Electronic Supplementary Information (ESI)

Highly porous, emulsion-templated, zwitterionic hydrogels: Amplified and accelerated uptakes with enhanced environmental sensitivity

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Experimental section

Materials. Pluronic® P-123 (a PEO_{20}-PPO_{70}-PEO_{20} triblock copolymer with poly(ethylene oxide) (PEO) and poly(propylene oxide) (PPO) blocks, M_n = 5800), *N,N'*-methylenebisacrylamide (MBAAm), *N,N,N',N'*-tetramethylethylenediamine (TEMED), NaBr, NaI, acrylamide (AAm) and sodium acrylate (NaA) were from Sigma-Aldrich, while ammonium persulfate (APS) was from Fluka. All the chemicals were used as received. The other reagents were analytical grade. Deionized water was used for all the syntheses.

Table S1 Recipes for the Z-*X*-*Y*[a]

	Z-85-20	Z-85-10	Z-85-5	Z-80-20	Z-80-10	Z-80-5	Z-75-20
Aqueous, continuous phase (wt %)							
Water	9.32	9.64	9.77	12.29	12.69	12.87	16.21
P-123	0.77	0.77	0.77	1.01	1.01	1.01	1.34
SBMA	4.10	4.10	4.10	5.40	5.40	5.40	7.13
MBAAm	0.57	0.25	0.12	0.74	0.34	0.16	0.98
APS	0.10	0.10	0.10	0.13	0.13	0.13	0.18
Total	14.86	14.86	14.86	19.57	19.57	19.57	25.84
Organic, dispersed phase (wt %)							
Hexane	85.04	85.04	85.04	80.30	80.30	80.30	73.98
Catalyst added following HIPE formation (wt %)							
TEMED	0.10	0.10	0.10	0.13	0.13	0.13	0.18

[a] *X* and *Y* represent the mass fraction of the dispersed phase in the HIPE and the mole fraction of MBAAm in the monomers, respectively.

Table S2 Recipes for the PH-80-10-*V*[a]

	PH-80-10-30	PH-80-10-0
Aqueous, continuous phase (wt %)		
Water	12.38	13.00
P-123	1.17	1.17
AAm	3.24	4.86
NaA	2.13	0
MBAAm	1.16	1.16
APS	0.12	0.12
Total	20.20	20.19
Organic, dispersed phase (wt %)		
Hexane	79.71	79.72
Catalyst added following HIPE formation (wt %)		
TEMED	0.09	0.09
Yield (%)	80	81
Density (g cm^{-3})	0.18	0.17

[a] 80 represents the mass fraction of the dispersed phase, 10 represents the mole fraction of MBAAm in the monomers, *V* represents the mole fraction of NaA in the monomers.

Results and Discussion

Macromolecular Structure. The influence of the Z-80-*Y* monomer composition on the macromolecular structure was investigated using Fourier transform infrared spectroscopy (FTIR). The FTIR spectra in Fig. S1 were normalized by the peak height at 1190 cm^{-1} that is associated with the carbonyl group in SBMA. SBMA: the peaks at 737 and 1043 cm^{-1} are the characteristic absorptions for -C-S- and -S=O, respectively,[1] and the peak at 1731 cm^{-1} is the characteristic absorption of the carboxyl group. MBAAm: the absorption peaks at 1644 and 1538 cm^{-1} are associate with the amide I C=O stretch and the amide II -N-H vibration, respectively.[2] These latter assignments were confirmed by the decrease in the normalized peak heights at 1644 and 1538 cm^{-1} with the decrease in the Z-80-*Y* MBAAm content.

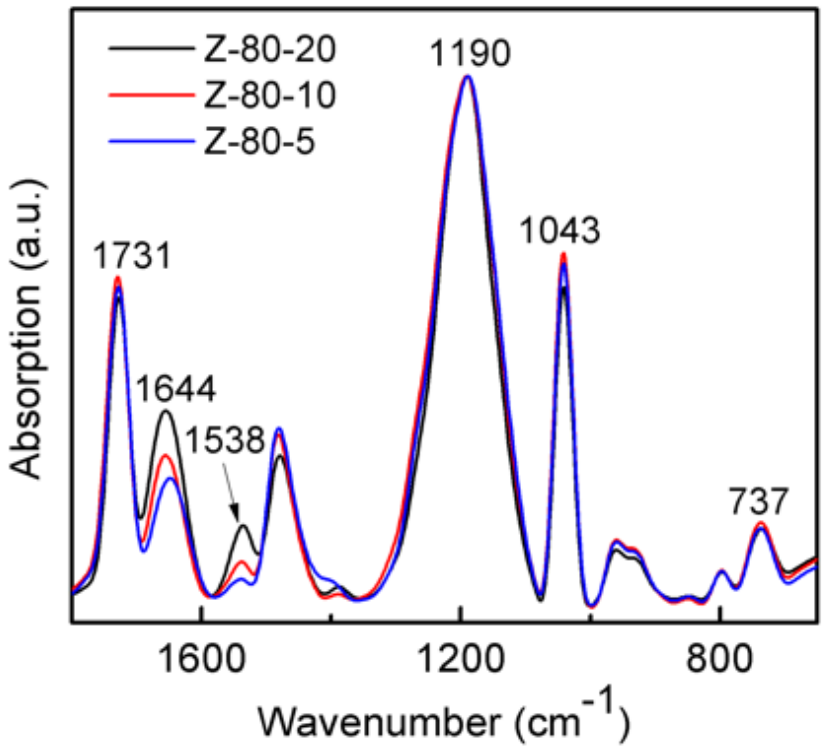

Fig. S1 FTIR spectra of the Z-80-*Y* normalized using the peak height at 1190 cm^{-1}.

Void Diameter Distributions

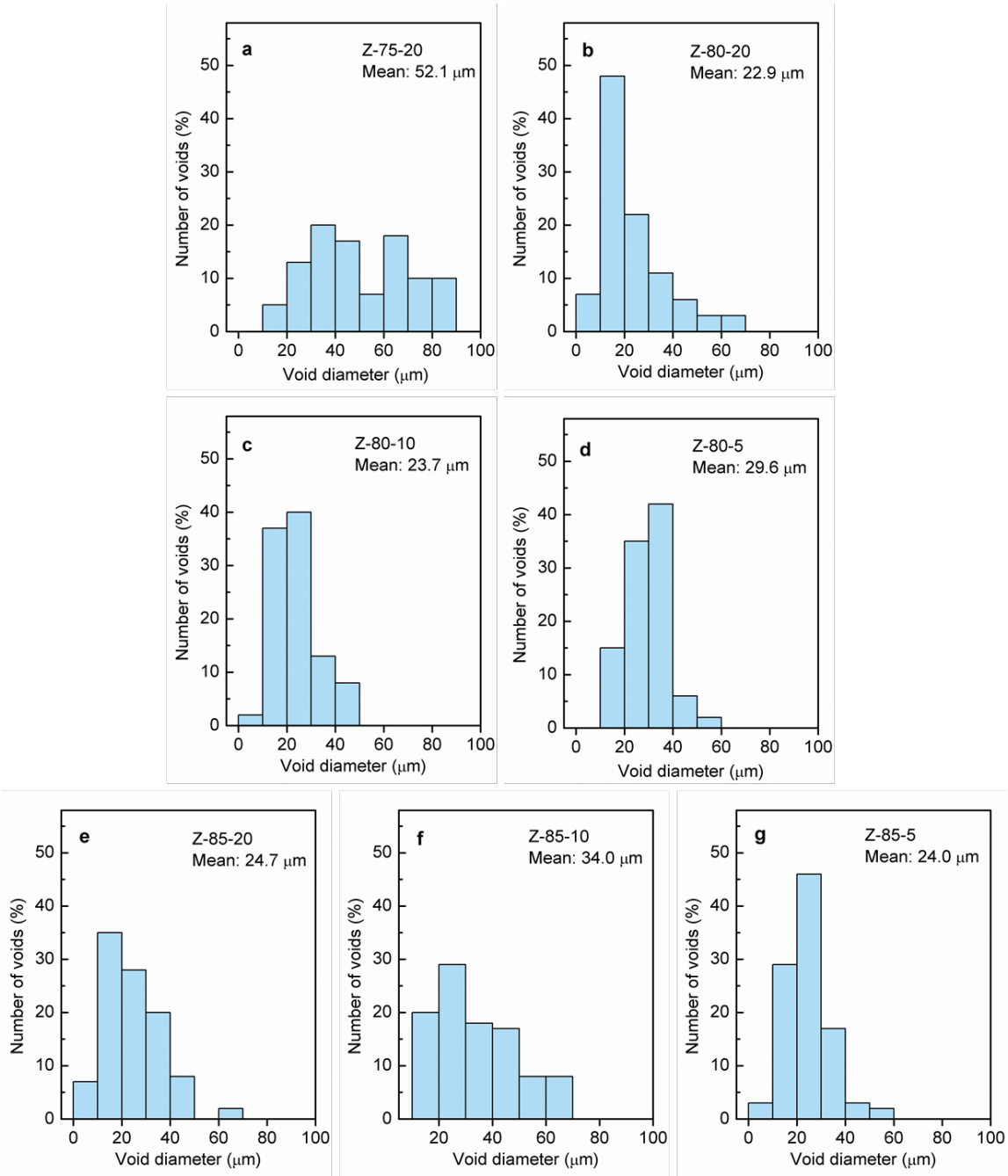

Fig. S2 Void diameter distributions: (a) Z-75-20; (b) Z-80-20; (c) Z-80-10; (d) Z-80-5; (e) Z-85-20; (f) Z-85-10; (g) Z-85-5.

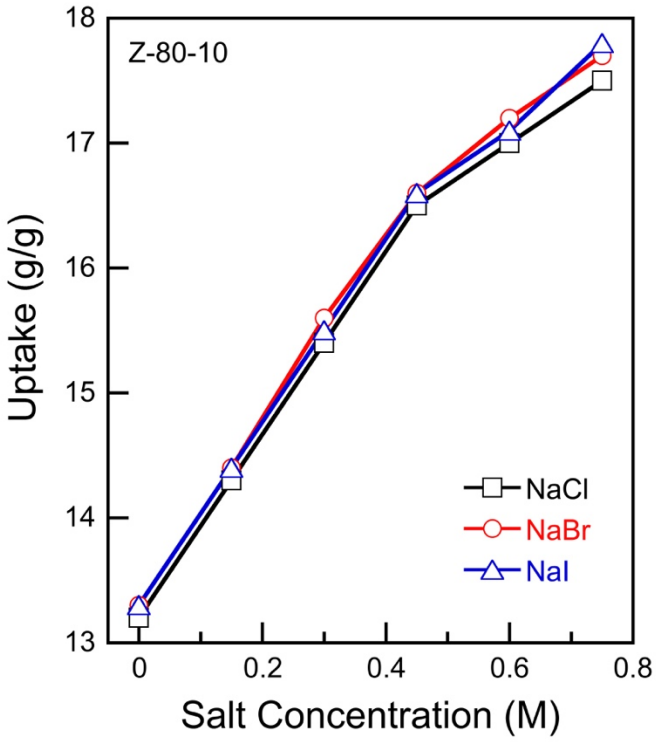

Fig. S3 The uptake of various sodium salt solutions by Z-80-10.

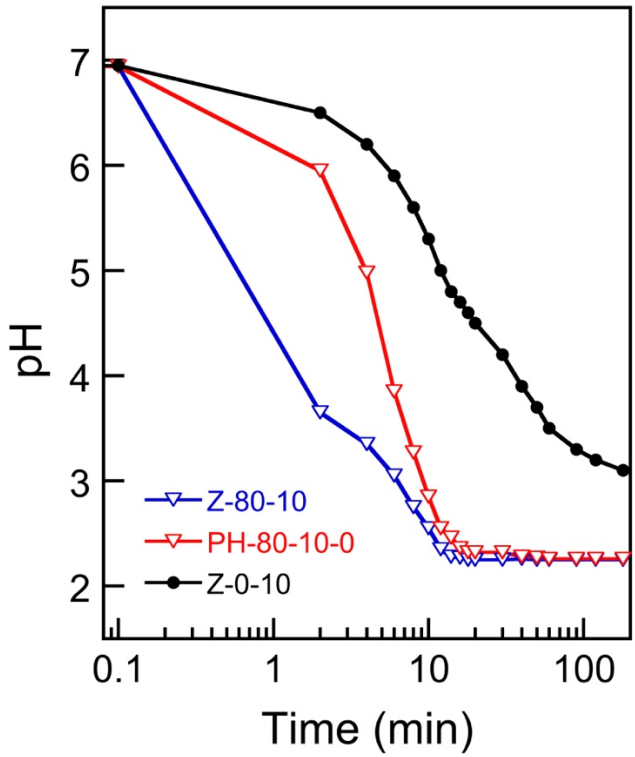

Fig. S4 The reduction in the pH of water following the immersion of a HCl-solution-swollen hydrogel (using a swollen-hydrogel to water ratio of 1:1000).

References

1. Y. Zhang, Z. Wang, W. Lin, H. Sun, L. Wu and S. Chen, *J. Membrane Sci.*, 2013, **446**, 164.

2. A. Vakıflı, G. B. Demirel and T. Caykara, *J. Appl. Polym. Sci.*, 2010, **117**, 817.