Electronic Supplementary Information

Exploring a Direct Injection Method for Microfluidic Generation of Polymer Microgels

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1. Materials

SU-8 50 photoresist was supplied from MicroChem Corp. (Newton, MA, USA). Poly(dimethyl siloxane) (PDMS; Sylgard 184) was obtained from Dow Corning (Midland, MI, USA). The ultra-low gelling temperature agarose (SeaPrep) was obtained from Lonza Rockland Inc. (Rockland, ME, USA). Phosphate buffered saline (PBS), mineral oil, sorbitan monooleate (Span 80) and methyl-β-cyclodextrin (MCD) were supplied by from Sigma (St. Louis, MO, USA). Sodium dodecyl sulfate (SDS) and glycerol were obtained from Sigma-Aldrich Co. (St. Louis, MO, USA). ABIL EM90 was donated by Evonic Goldschmidt Corp. (Hopewell, VA, USA). Poly(ethylene glycol) end-terminated with octadecyl unimer groups (PEG-ODU; molecular weight 20 kg/mol) was synthesized and purified as described elsewhere.[1,2]

2. Dimensions of channels in the microfluidic devices

We used MF devices with a similar design for the preparation of agarose and PEG-ODU microgels. The height of the microchannels was 60 μm. The dimensions of the microchannels were W_o=67 μm, W_{a1}=60 μm, W_s=100 μm and W_o'=100 μm

(Fig. S1). The widths of the side channels used for direct injections were W_{a2}=100 μm (Fig. S1a) and W_{a2}'=30 μm (Fig. S1b) for the preparation of agarose microgels and PEG-ODU microgels, respectively.

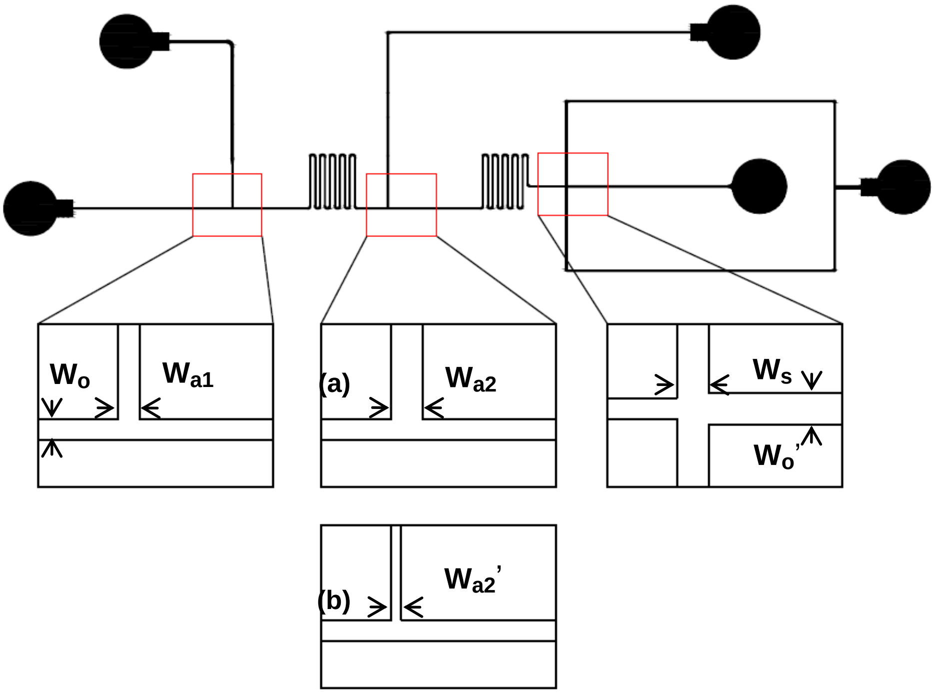

Fig. S1. Design of MF device used for the preparation of microgels. (a) and (b) shows the widths of the injection channels used for the preparation of agarose microgels and PEG-ODU microgels, respectively.

3. Viscosity of agarose solutions

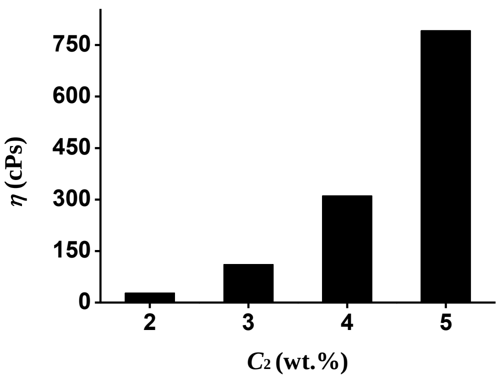

Fig. S2. Variation in viscosity of agarose solutions, plotted as a function of weight concentration of agarose. The shear rate was 125 s^{-1}, the temperature is 37 ^{o}C.

4. Size distribution of agarose microgels

Experiment was conducted as C_1=2 wt.%; C_2= 5 wt.%; and Q_i, Q_{ii} and Q_{iii} of 0.1, 0.05 and 0.05 mL/hr, respectively. Injection was conducted at Q_{iii}= 0.05 mL/hr, at which the maximum volume of 1.85×10^5 μm^3 of 5 wt.% agarose solution was injected to the primary plugs (at V_2/V_3=0.28). D_d is the diameter of the microgels. The data points of D_d were fitted with Gaussian distribution. The polydispersity of the microgels was 3.4%.

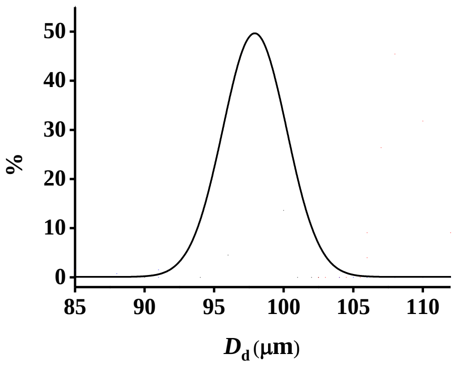

Fig. S3. Distribution of diameters of agarose microgels

5. Viscosity measurements of MCD+PEG-ODU and SDS+MCD+PEG-ODU solutions

Viscosities of mixed solutions PEG-ODU+MCD at different α (defined as molar ratio between MCD and PEG-ODU) were measured by adding a particular amount of MCD (solid) to a PEG-ODU solution, while maintaining the concentration of PEG-ODU at 8 wt.%. The solution was mixed (for 10 min at 37 ℃) to achieve complete MCD dissolution.

Similarly, viscosities of PEG-ODU+MCD+SDS mixtures in water at different β (defined as the molar ratio of SDS-to-MCD) were measured by adding a particular amount of SDS (solid) to the solution of PEG-ODU and MCD, while maintaining the constant concentrations of PEG-ODU and MCD at 4 wt.% and 0.5 wt.%, respectively. After addition of SDS, the system was mixed for 10 min to achieve full SDS dissolution.

6. Videos of injections of agarose and SDS solutions in primary plugs

The scale bars in the videos of injections of agarose and SDS solutions are 200 and 100 μm, respectively.

Notes and References

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1 Q. T. Pham, W. B. Russel and W. Lau, *J. Rheol.*, 1998, **42**, 159-176.

2 Q. T. Pham, W. B. Russel, J. C. Thibeault and W. Lau, *Macromolecules*, 1999, **32**, 2996-3005.