Solvato-morphologically controlled photo-actuated hydrogels

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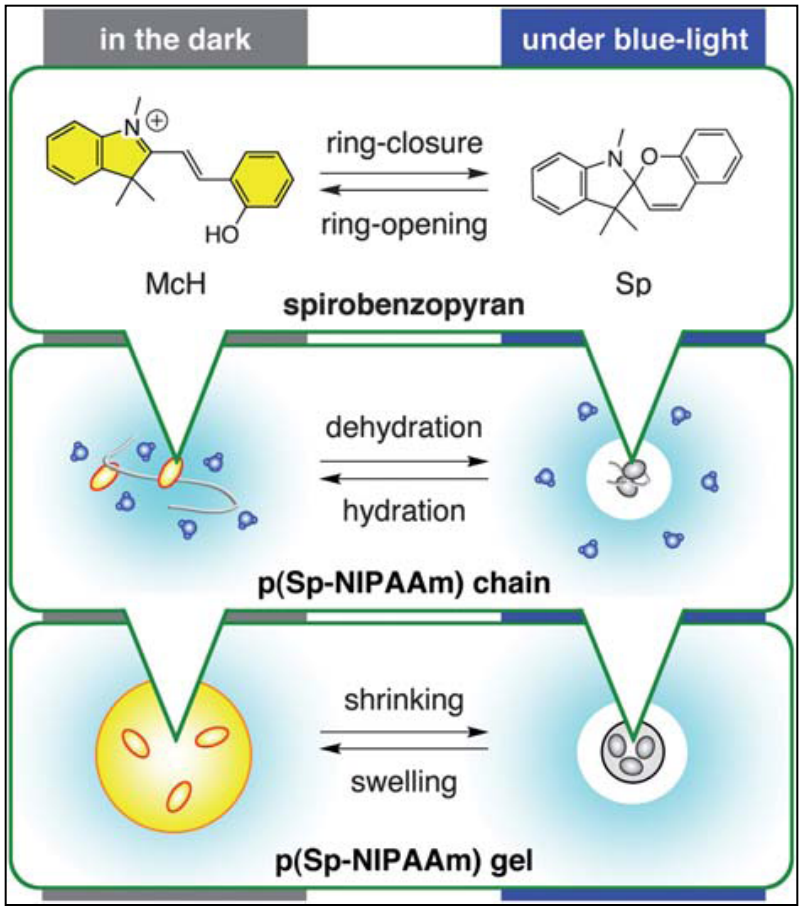
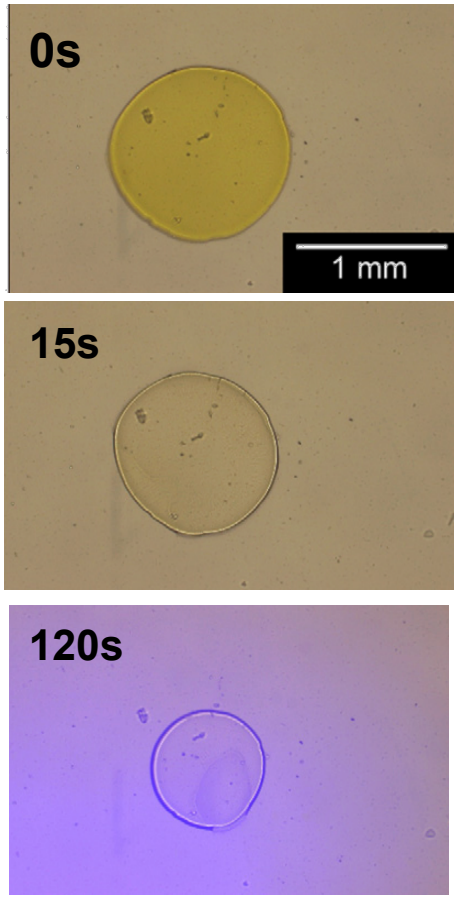
PhD Researcher

Background

- p(NIPAAm) based hydrogels that incorporate a spiropyran photochromic unit

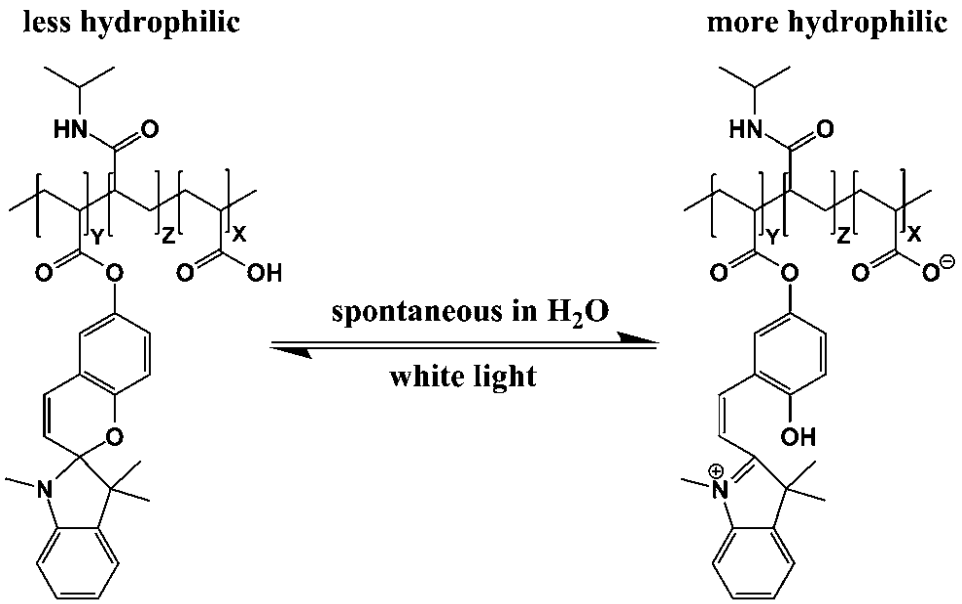


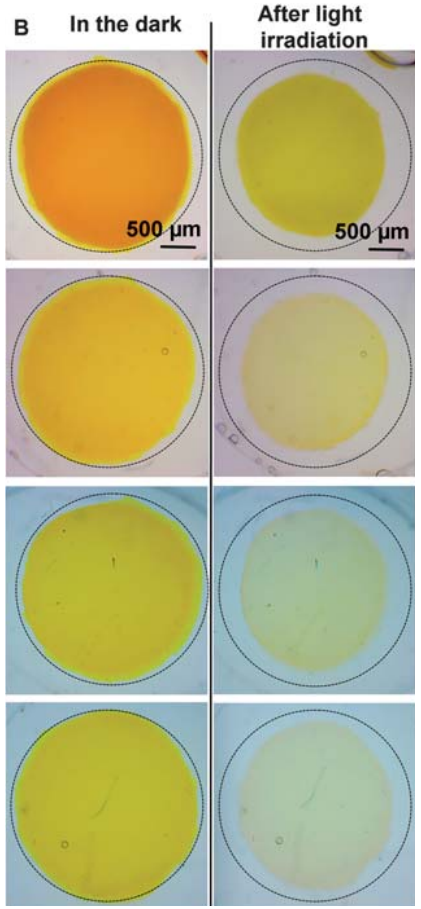


- Drawback: These hydrogels function only in acidic conditions (HCl, pH~3)

Background

- Recent work: co-polymerised Acrylic Acid inside p(NIPAAm) in the hydrogel



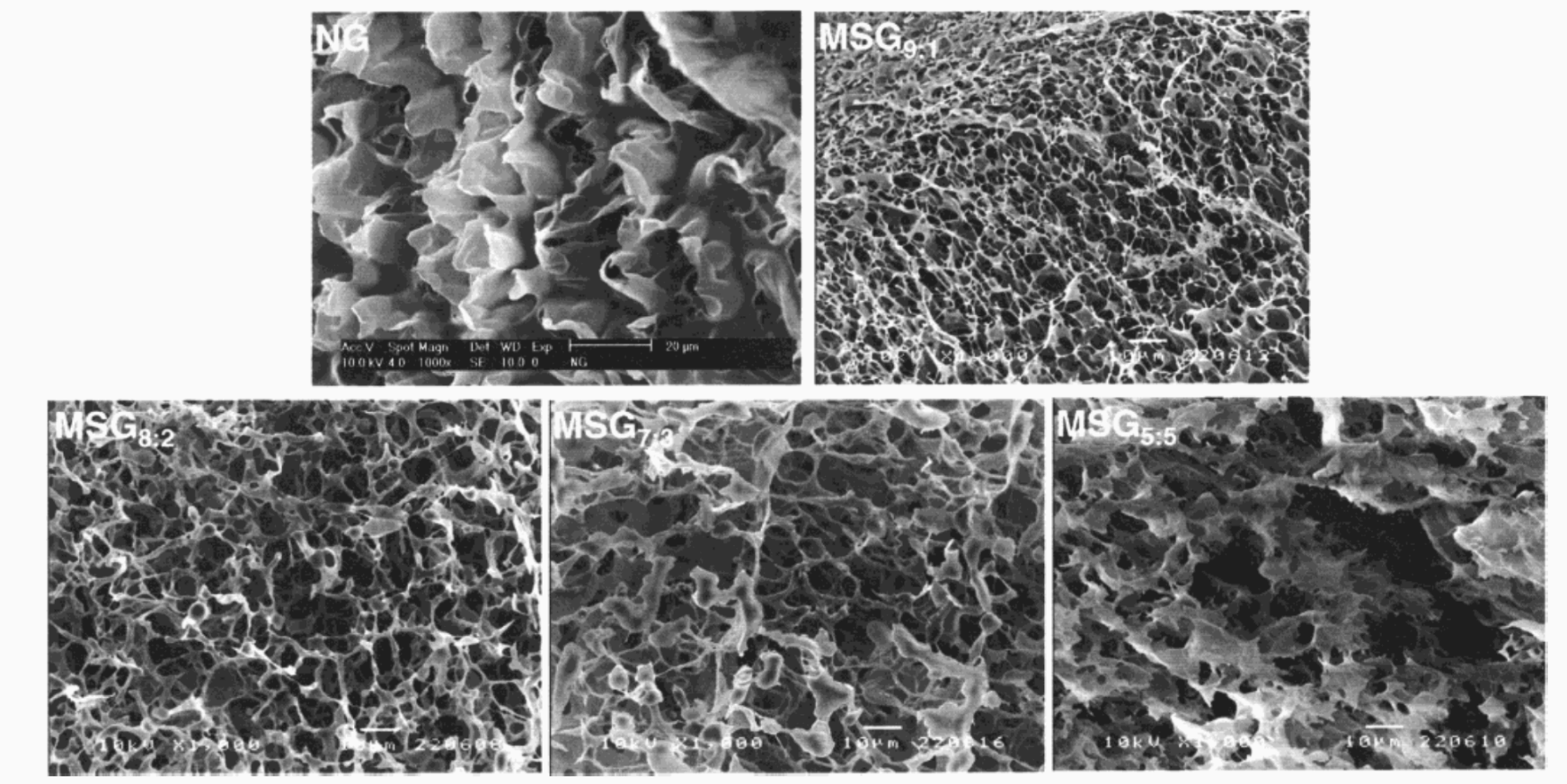


- Advantage: These hydrogels function in water.

(B.Ziolkowski et al, Soft Matter,2013,9,8754-8760)

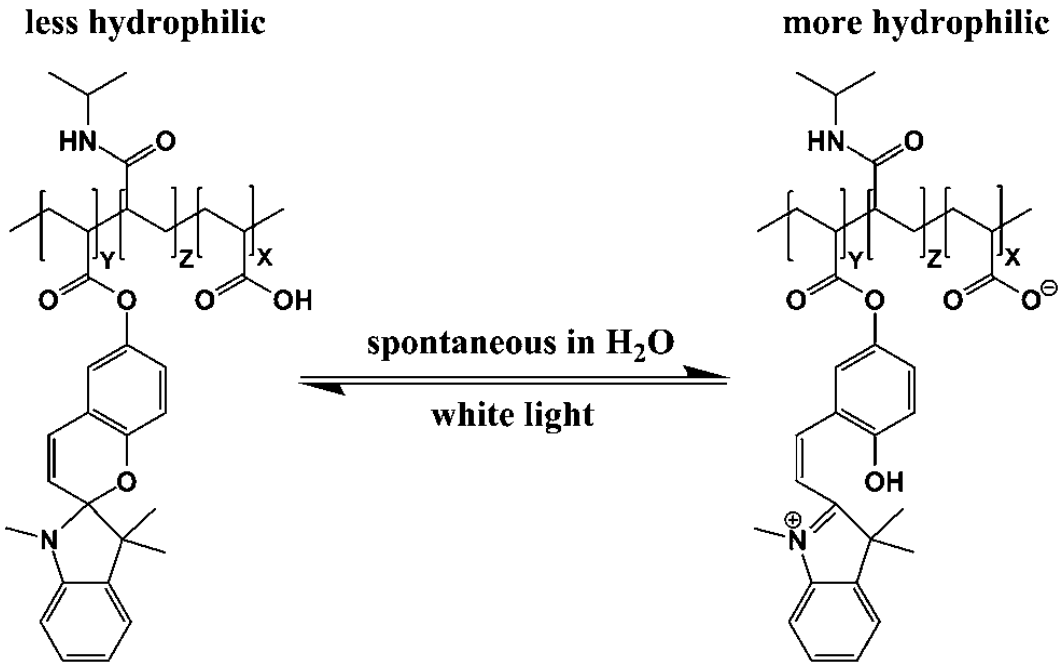
Background

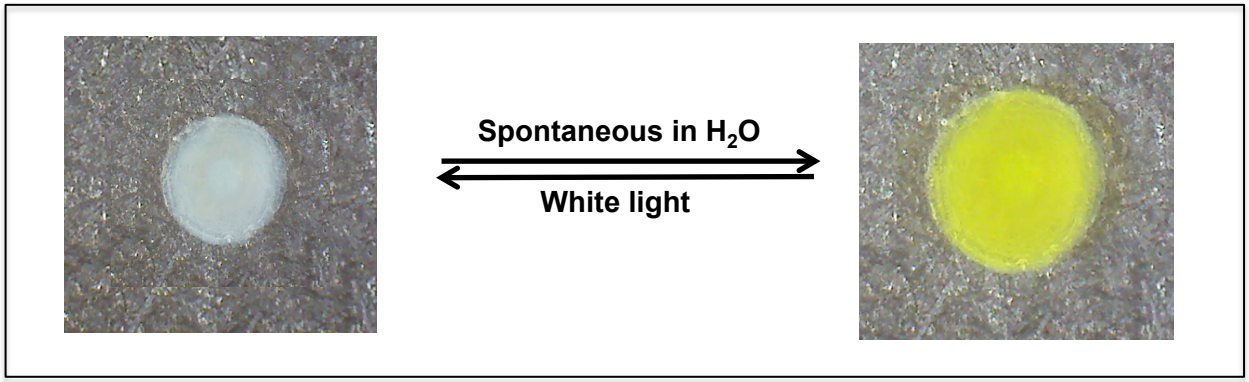
- **Changing the polymerisation solvent can control the hydrogel morphology.**



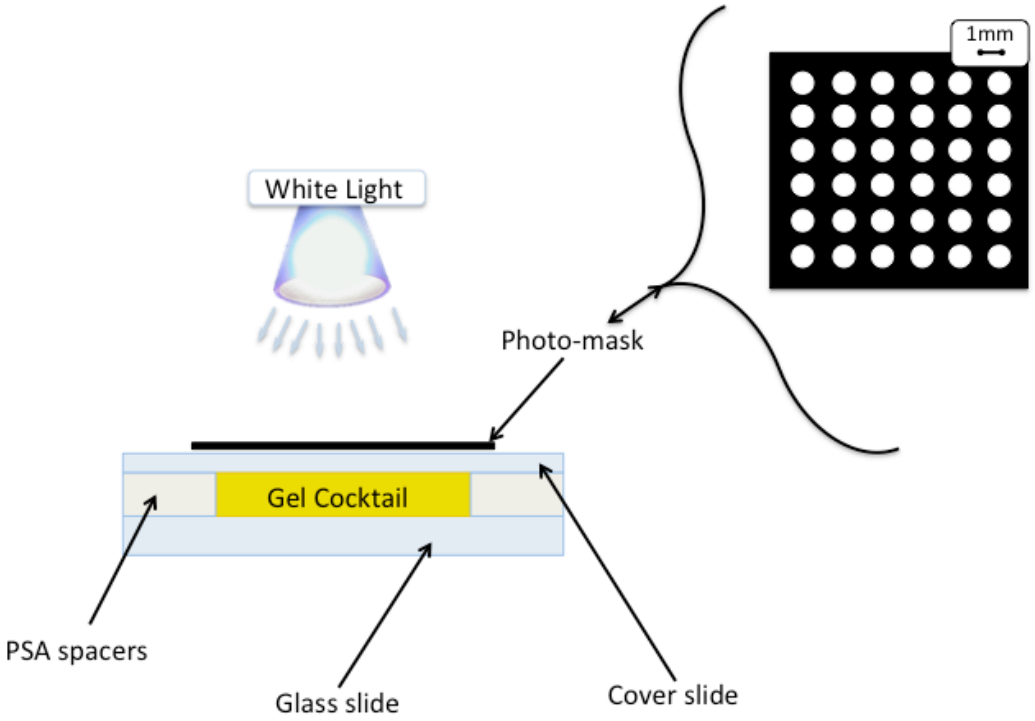
(Zhang et. al, Langmuir, Vol 18, No. 7, 2002, 2538-2542)

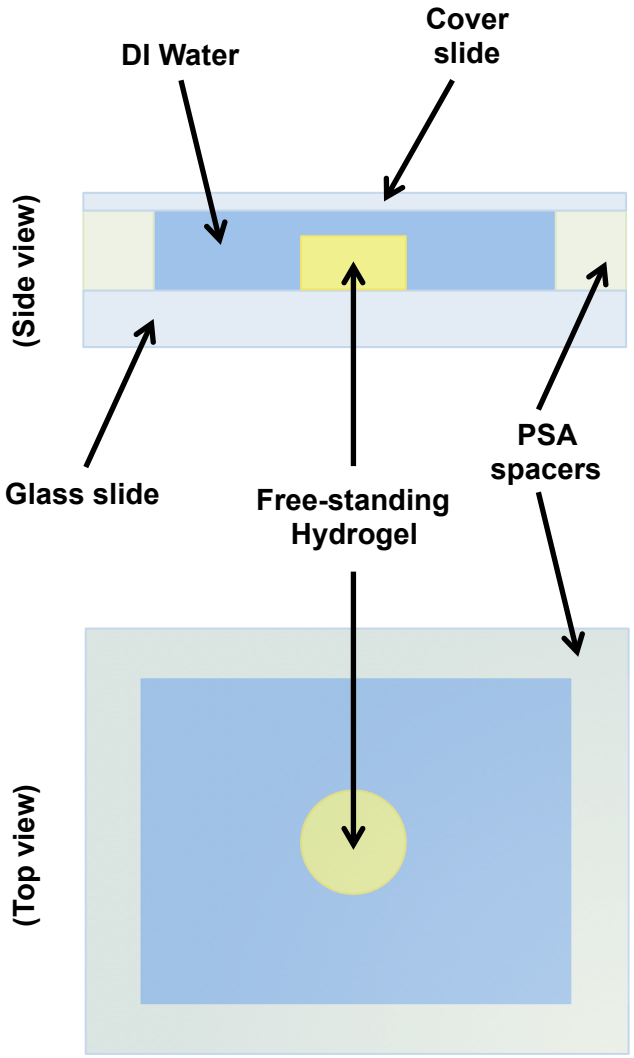
Photo-responsive hydrogels





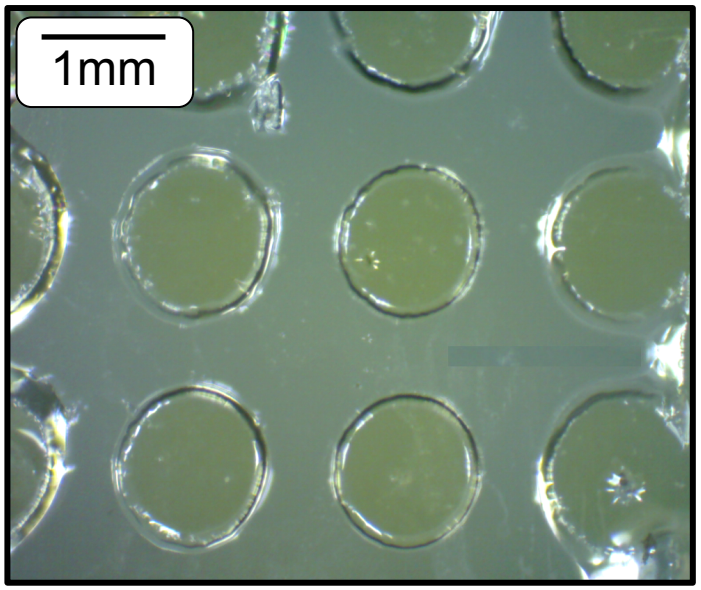
Hydrogel fabrication



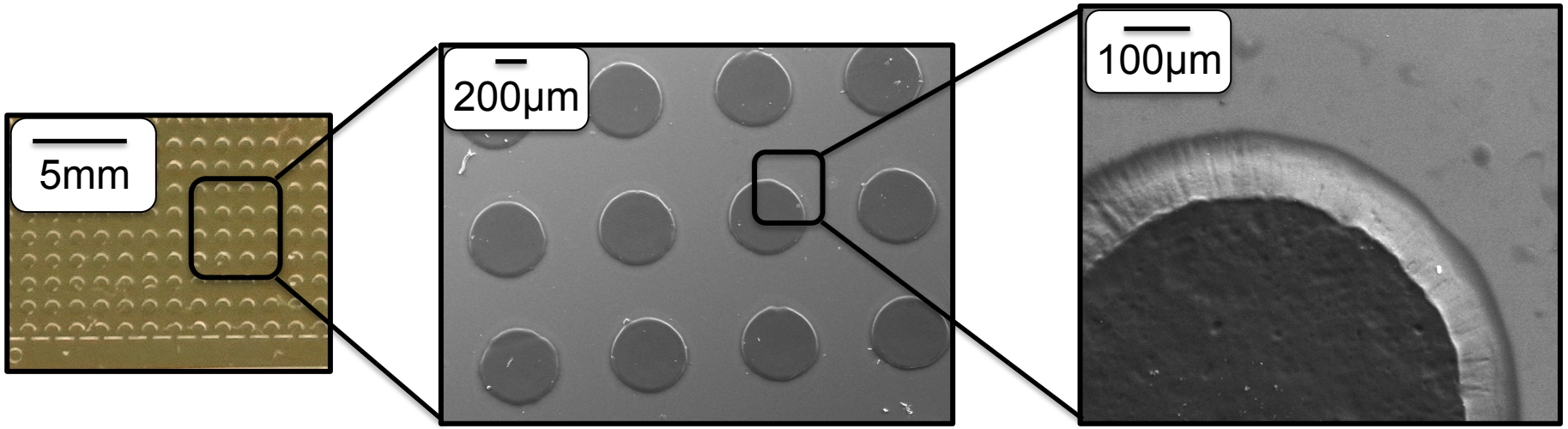


View of the free standing gels under microscope →

Hydrogel microstructure



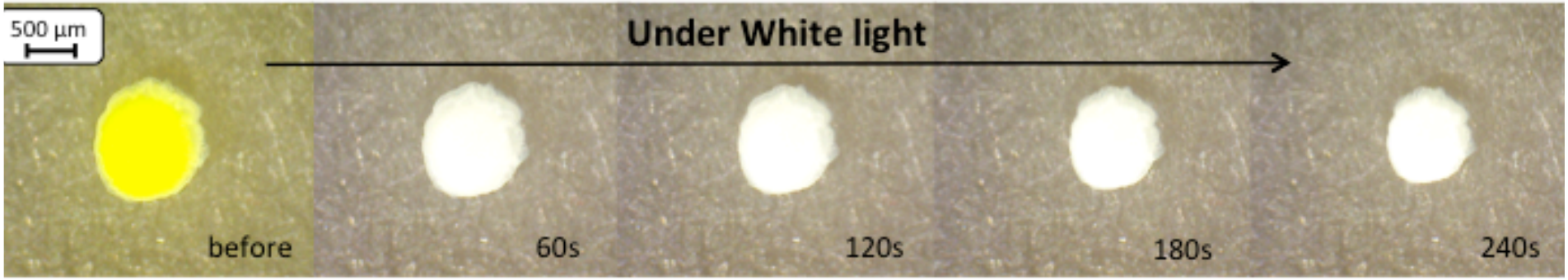
200 mg NIPAM
5 mol % Acrylic acid
1 mol % acrylated-Spiropyran
3 mol %MBIS
1 mol% PBPO
Polymerization solvent



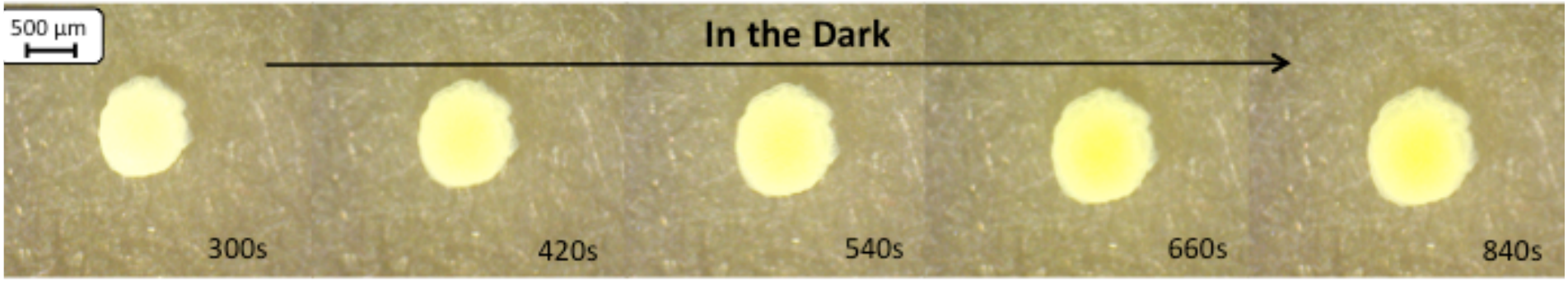
Polymerisation solvent:

THF :Water

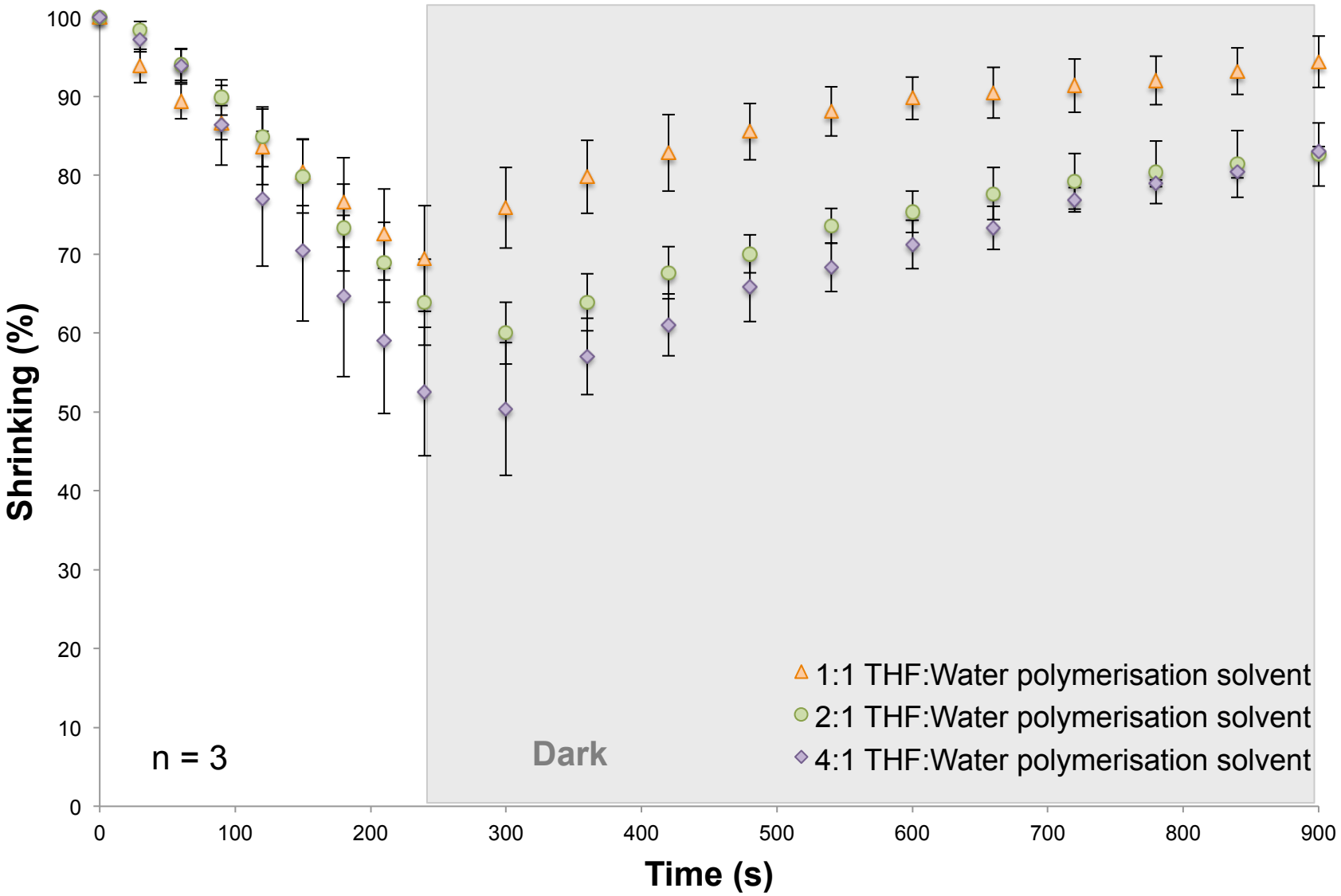
THF:Water



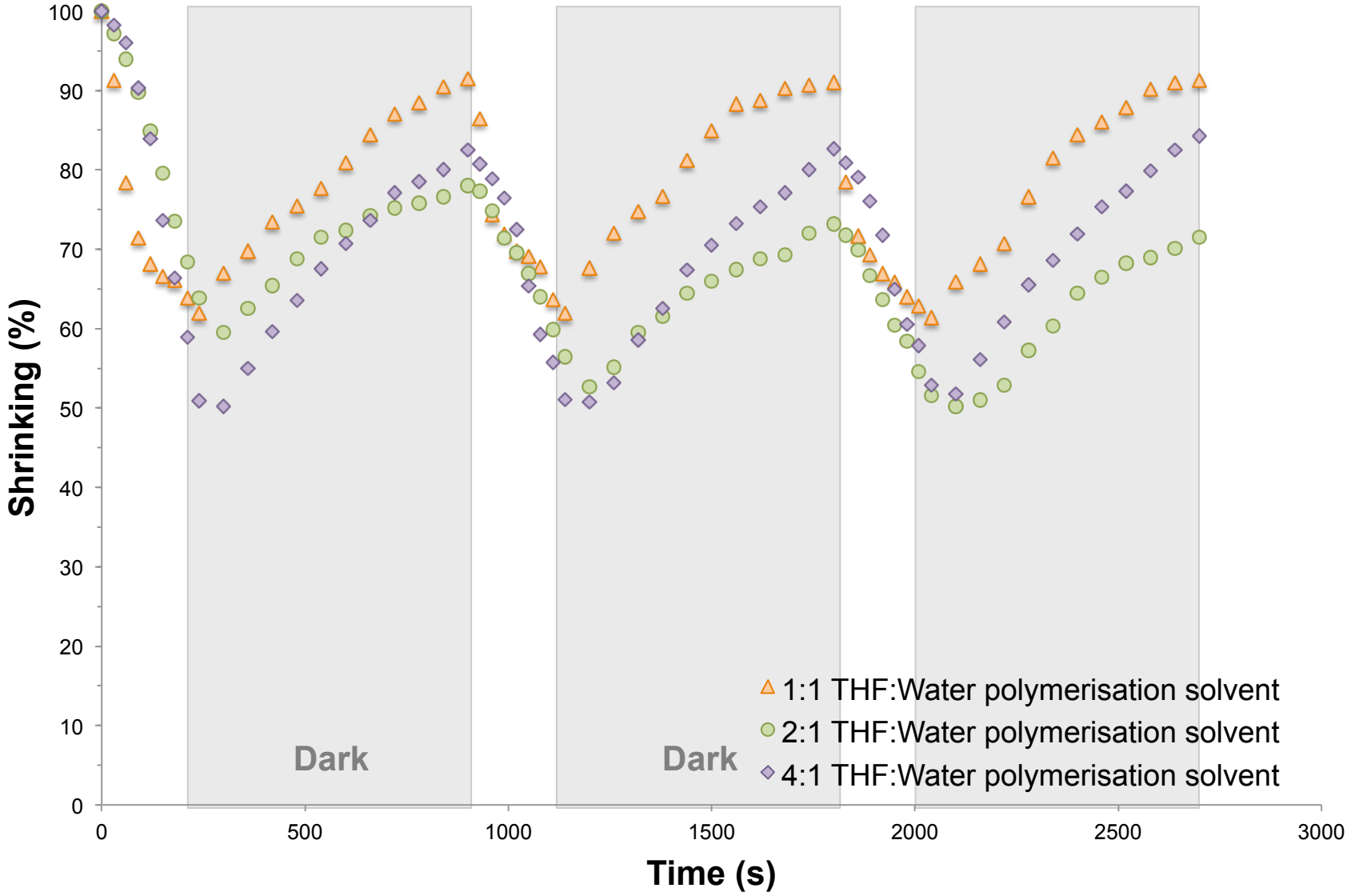
1:1 THF: DI Water



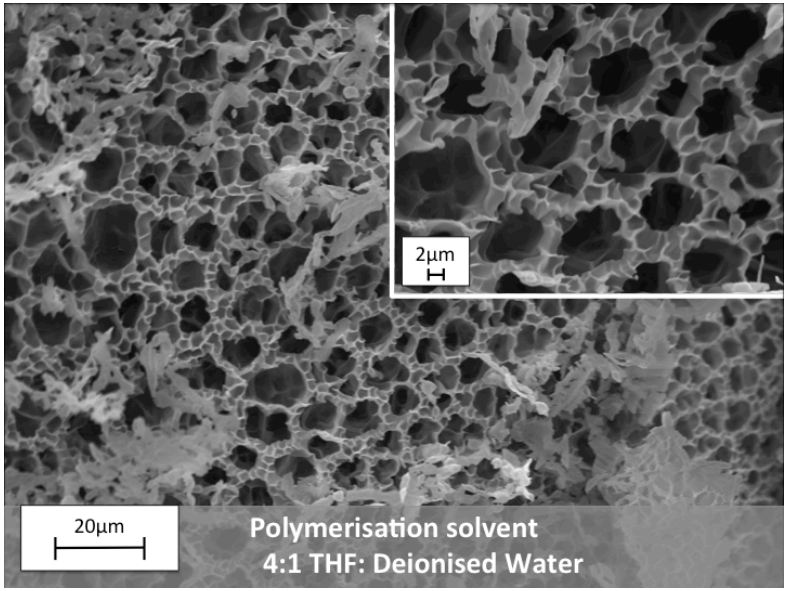
1st irradiation cycle

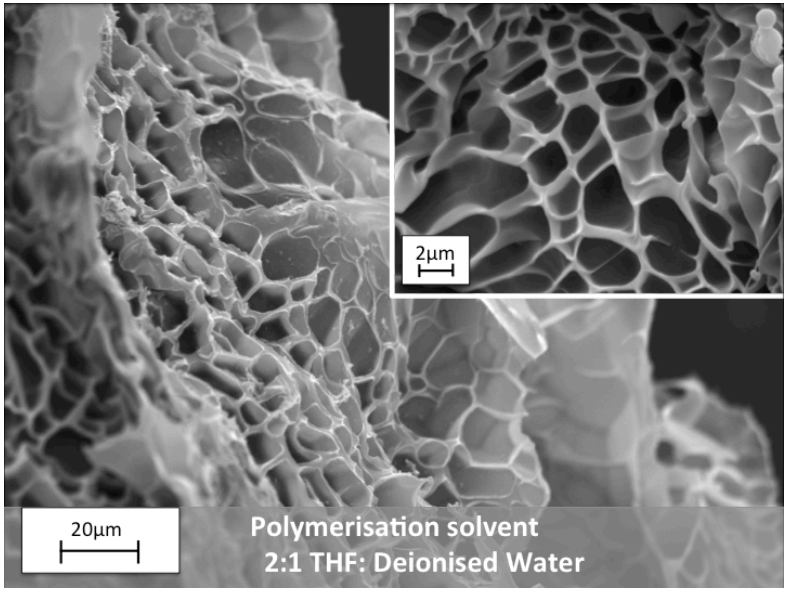


Multiple irradiation cycles



SEM Imaging


2µm
20µm
Polymerisation solvent
4:1 THF: Deionised Water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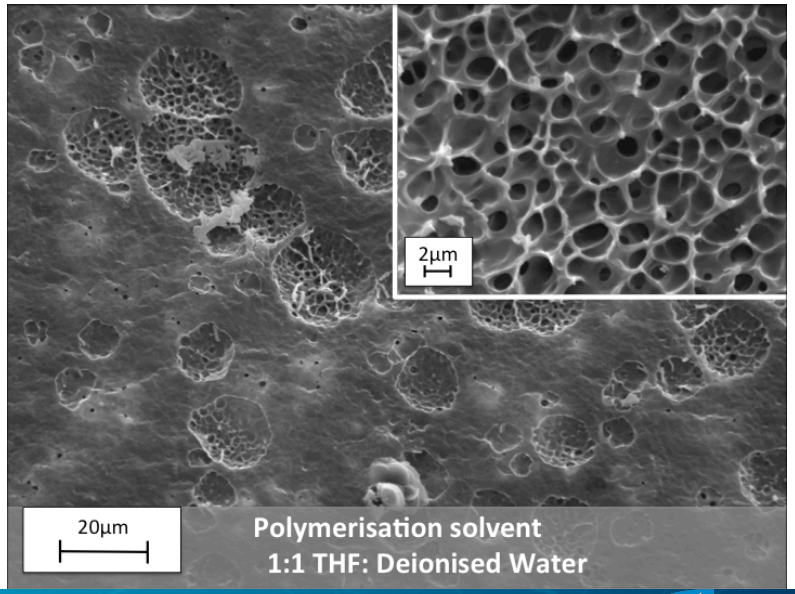
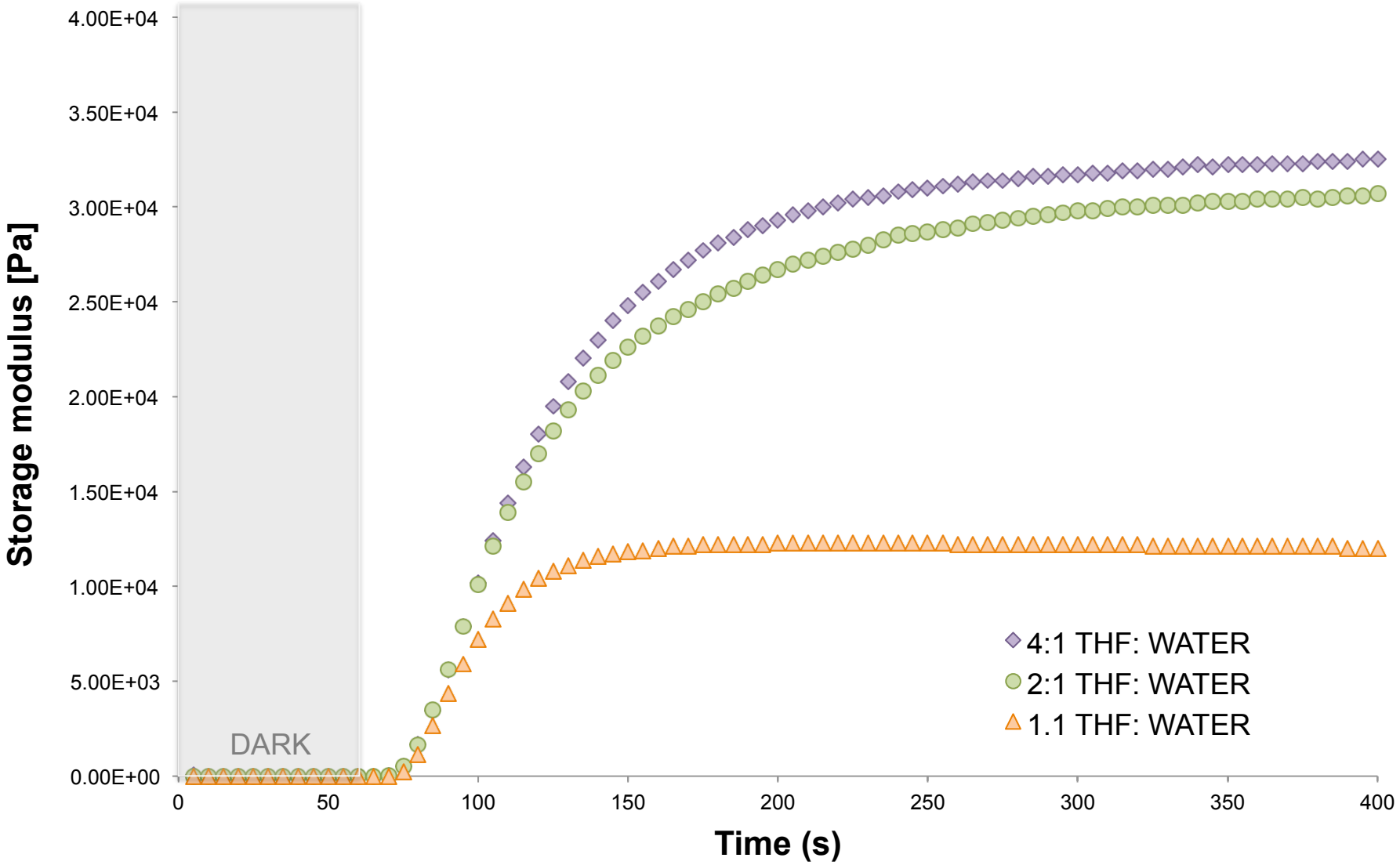

2µm
20µm
Polymerisation solvent
1:1 THF: Deionised Water

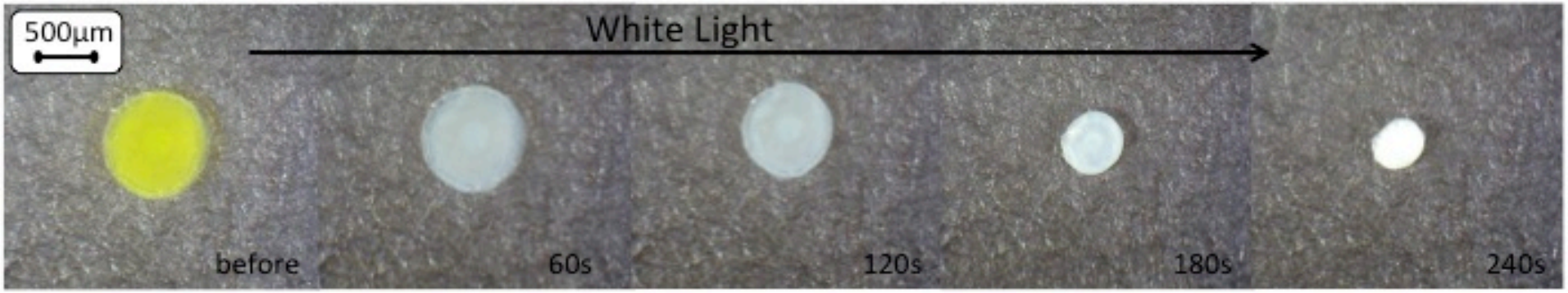
Rheology, Curing tests



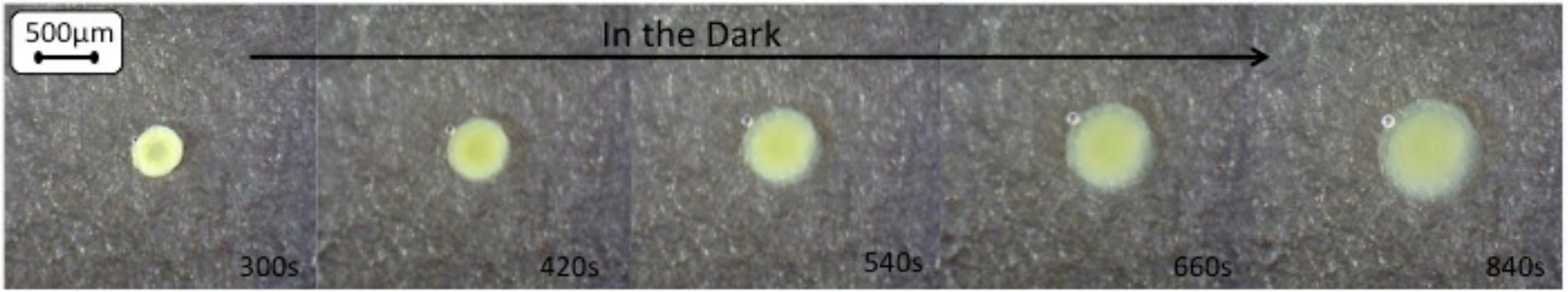
Polymerisation solvent:

Dioxane :Water

Dioxane:Water



1:1 Dioxane: DI Water



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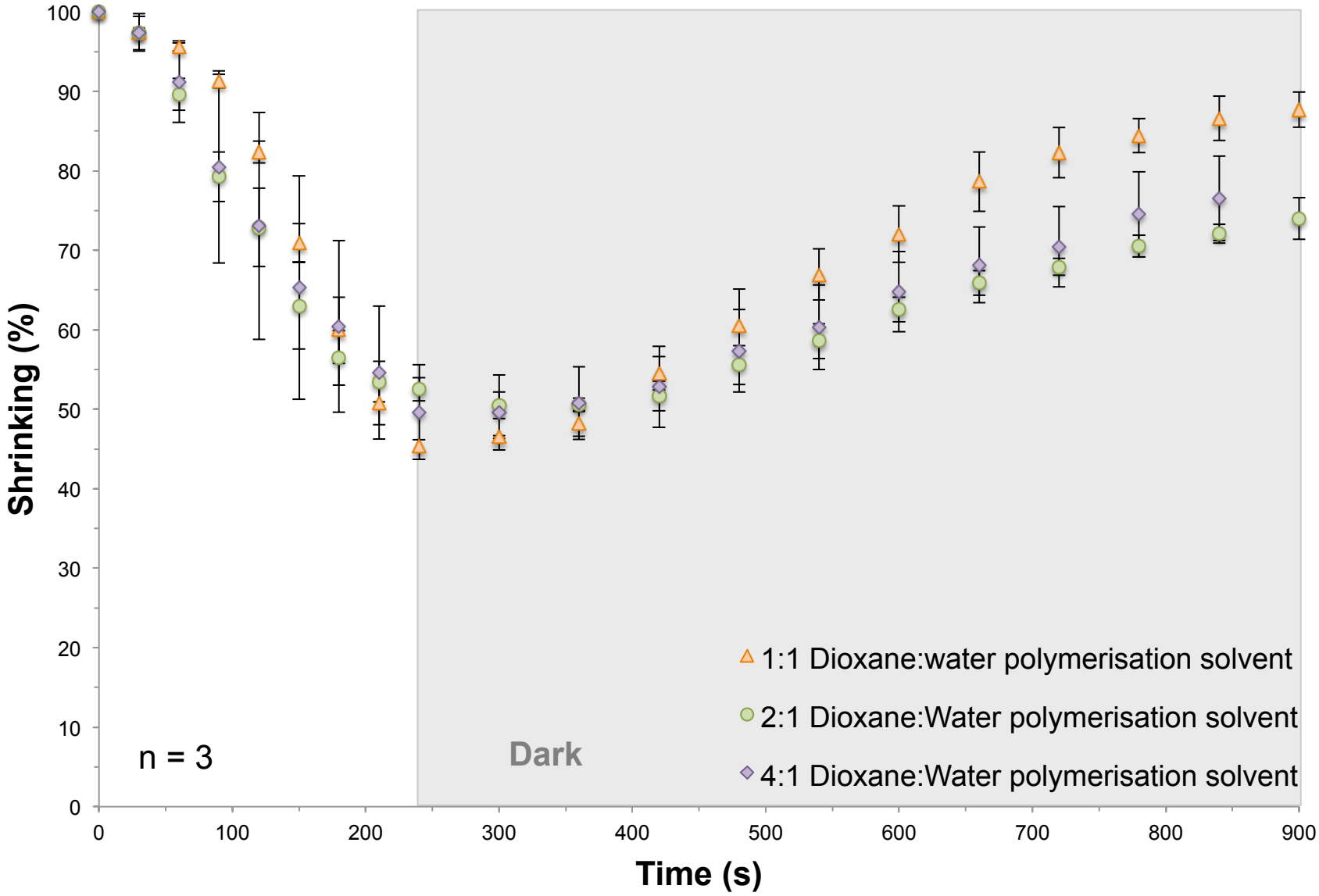
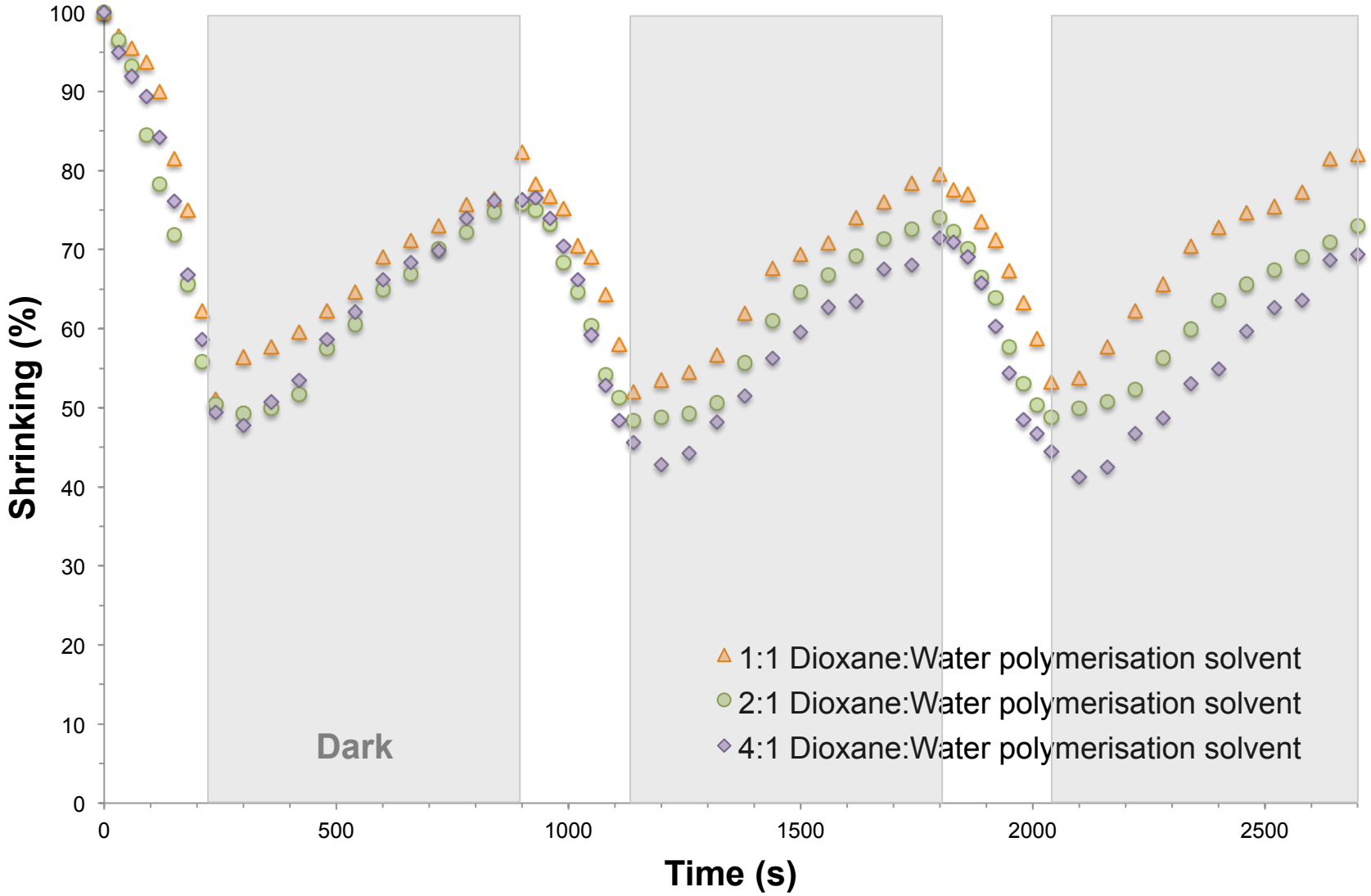
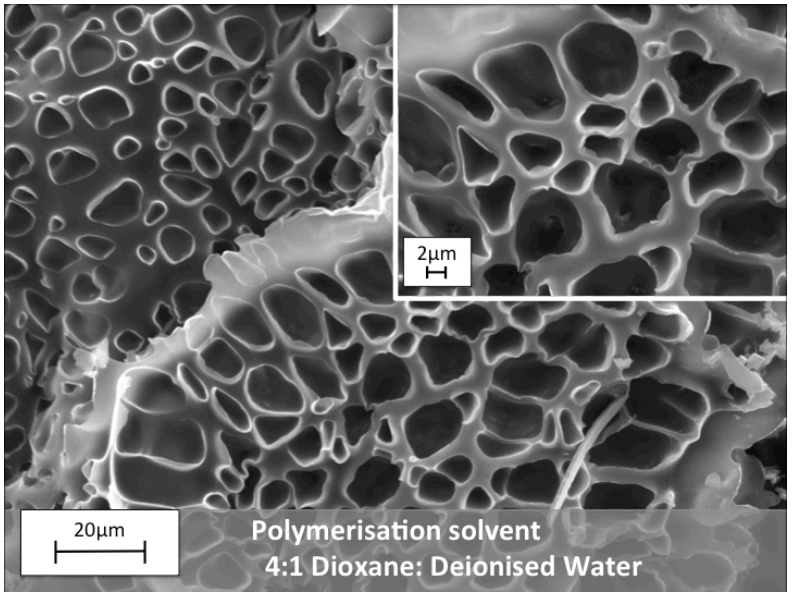


Multiple irradiation cycles



SEM Imaging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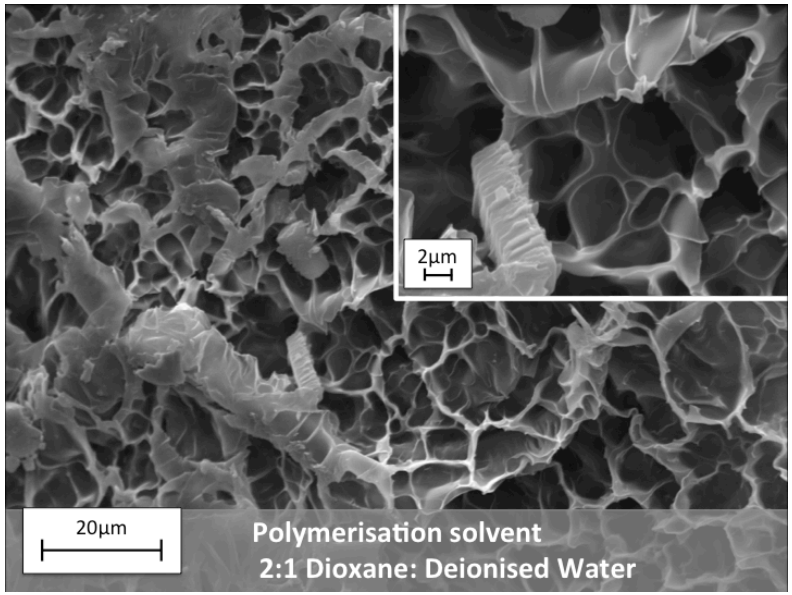
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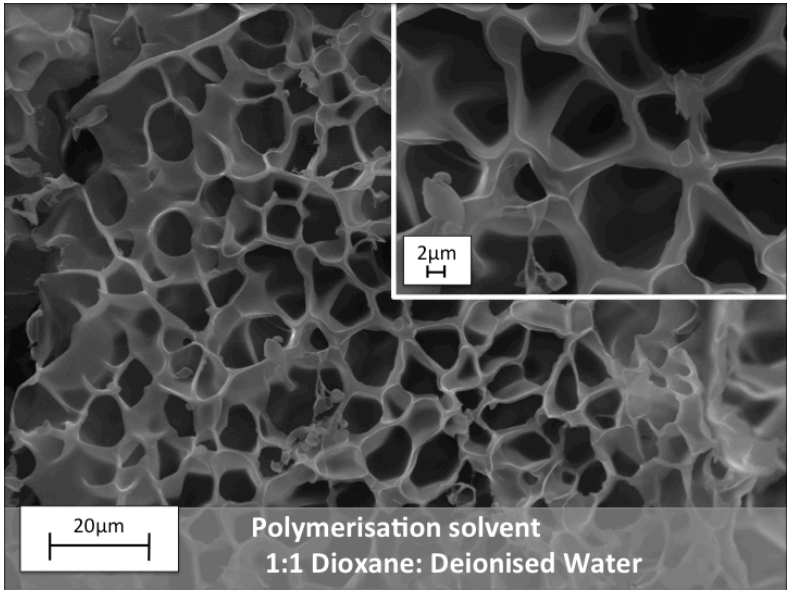
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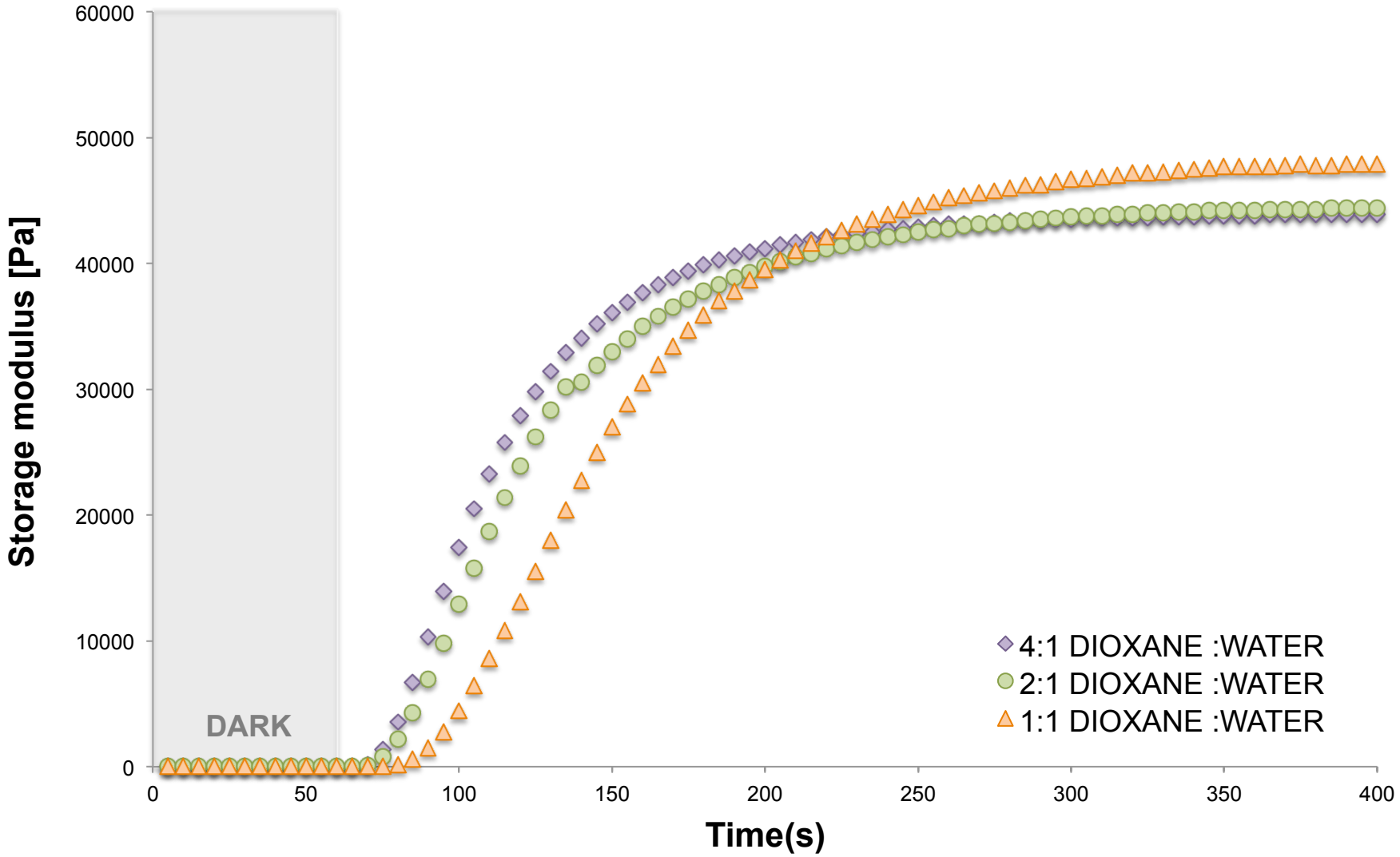
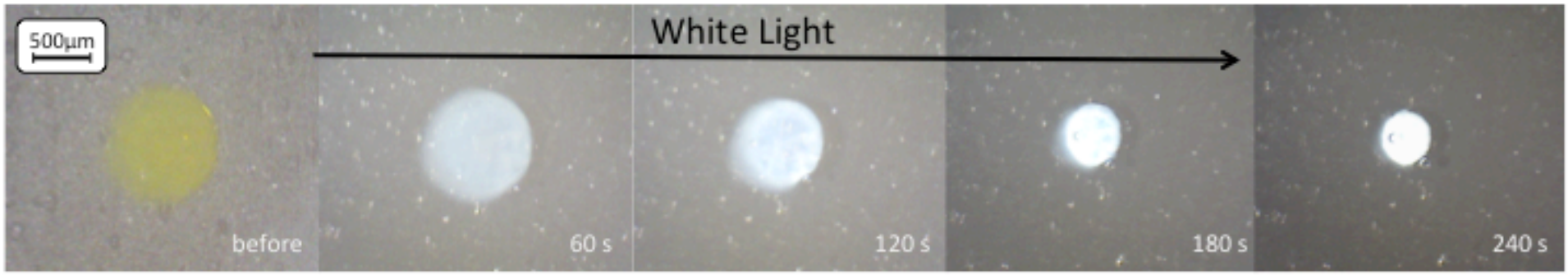


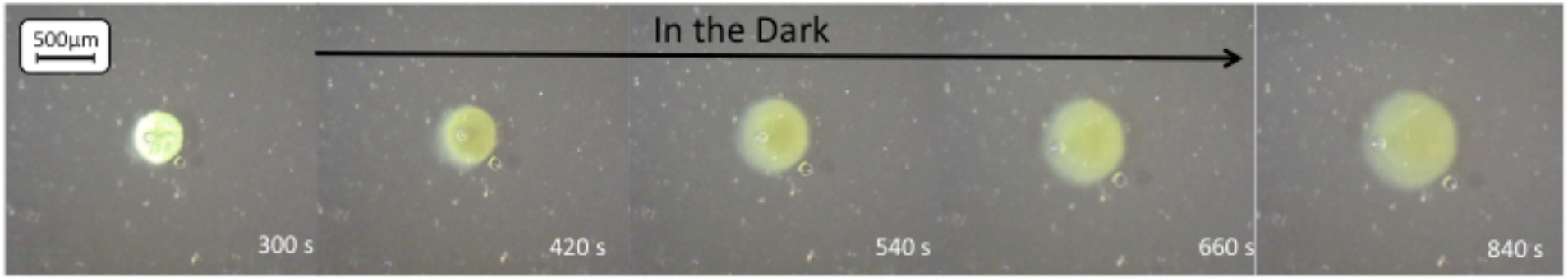
Polymerisation solvent:

Acetone :Water

Acetone :Water



1:1 Acetone: DI Water



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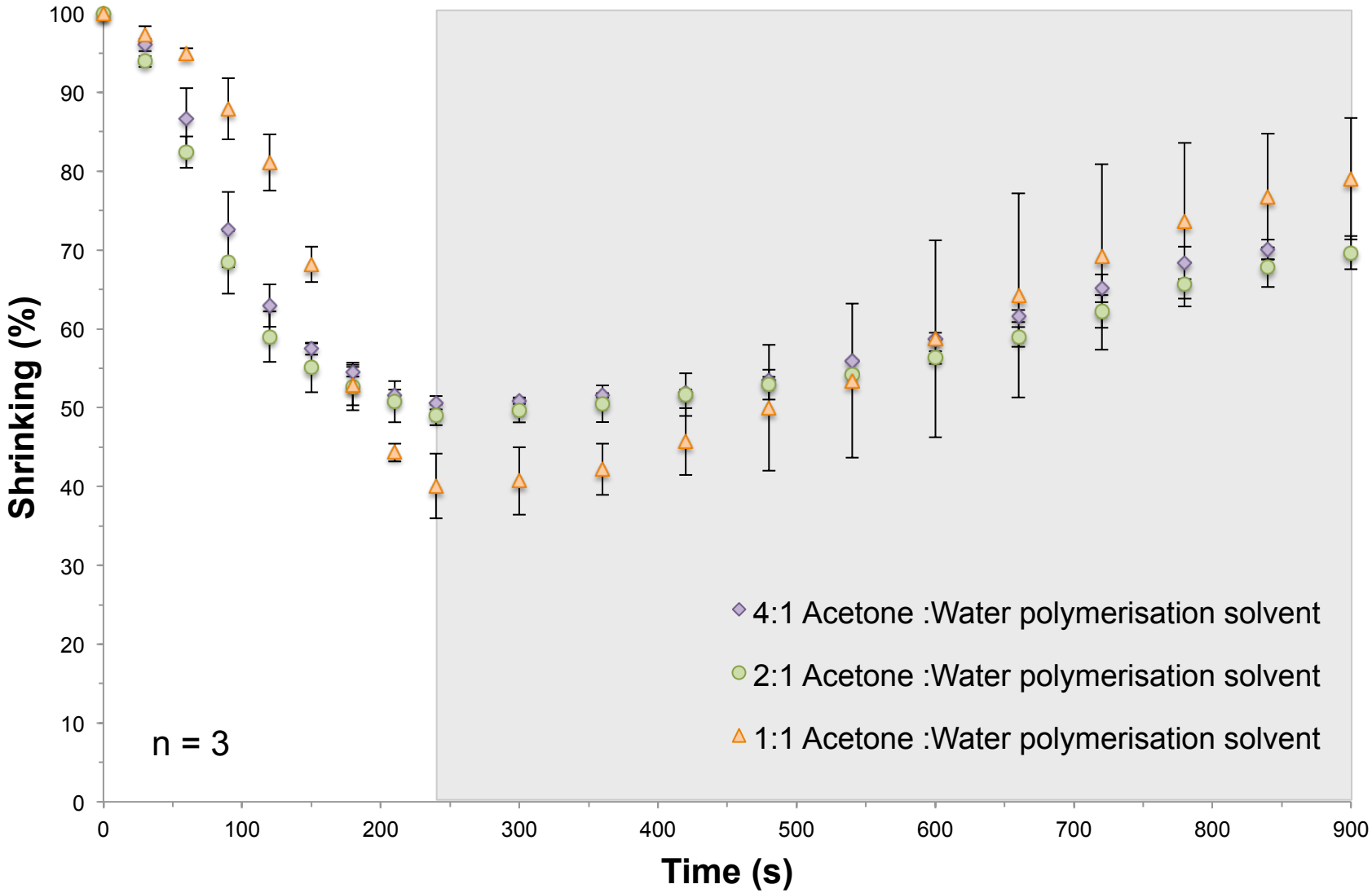
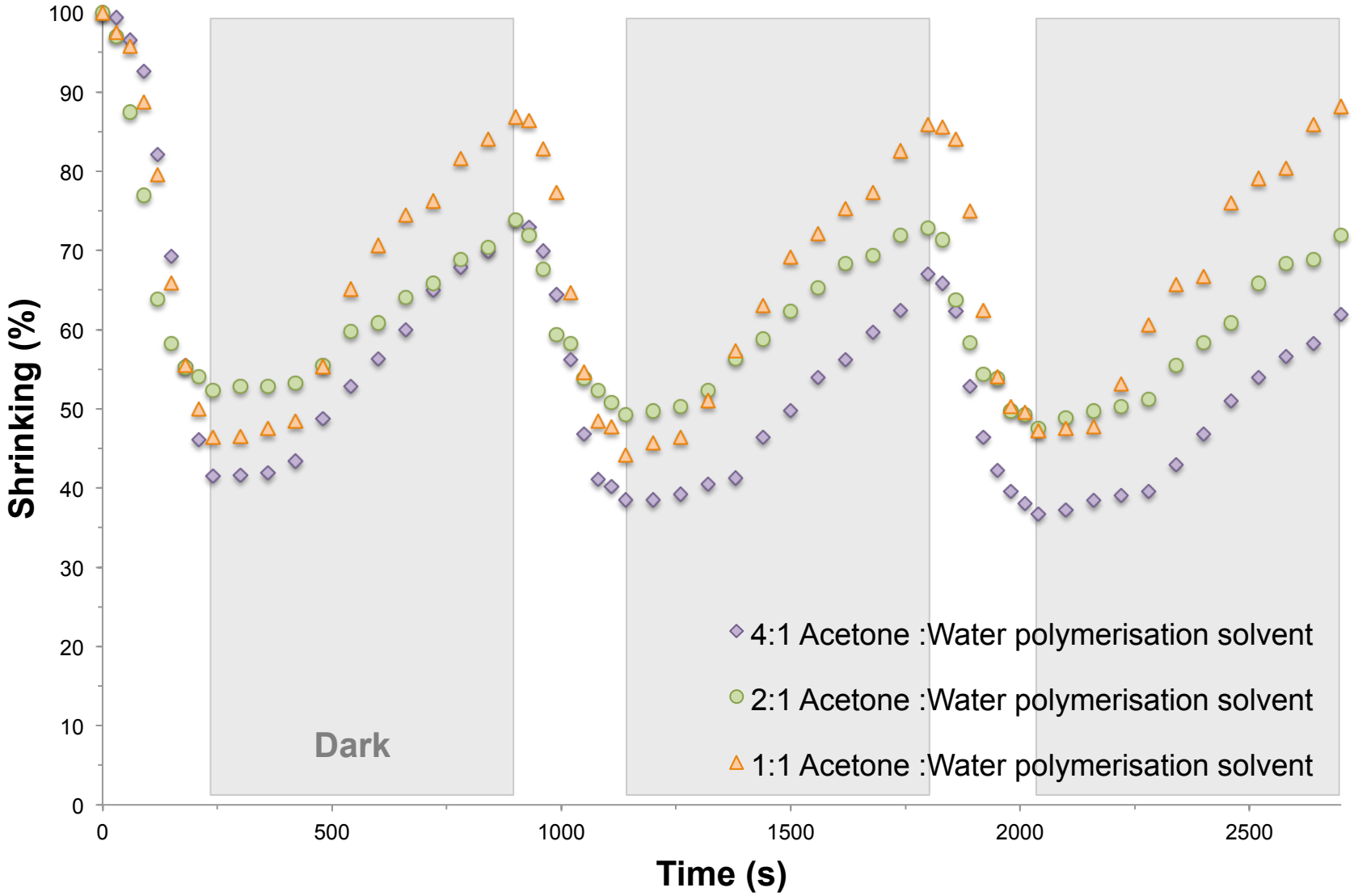


Multiple irradiation cycles



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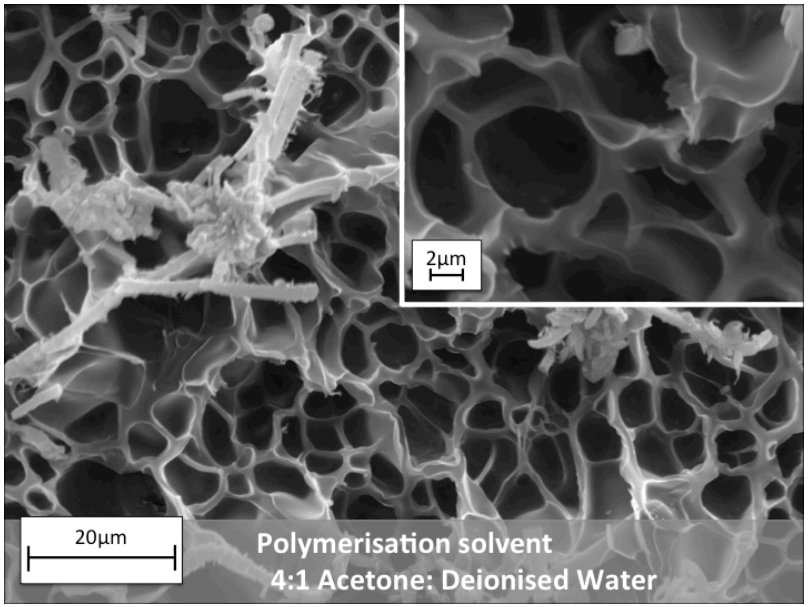
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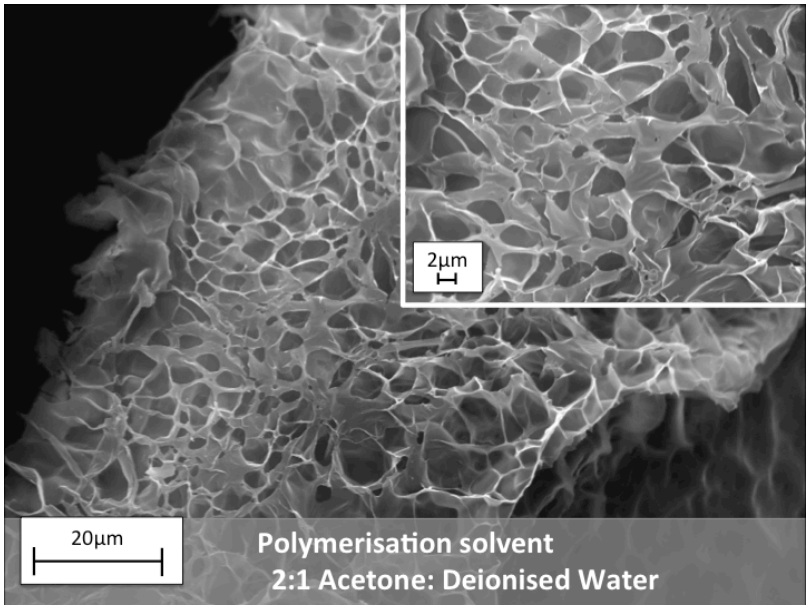
Polymerisation solvent
4:1 Acetone: Deionised Water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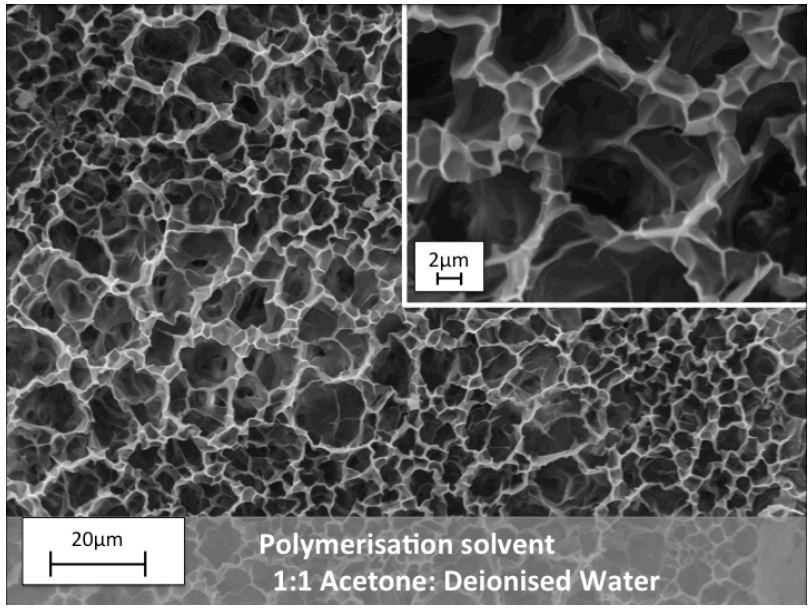
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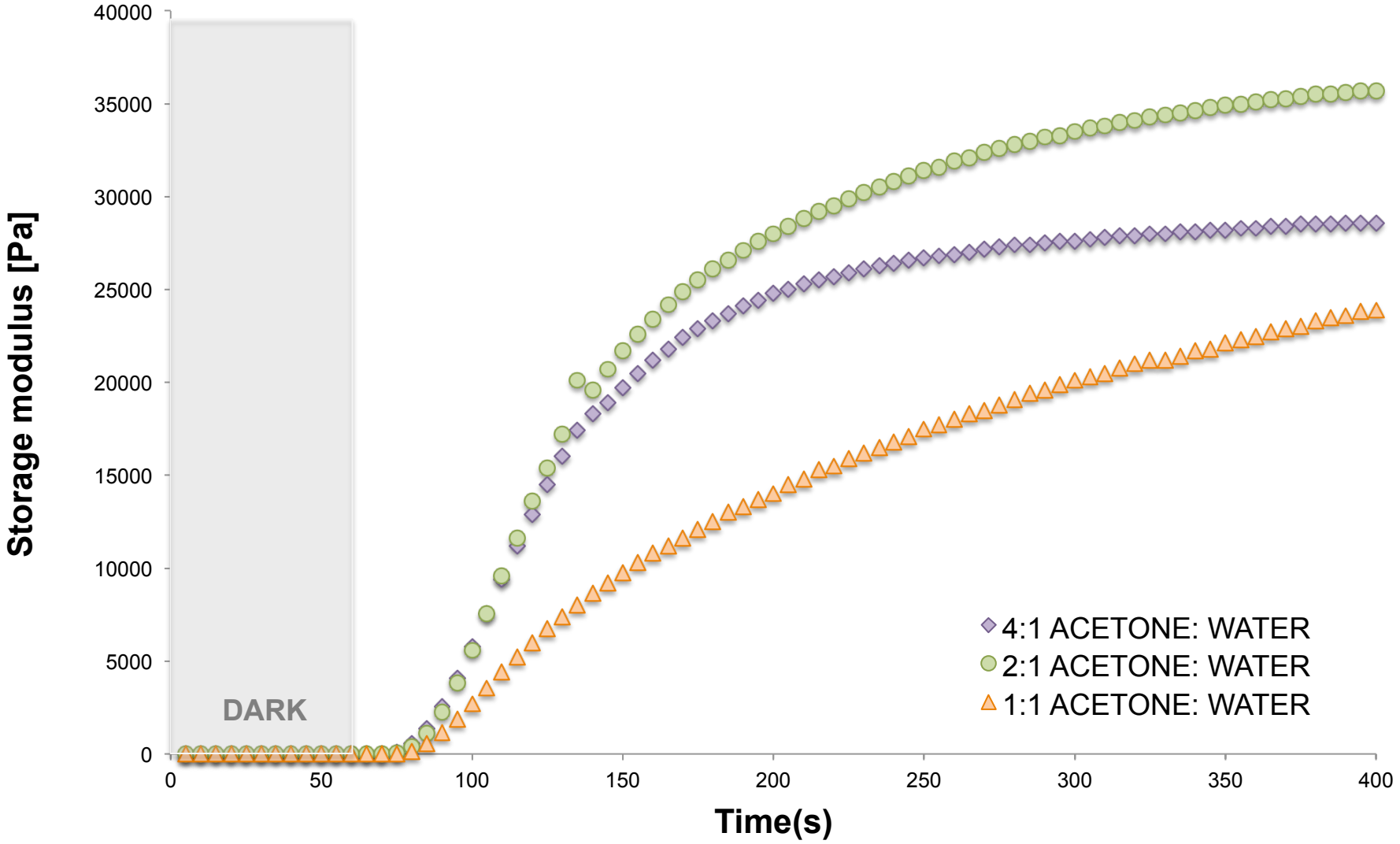
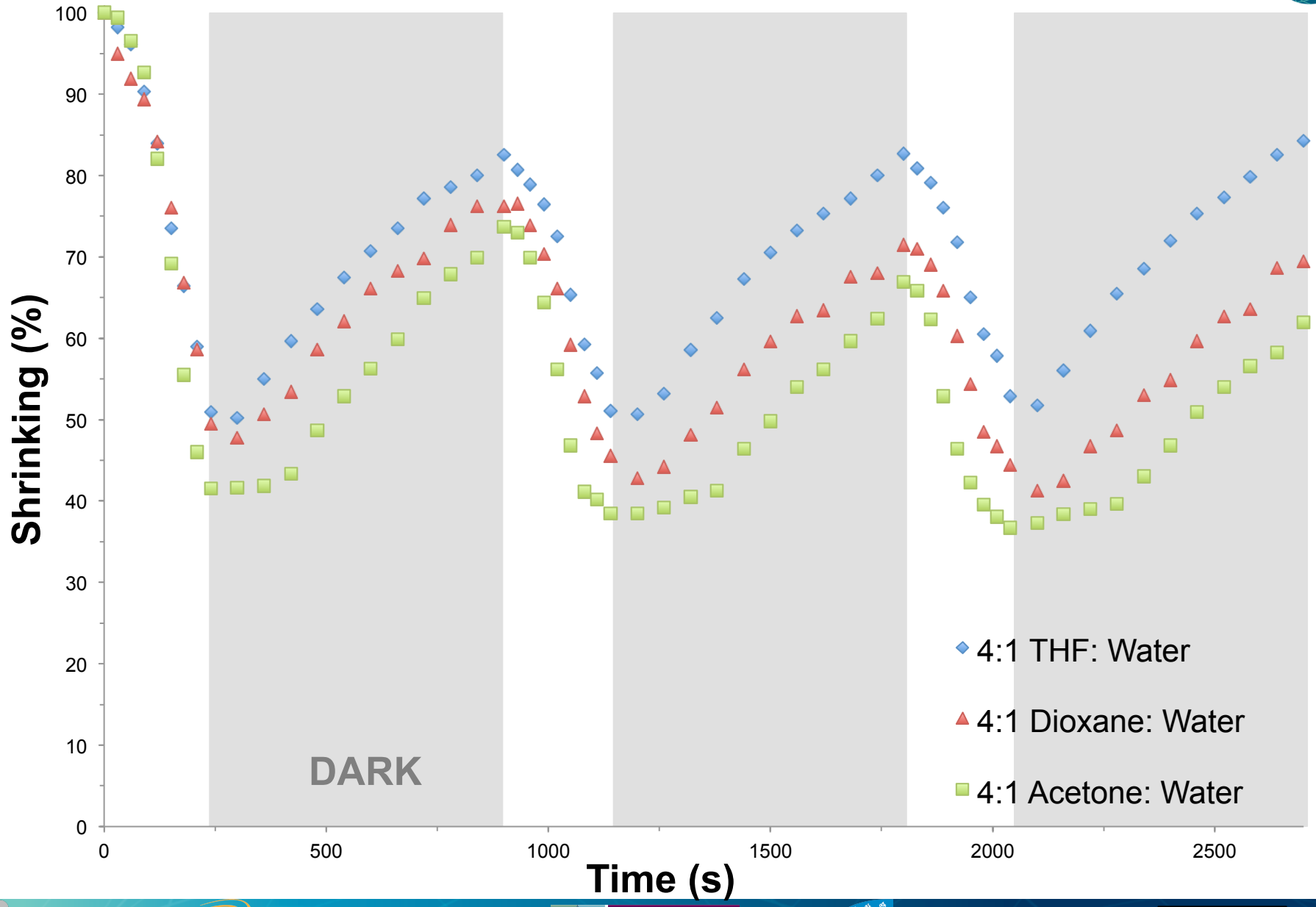
Rheology, Curing tests



Solvent comparison



Conclusion

- Successful demonstration of how different polymerisation solvents effect the morphology of the hydrogel.

- Possibility to control the photo-actuation of the hydrogels by varying the polymerisation solvent.

- Providing faster and repeatable shrinking and reswelling kinetics.

Thank You

- RACI Congress committee

- Prof. Dermot Diamond
- Dr. Larisa Florea
- Dr. Simon Gallagher
- Adaptive Sensors Group

Insight

DCU

NCSR
National Centre for Sensor Research

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