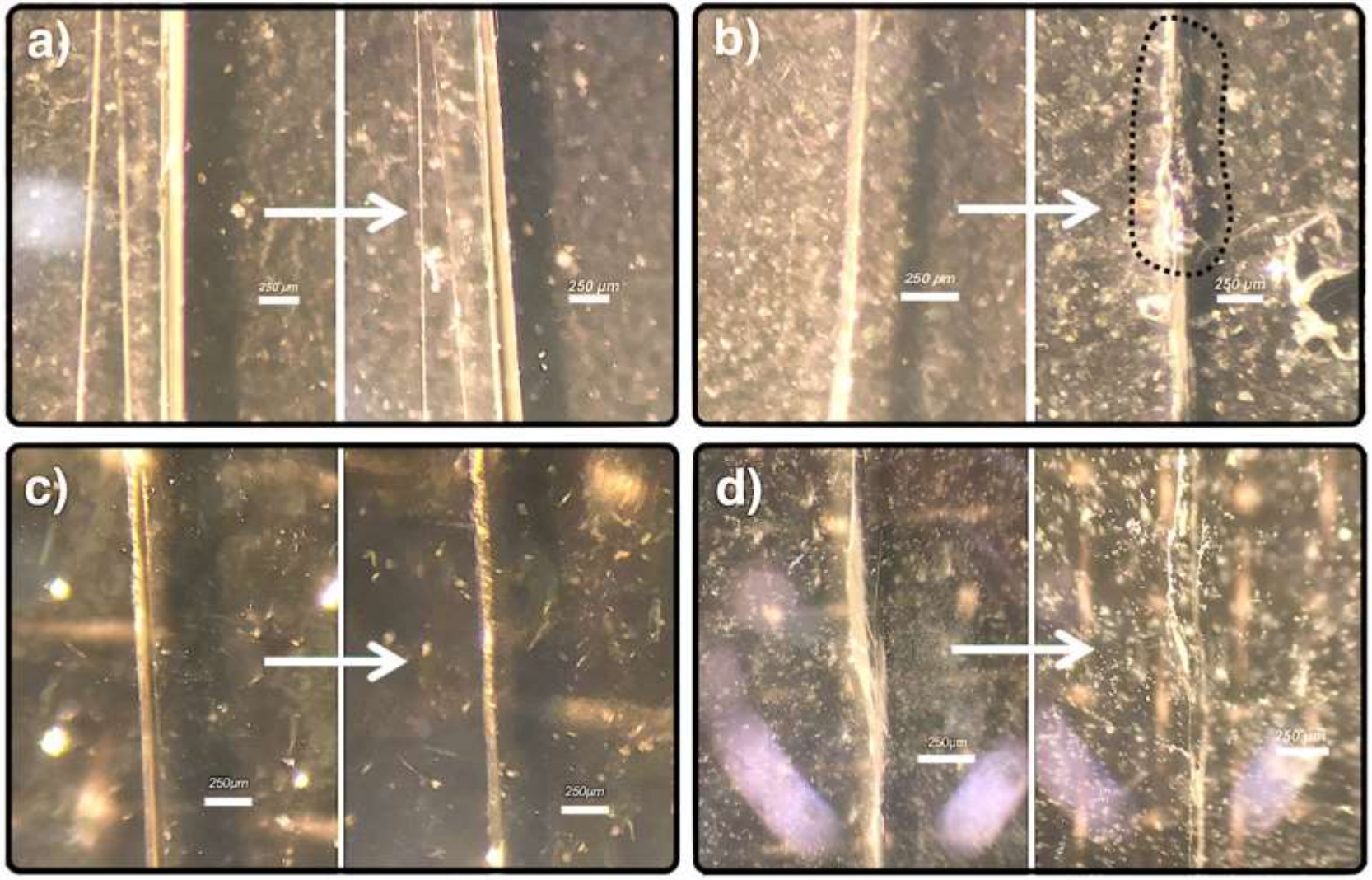
UPy-Monomer: Optical Self-Healing

CONTROL

UPy-2

UPy-3

UPy-2, 50˚C



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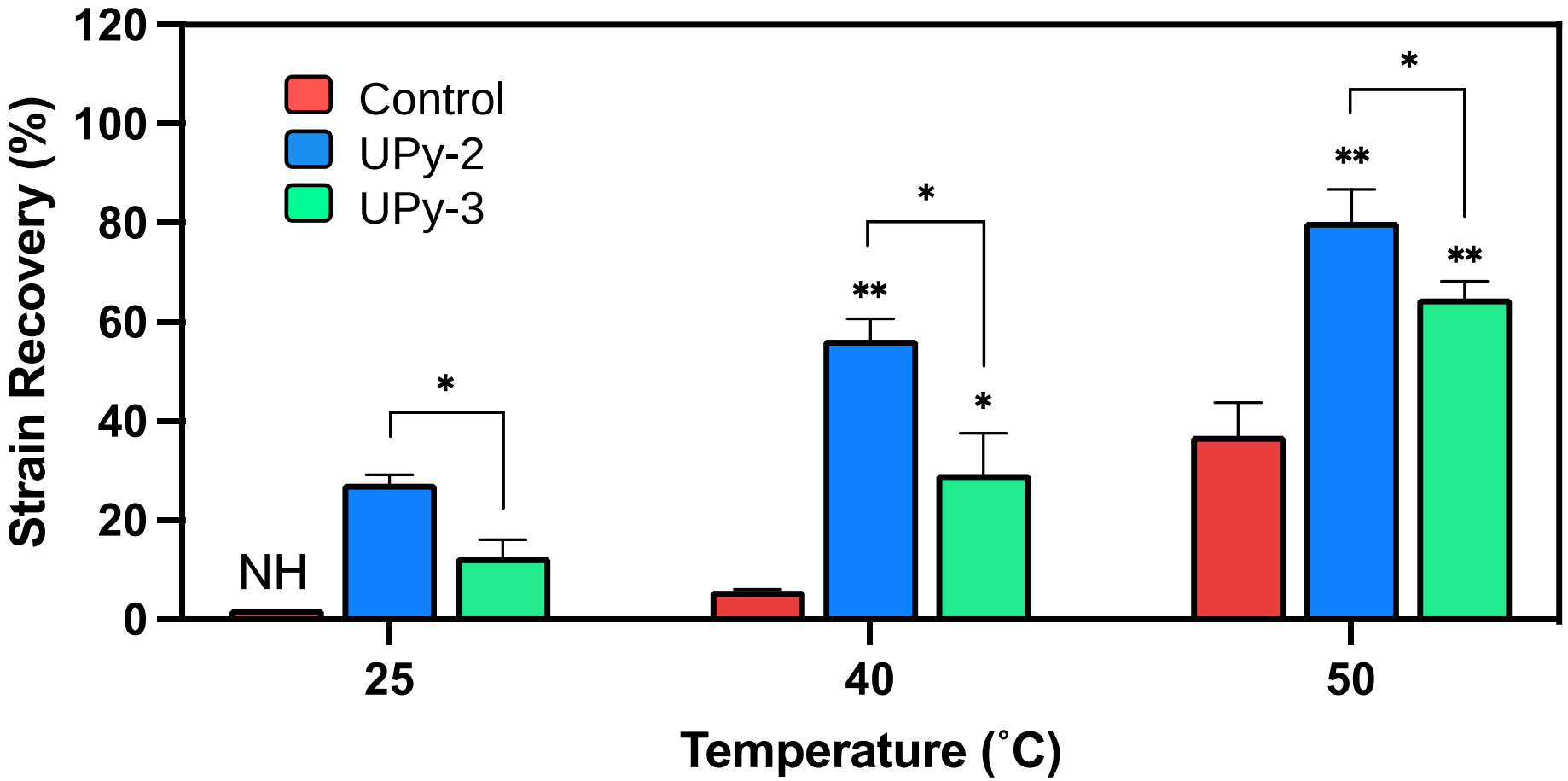
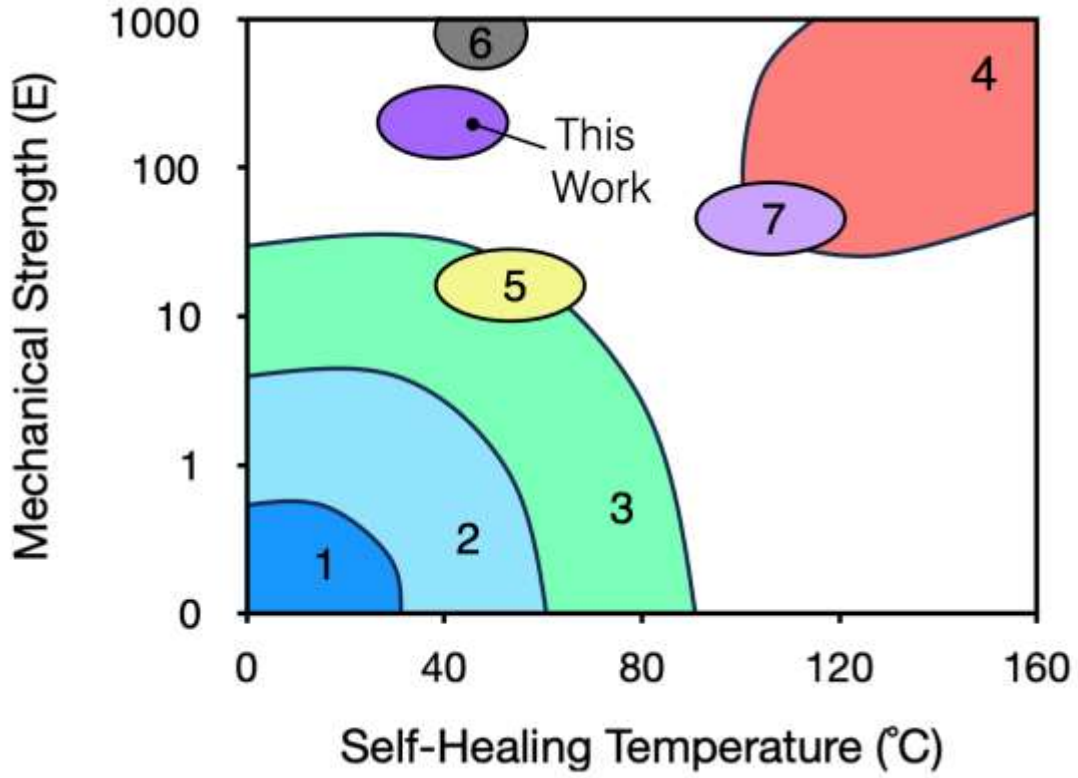
UPy-Monomer: Strain Recovery



Conclusion

UPy monomers were synthesized and incorporated into an acrylic latex

An acrylic coating was formed which was able to self-heal at room temperature



1: Hydrogels
2: Elastomers
3: Thermoplastics
4: Epoxy resins
5: Multiphasic materials
6: Specialized thermosets
7: Other acrylic coatings

Acknowledgements

A/Prof. Georgina Such

Dr Tim Davey

1. A self-healing waterborne acrylic latex coating based on intrinsic hydrogen bonding, Progress in Organic Coatings, 188 (**2024**) 108189.