Electronic supplementary information (ESI) for

Synthesis of a contraction-type glucose-sensitive microgel working at physiological temperature guided by a new glucose-sensing mechanism

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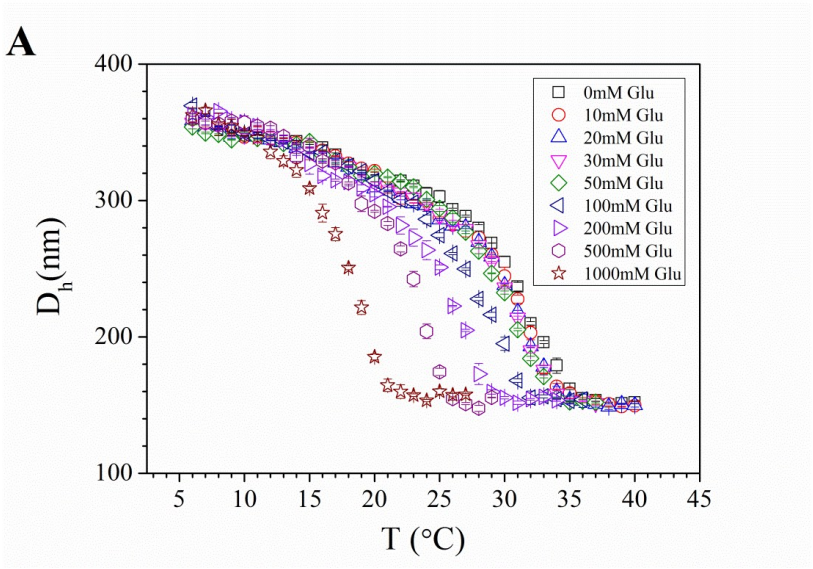


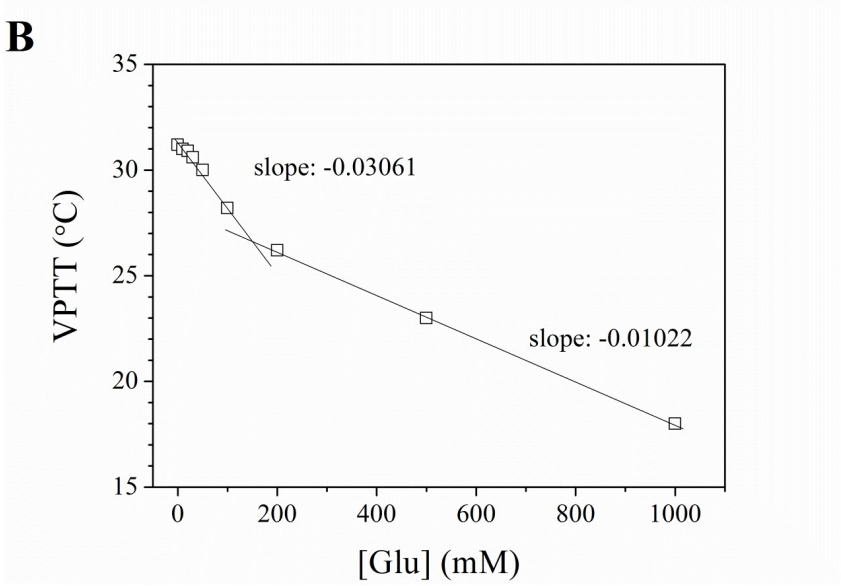
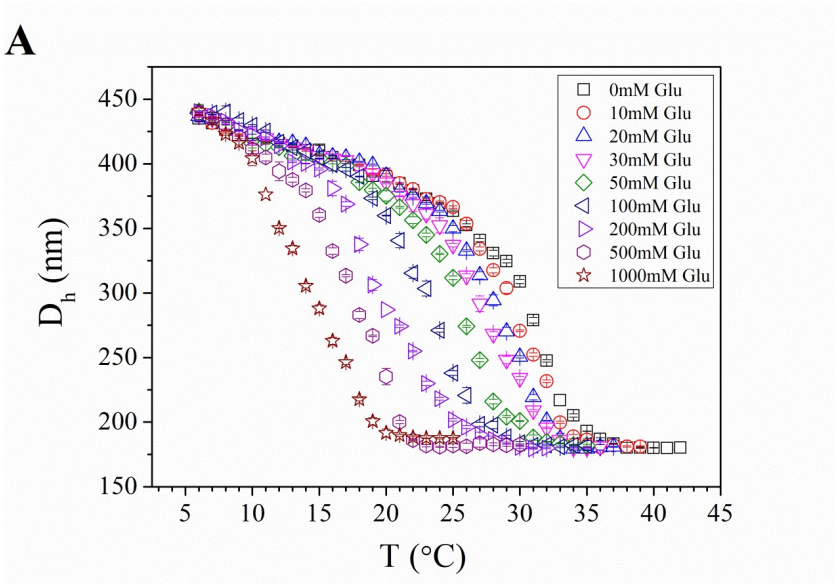


Fig. S1. (A) Temperature-induced volume phase transition of a P(NIPAM-2-AAPBA) microgel with a PBA content of 10 mol% in the presence of various concentrations of glucose. Measured in 20 mM pH7.4 phosphate buffer. (B) VPTT of the microgel as a function of glucose concentration.



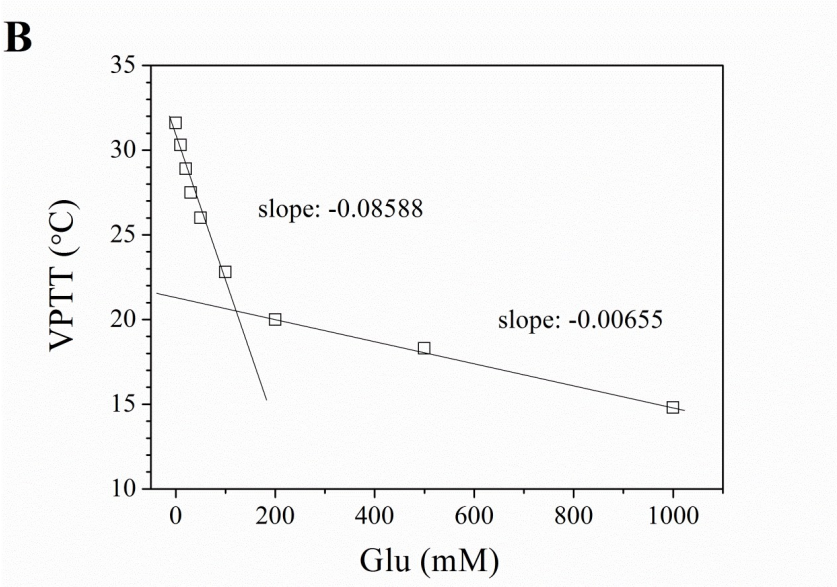
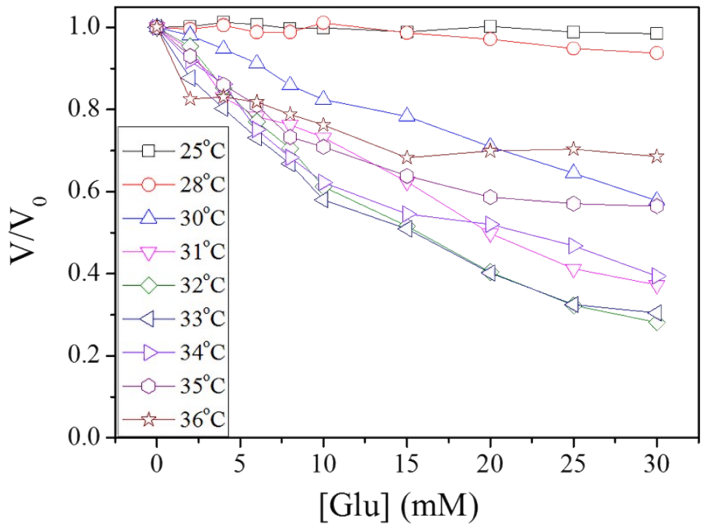
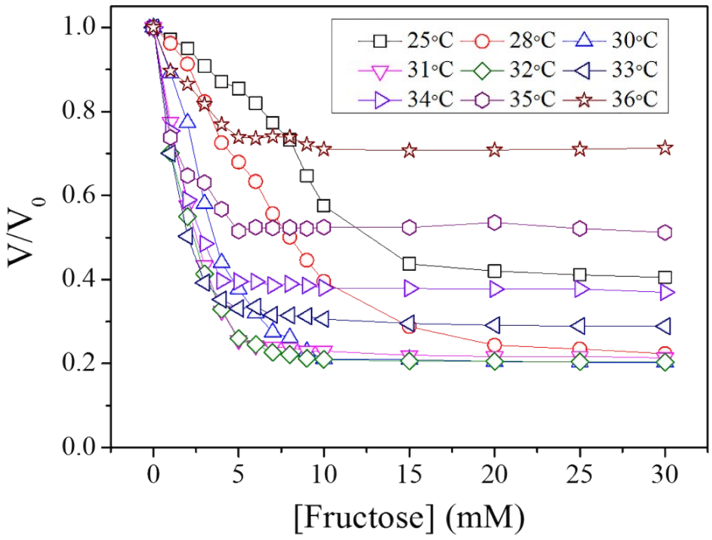


Fig. S2. (A) Temperature-induced volume phase transition of a P(NIPAM-2-AAPBA) microgel with a PBA content of 20 mol% in the presence of various concentrations of glucose. Measured in 20 mM pH7.4 phosphate buffer. (B) VPTT of the microgel as a function of glucose concentration.

A


1.0
0.8
0.6
0.4
0.2
0.0
V/V0
25°C
28°C
30°C
31°C
32°C
33°C
34°C
35°C
36°C
0
5
10
15
20
25
30
[Glu] (mM)

B


1.0
0.8
0.6
0.4
0.2
0.0
V/V0
25°C
28°C
30°C
31°C
32°C
33°C
34°C
35°C
36°C
0
5
10
15
20
25
30
[Fructose] (mM)

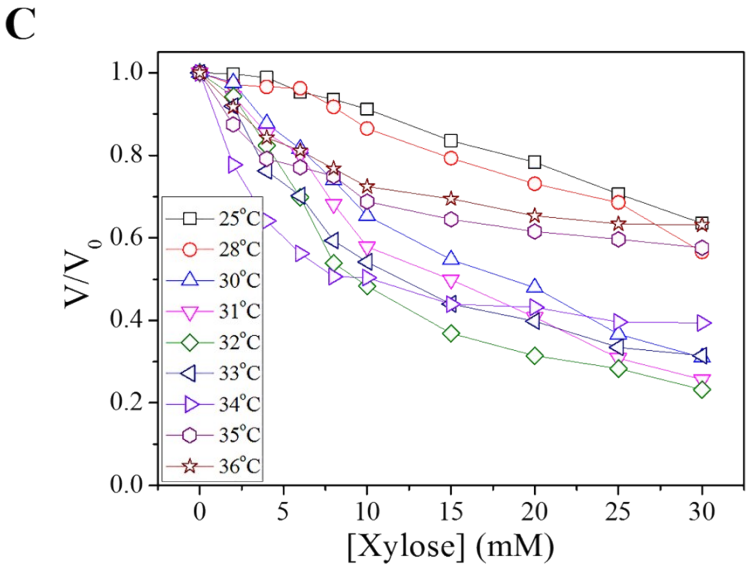
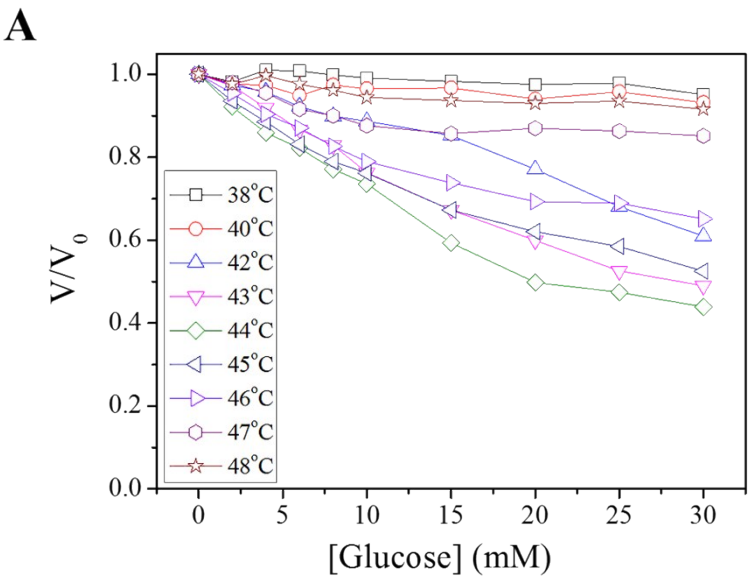


Fig. S3. Response of P(NIPAM-2-AAPBA) microgel to glucose (A), fructose (B), and xylose (C) at various temperatures as indicated, expressed as the ratio of the microgel particle volume in the presence of the saccharide (V) to the particle volume in the absence of saccharide (V_0). Measurements were all carried out in pH7.4 20 mM phosphate buffer. The lines are provided as a guide for the eye.



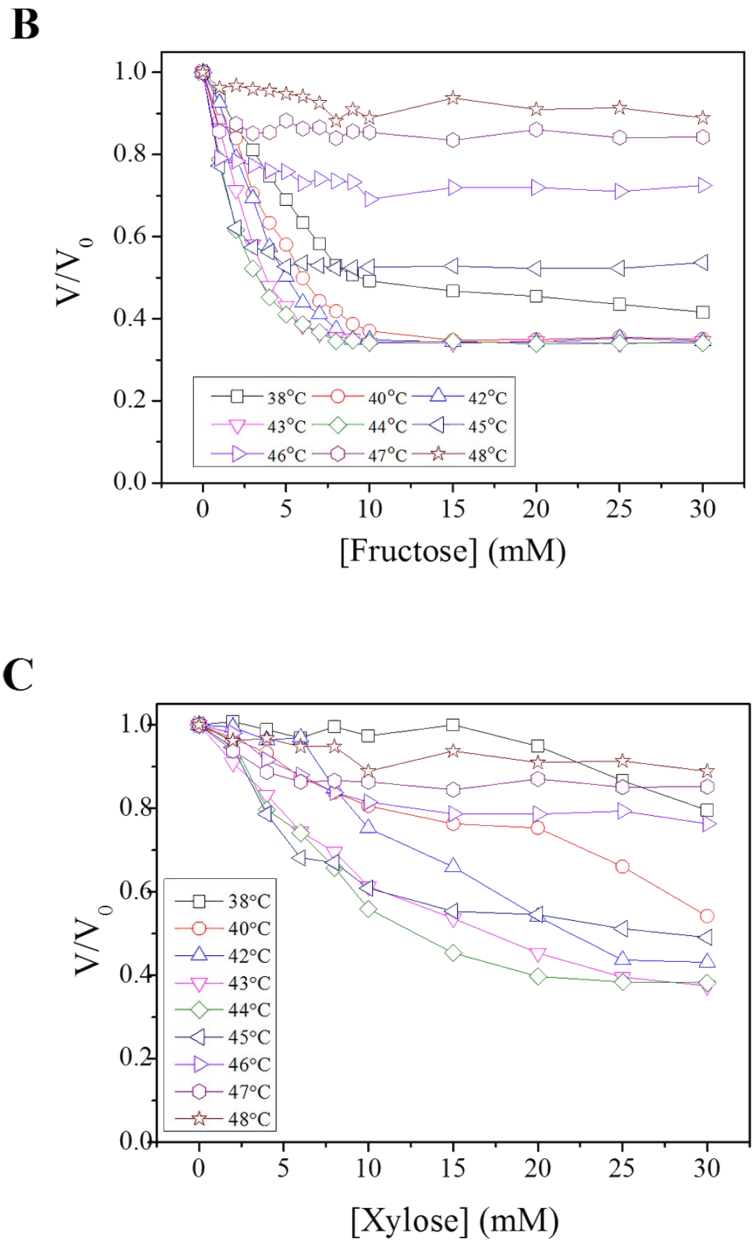
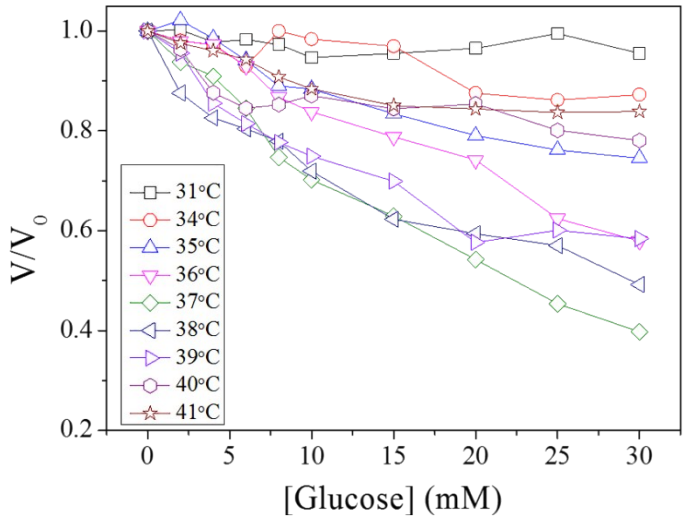
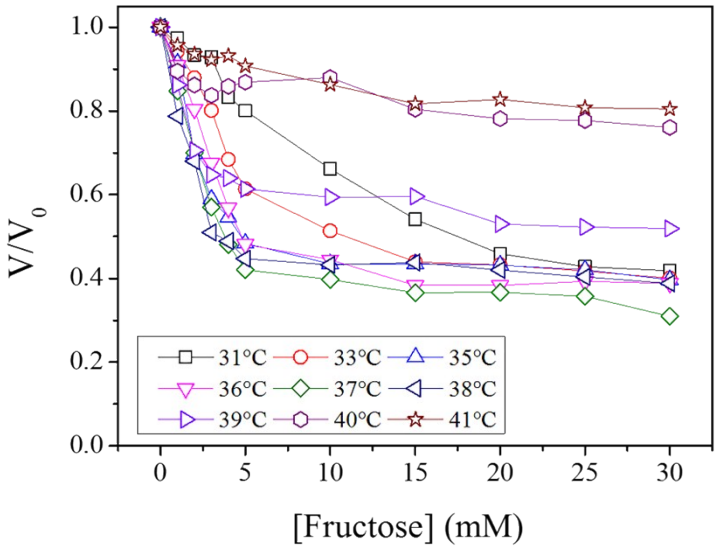


Fig. S4. Response of P(NIPMAM-2-AAPBA) microgel to glucose (A), fructose (B), and xylose (C) at various temperatures as indicated, expressed as the ratio of the microgel particle volume in the presence of the saccharide (V) to the particle volume in the absence of saccharide (V_0). Measurements were all carried out in pH7.4 20 mM phosphate buffer. The lines are provided as a guide for the eye.

A


1.0
0.8
0.6
0.4
0.2
V/V0
0
5
10
15
20
25
30
[Glucose] (mM)
31°C
34°C
35°C
36°C
37°C
38°C
39°C
40°C
41°C

B


1.0
0.8
0.6
0.4
0.2
0.0
V/V0
0
5
10
15
20
25
30
[Fructose] (mM)
31°C
33°C
35°C
36°C
37°C
38°C
39°C
40°C
41°C

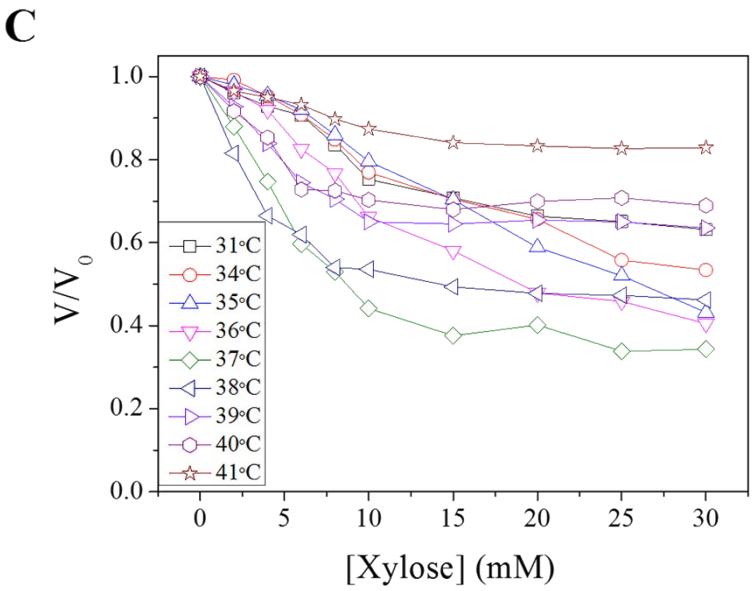


Fig. S5. Response of P(NIPAM-NMIPAM-2-AAPBA) microgel to glucose (A), fructose (B), and xylose (C) at various temperatures as indicated, expressed as the ratio of the microgel particle volume in the presence of the saccharide (V) to the particle volume in the absence of saccharide (V_0). Measurements were all carried out in pH7.4 20 mM phosphate buffer. The lines are provided as a guide for the eye.

Further discussion on why the percentage of PBA reacted with glucose is only dependent on glucose concentration in the media:

The reaction between glucose and PBA can be written as

$$\text{Glu} + \text{PBA} \rightleftharpoons \text{Glu/PBA}$$

Under the experimental condition, the total concentration of glucose is much larger than the total concentration of PBA, i.e., $[Glu]_0 >> [PBA]_0$. Therefore the reaction equilibrium between glucose and PBA can be written as:

$$K_a = \frac{[Glu/PBA]}{[Glu] \bullet [PBA]} \approx \frac{[PBA]_0 - [PBA]}{[Glu]_0 \bullet [PBA]}$$

Where K_a is the equilibrium constant. [PBA], [Glu/PBA], [Glu] are the concentration of PBA, Glu/PBA complex and glucose. Therefore

$$\frac{[PBA]}{[PBA]_0} = \frac{1}{1 + K_a \bullet [Glu]_0}$$

The result indicates that the percentage of unreacted PBA groups in the gel is only dependent on $[Glu]_0$, not on $[PBA]_0$. Therefore the percentage of PBA reacted with glucose is also only dependent on glucose concentration in the media.