**Electronic Supplementary Information**

# Microfluidic Production of Degradable Thermoresponsive Poly(N-isopropylacrylamide)-Based Microgels

Daryl Sivakumaran†, Eva Mueller† and Todd Hoare*

*Department of Chemical Engineering, McMaster University, 1280 Main St. W., Hamilton, Ontario, Canada L8S 4L7*

* To whom correspondence should be addressed: hoaretr@mcmaster.ca

† These authors contributed equally to the work

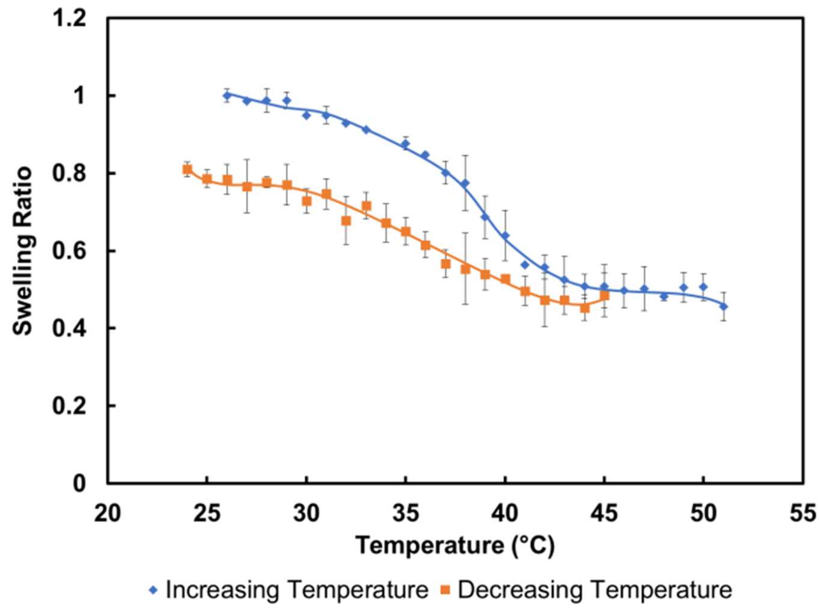


**Figure S1.** Swelling ratio hysteresis associated with the first heating/cooling cycle for PNIPAM microgels made with an oil flow rate of 1.1 mL/h. Note that such hysteresis is very common for bulk hydrogels and, to a lesser extent, nanogels, with this result (as anticipated) lying in between those two extreme cases.

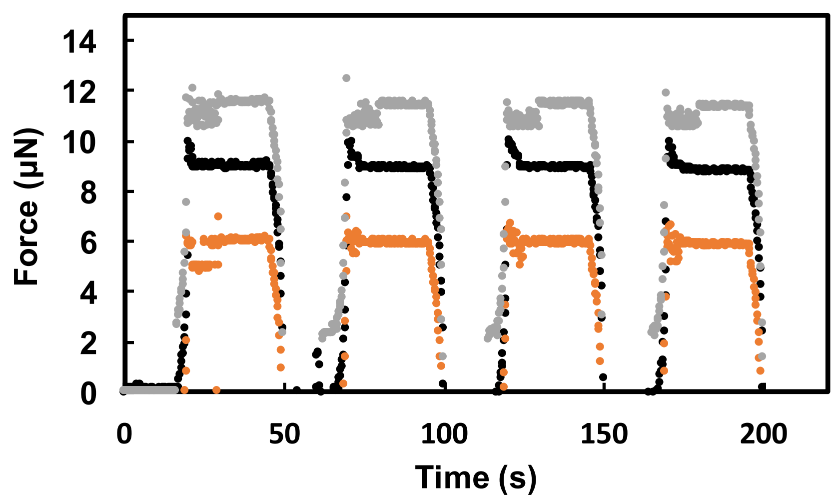


**Figure S2.** Compression cycles for three microgels at 10% (orange), 20% (black) and 40% (grey) strains. There is no hysteresis between any of the cycles at any deformation, with full elastic recovery observed after each cycle.

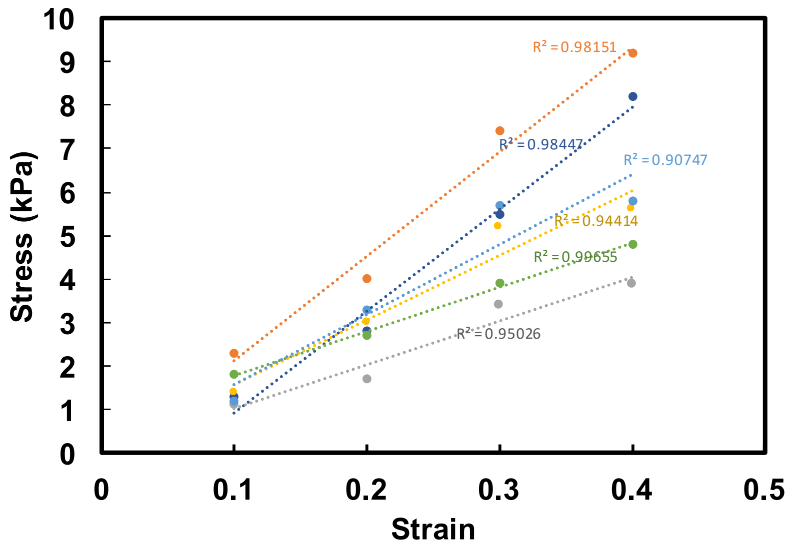


**Figure S3.** Stress versus strain plot and linear regression fits to calculate modulus (with $R^2$ values) of six replicate bulk hydrogel compression experiments

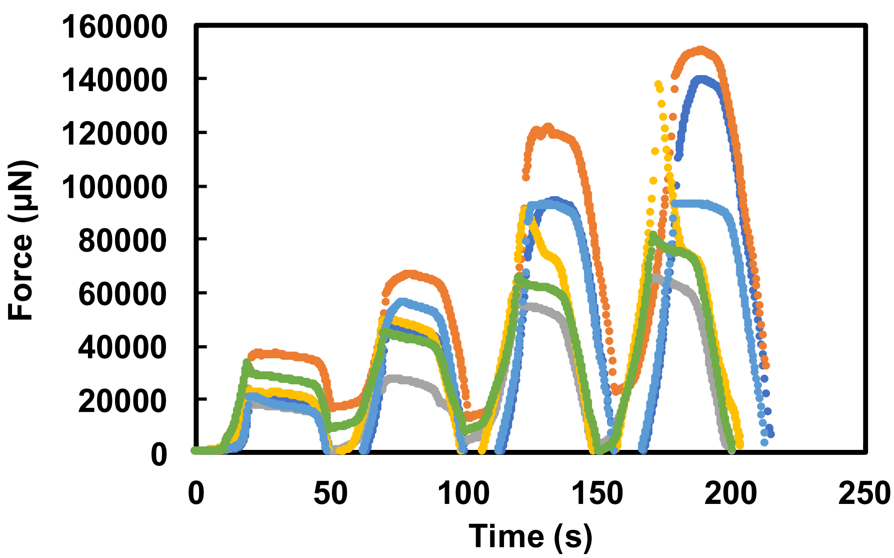


**Figure S4.** Raw force versus time results from mechanical testing of the six bulk hydrogels tested (all the same composition)

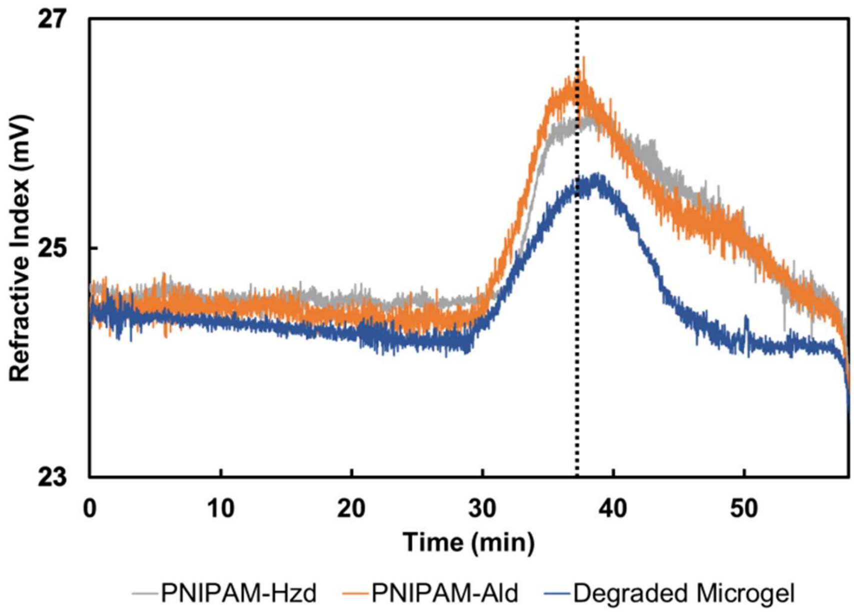


**Figure S5.** Gel permeation chromatography traces comparing molecular weight distributions of PNIPAM-Hzd and PNIPAM-Ald precursor polymers with the degradation products following complete digestion of the microgels in 1 M HCl

**Table S1.** Stress versus strain results for six replicated bulk hydrogels prepared with the same PNIPAM-hydrazide and PNIPAM-aldehyde concentrations as used in the microfluidic microgel assembly process.

| **Strain** | **Stress (kPa)** | | | | | |
|---|---|---|---|---|---|---|
| 0.1 | 1.3 | 2.3 | 1.1 | 1.4 | 1.2 | 1.8 |
| 0.2 | 2.8 | 4.0 | 1.7 | 3.0 | 3.3 | 2.7 |
| 0.3 | 5.5 | 7.4 | 3.4 | 5.2 | 5.7 | 3.9 |
| 0.4 | 8.2 | 9.2 | 3.9 | 5.6 | 5.8 | 4.8 |
| Modulus* | 23.2 | 25.9 | 10.3 | 14.9 | 16.4 | 10.2 |
| Standard Error | 2.0 | 6.7 | 1.6 | 2.4 | 3.8 | 0.4 |
| Average Modulus | 16.8 ± 6.6 | | | | | |

* slope of linear regression

**Table S2.** Plateau force measurements for microgels compressed to different strains showing no significant mechanical hysteresis and high elasticity (see raw data in Supplementary Fig. S2).

| | **Plateau Force (μN)** | | |
|---|---|---|---|
| | **Strain = 10%** | **Strain = 20%** | **Strain = 40%** |
| Cycle 1 | 6.6 ± 1.8 | 9.4 ± 0.6 | 15.3 ± 2.3 |
| Cycle 2 | 6.3 ± 1.8 | 9.3 ± 2.1 | 14.8 ± 2.1 |
| Cycle 3 | 6.8 ± 0.3 | 9.2 ± 0.8 | 14.5 ± 1.8 |
| Cycle 4 | 6.5 ± 0.4 | 9.2 ± 1.3 | 15.1 ± 1.7 |

**Modulus calculations for bulk hydrogels:**

(1) Measure average plateau force ($\mu$N) during the hold step at each tested strain
(2) Calculate stress = force/area, where area is the surface area of the platen (4 mm x 4 mm); the gel was rectangular and larger than the platen used for the testing
(3) Plot stress versus strain (Figure S3), where the slope represents the modulus

**Modulus calculations for microfluidic particles:**

(1) Take average plateau force at each strain
(2) Calculate modulus using Hertzian equation (because of spherical geometry)
(3) Back-calculate stress from modulus and strain to then plot stress versus strain