Electronic Supplementary Material (ESI) for Polymer Chemistry.

Supporting Information

Synthesis, aggregation and responsivity of block copolymers containing organic arsenicals

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Materials and methods

p-Arsanilic acid, acryloyl chloride, glutathione (GSH), hypophosphorous acid (50%), *N*-Isopropylacrylamide (NIPAm, 97%) and poly(ethylene glycol) methyl ether acrylate (PEGA, average M_n = 480) were purchased from Sigma Aldrich and used as received. HPLC grade water (H_2O, VWR international, LLC) was used as the solvent for disproportionation and polymerisation. Copper(I) bromide (CuBr, 98%, Sigma-Aldrich) was purified prior to use via sequentially washing with acetic acid and ethanol and then dried under vacuum. *Tris*(2-(dimethylamino)ethyl)amine[1] and 2,3-dihydroxypropyl 2-bromo-2-methylpropanoate[2] were prepared as reported in the literature. was synthesized according to the literature procedure. Membrane dialysis tubing (nMWCO 3.5 kDa) was obtained from Spectrum Laboratories. All other solvents and reagents were purchased from commercial suppliers (Sigma-Aldrich, Fisher Scientific) and use as received unless otherwise stated.

Nuclear Magnetic Resonance (NMR) spectroscopy (^{1}H NMR) spectra were recorded on a Bruker HD 300 spectrometer (300 MHz) at 27 °C in deuterated water (D_2O). Chemical shift values (δ_{ppm}) are reported in ppm. The residual proton signal of the solvent (δ_H = 4.79 ppm) was used as internal reference. ACDLABS software was used to analyse the data obtained. Number-average molar masses ($M_{n,SEC}$) and dispersity values ($Đ$) were determined using Size exclusion Chromatography (SEC) with DMF as an eluent. SEC analysis was conducted on Polymer Laboratories PL-GPC 50 Plus system using a Polar Gel-M guard column (7.5 × 50 mm) followed by two Polar Gel-M columns (7.5 ×300 mm). DMF (0.1% LiBr) was used as eluent at 1.0 mL min^{-1} at 50 °C. All polymer samples were filtered through a nylon membrane with 0.45 μm pore size before injection (100 μL). Commercial narrow linear poly(methyl methacrylate) (PMMA) standards in range of 2.0 × 102 −1.0 × 106 gmol^{-1} were used to calibrate the DMF SEC system. The SEC data obtained were analysed using Agilent technologies GPC/SEC software to determine $M_{n,SEC}$ and $Đ$ based on the PMMA calibration. Hydrodynamic diameters (D_h) and size distributions were determined by Dynamic Light Scattering (DLS) on a MALVERN Zetasizer Nano ZS operating at 25 °C with a 4 mW He-Ne 633 nm laser module. Measurements were made at a detection angle of 173° (back scattering). Measurements were repeated three times with automatic attenuation selection and measurement position. The results were analysed using Malvern DTS 6.20 software. PDI values were calculated using equation Eq 1

$$PDI = \sigma^2/d^2 \qquad \text{(Eq 1)}$$

Where σ is the standard deviation, and d is the diameter, both obtained from the number distribution.

Determination of M_w by Static Light Scattering. The incremental refractive index, dn/dC, was determined by measuring the refractive index of the polymer over a range of concentrations (1.33, 0.66, 0.33, 0.167 mg/ml). The RI was determined using a Shodex RI detector, operating at a wavelength of 632 nm. Multiplying the gradient, of the plot of RI vs. concentration, by the refractive index of the solvent (water = 1.3325) and dividing by the RI constant of the instrument (−1 398 000) gives the dn/dC of the polymer (Table S3). Light scattering measurements were obtained using an ALV-CGS3 system operating with a vertically polarized laser with the wavelength λ = 632 nm. The measurements were taken at 20 °C over a range of scattering wave vectors ($q = 4\pi n\sin(\theta/2)/\lambda$, with θ being the angle of observation and n the refractive index of the solvent). The Rayleigh ratio, R_θ, was determined using eqn (2);

$$R_\theta = \frac{I_{solution}(\theta) - I_{solvent}(\theta)}{I_{toluene}(\theta)} \cdot \left(\frac{n_{solution}}{n_{toluene}}\right)^2 . R_{toluene} \qquad \text{(Eq 2)}$$

Where $I_{solution}$, $I_{solvent}$ and $I_{toluene}$ are the scattering intensities of the solution, solvent and reference (toluene) respectively, n is the refractive index (n_{water}= 1.333, $n_{toluene}$=1.496) and $R_{toluene}$ the Rayleigh

ratio of toluene ($R_{toluene}$= 1.35 × 10^{-5} cm^{-1} for λ = 632.8 nm). The optical constant, K, is defined by eqn (3), where N_a is the Avogadro number and dn/dC is the incremental refractive index.

$$K = \frac{4\pi^2 {n_{solvent}}^2}{\lambda^4 N_a}\left(\frac{\partial n}{\partial C}\right)^2 \quad \text{(Eq 3)}$$

In all cases it was verified that the apparent radius of gyration of the systems verified q × Rg < 1. The Zimm approximation can thus be used to obtain eqn (4). Plotting KC/Rθ as a function of q^2 for each concentration yielded the apparent radius of gyration Rg of the scatterers as well as their apparent molecular weight extrapolated to zero angle, Ma. Representative plots are shown in the ESI.

$$\frac{KC}{R_\theta} = \frac{1}{M_a}\left(1 + \frac{q^2 {R_g}^2}{3}\right) \quad \text{(Eq 4)}$$

At a given concentration the Rayleigh ratio, Rθ, is related to the apparent molecular weight of the sample, given by eqn (4). It is only at infinite dilutions, where the interactions between scattering particles are negligible, that the apparent molecular weight is equal to the true molecular weight. Multiple concentrations were measured and a plot of linear regression was used to determine the apparent molecular weight at a concentration of 0 $mgml^{-1}$.

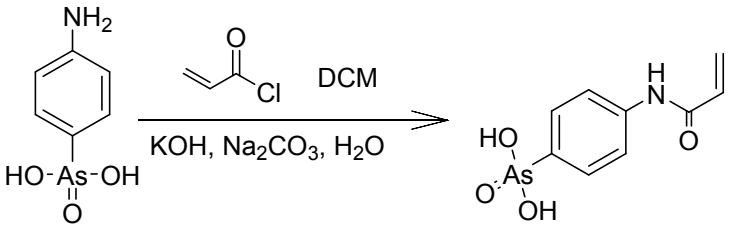
Cell viability. PC3 (human prostate cancer) cells were cultured in High Glucose DMEM medium supplemented with 10% fetal bovine serum. For cell viability evaluation, PC3 cells were seeded in a 96 well plate at a density of 1 × 10^4 cells per well. After 16 hours, the culture medium was replaced by fresh media containing a series of dilution of the polymers (0.5, 2, 5, 20 and 50 µM), prepared from stock solutions in PBS at 500 µM. Following 24 hours incubation, the medium was removed and replaced with fresh medium. The cells were incubated with a freshly prepared solution of XTT (0.2 mg/mL^{-1}) and N-methyl dibenzopyrazine methyl sulfate (250 µM) in medium for 16 hours. Absorbance of the samples was finally measured using a plate reader at 450 nm and 650 nm. The data presented are representative of a minimum of two independent experiments where each sample was measured in triplicate. Errors reported correspond to the standard deviation of the mean.

Atomic Force Microscopy (AFM). AFM images were acquired in AC mode on a Cypher S system (Asylum Research). The probes used were the AC160TS from Olympus probes with a nominal resonant frequency of 300 kHz and a spring constant of approximately 40 N m^{-1} on a Multimode AFM (Asylum Research). Images were acquired at a pixel resolution of 512 and a scan rate of 1 Hz. Samples were diluted to 0.1 mg mL^{-1} in water and 4 µL of solution was drop-deposited onto freshly cleaved mica discs. The data were analyzed by the Asylum Research software.

Transmission Electron Microscopy (TEM). Nanoparticle solutions at a concentration of 0.1 mg/ml were deposited as 5 µl aliquots on 400 mesh carbon-coated Formvar copper grids and allowed to dry completely. Once dry, grids were stained with 1% aqueous uranyl acetate (UA) by touching the grid to 5 µl UA and drawing off stain immediately, followed by placing the grid atop a 5 µl drop of UA for 15 s in the dark, and drawing off excess liquid as before. Samples were imaged on a FEI Tecnai F20 transmission electron microscope, utilising a Gatan Ultrascan 1000 (2k x 2k) CCD camera

Synthetic procedures

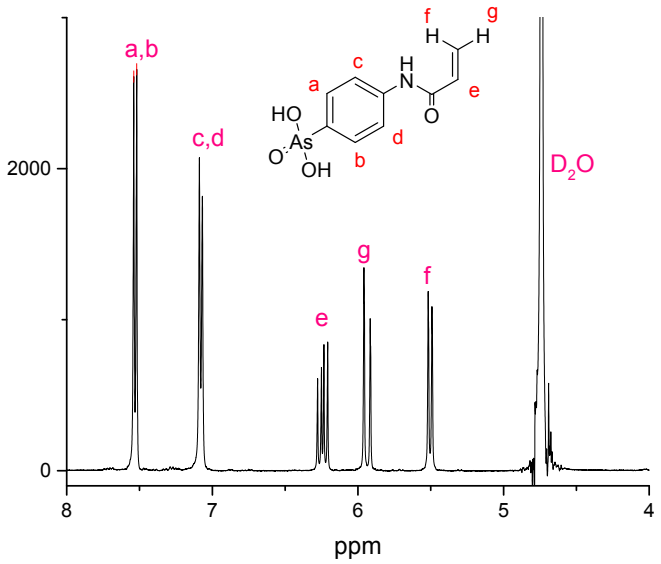
Synthesis of As functional monomer 4-(*N*-acrylamido)phenylarsonic acid[3,4]



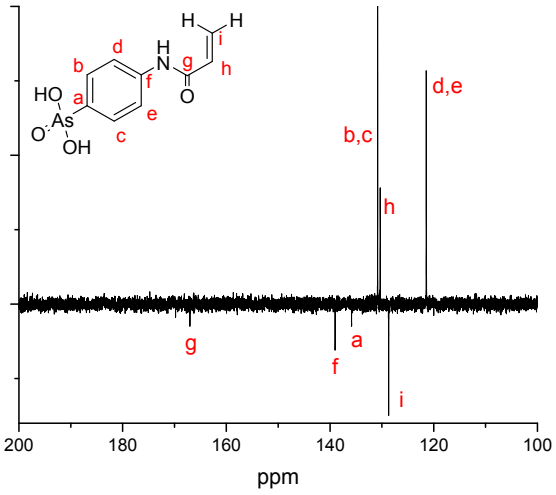
p-arsanilic acid

4-(*N*-acrylamido)phenylarsonic acid

Potassium hydroxide (5.1 g, 91.8 mmol) was dissolved in deionised water (125 mL). The mixture of *p*-arsanilic acid (10.0 g, 46.1 mmol) and Na_2CO_3 (14.5 g, 137.1 mmol) was added portionwise to the KOH to afford dissolution. Acryloyl chloride (5.6 mL, 68.9 mmol), in dichloromethane (25 mL) was quickly added into the *p*-arsanilic acid solution at 0 °C. and stirred for 15 minutes. The aqueous phase was collected are carefully acidified (to minimise effervescence) to pH 1 through the addition of H_2SO_4 (98%) which resulted in precipitation of product. The precipitate was collected by filtration, washed with cold water and dried in the vacuum oven overnight to afford the title compound as a white solid. (11.2 g, 41.5 mmol, 90%) The spectroscopic data matched the reported values in the literature.



^{1}H NMR spectrum of 4-(*N*-acrylamido)phenylarsonic acid



^{13}C NMR spectrum of 4-(*N*-acrylamido)phenylarsonic acid

General procedure for synthesis of [PPEGA$_{20-n}$-*co*-AsAm$_n$]-*b*-NIPAm$_{80}$ by aqueous SET-LRP. Me_6Tren (14 µL, 52 µmol, 0.6 eq) was dissolved in HPLC grade H_2O (1 ml) prior to addition of CuBr (10 mg, 70 µmol, 0.8 eq). The resulting solution was deoxygenated with N_2 affording disproportionation as indicated by the strong blue colour of the solution and precipitation of Cu(0). Simultaneously, in a separate vessel 2,3-dihydroxypropyl-2-bromo-2-methylpropanoate (1 eq) and PEGA (20-n eq, M_n = 480 g.mol^{-1}) were dissolved in HPLC grade H_2O prior to addition of AsAm (n eq) dissolved in 0.5 M NaOH (n eq) to give a total volume of 2.5 ml. The resulting solution was also deoxygenated by bubbling N_2 for 15 mins. The monomer/initiator mixture was then added as a single portion to the disproportionation solution via deoxygenated syringe. The progress of the reaction was followed by ^{1}H NMR and SEC analysis. Upon completion (typically >99% conversion in 15-30 mins) a deoxygenated solution of NIPAm (80 eq) in HPLC grade H_2O (3 mL) was added as a single portion to the polymerisation solution via deoxygenated syringe. The progress of the chain extension was followed by ^{1}H NMR and SEC. Upon completion the Cuprisorb® was added the reaction mixture to remove the (in)soluble copper species prior to dialysis (nMWCO 3.5 KDa) against de-ionised water. The purified polymers were isolated by lyophilisation to obtain the pure polymers as white solids in 70-90 % yield.

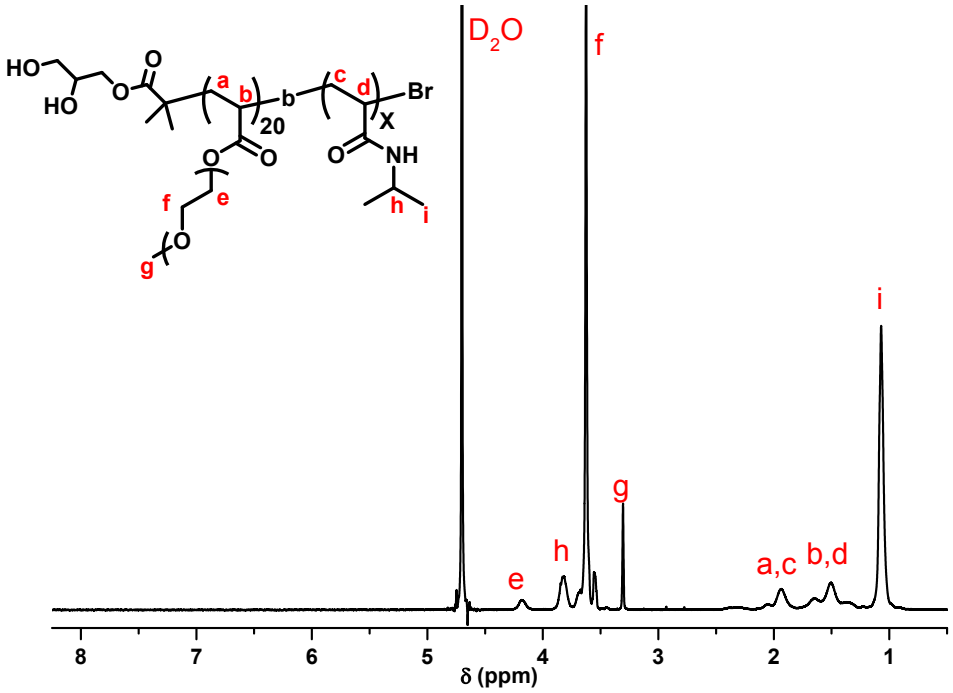
General procedure for synthesis of PPEGA$_{20}$-*b*-[NIPAm$_{80-n}$-*co*-AsAm$_n$] by aqueous SET-LRP. Me_6Tren (14 µL, 52 µmol, 0.6 eq) was dissolved in HPLC grade H_2O (1 ml) prior to addition of CuBr (10 mg, 70 µmol, 0.8 eq). The resulting solution was deoxygenated with N_2 affording disproportionation as indicated by the strong blue colour of the solution and precipitation of Cu(0). Simultaneously, in a separate vessel 2,3-dihydroxypropyl-2-bromo-2-methylpropanoate (1 eq) and PEGA (20 eq, M_n = 480 g.mol^{-1}) were dissolved in HPLC grade H_2O (1 mL). The resulting solution was also deoxygenated by bubbling N_2 for 15 mins. The monomer/initiator mixture was then added as a single portion to the disproportionation solution via deoxygenated syringe. The progress of the reaction was followed by ^{1}H NMR and SEC analysis. Upon completion (typically >99% conversion in 15-30 mins) a solution of AsAm (n eq) dissolved in 0.5 M NaOH (n eq) was added to a solution of NIPAm (80-n eq) in HPLC grade H_2O give a total volume of 4.0 ml and the resulting mixture was deoxygenated with N_2 prior to addition to the polymerisation solution as a single portion via deoxygenated syringe. The progress of the chain extension was followed by ^{1}H NMR and SEC. Upon completion the Cuprisorb® was added the reaction

mixture to remove the (in)soluble copper species prior to dialysis (nMWCO 3.5 KDa) against de-ionised water. The purified polymers were isolated by lyophilisation. Alternatively, following completion of the second block, 1 M HCl was added until the blue colour of the Cu(II)-Me_6Tren complex disappeared and the insoluble Cu(0) was filtered off to afford a homogeneous colourless solution which was then dialysed (nMWCO 3.5 KDa) against de-ionised water for 2 days changing the water twice. The purified polymers were isolated by lyophilisation to obtain the pure polymers as white solids in 70 -90 % yield.

General procedure for self-assembly and crosslinking of [$PEGA_{20-n}$-*co*-$AsAm_n$]-*b*-$NIPAm_{80}$ and $PEGA_{20}$-*b*-[$NIPAm_{80-n}$-*co*-$AsAm_n$]. The procedure reported for the reductive coupling of organic arsenicals was translated to the As-functional block copolymers. Briefly, As-functional polymer was dissolved in a deoxygenated aqueous solution of hypophosphorus acid (H_3PO_2, 10 wt%, 10 mg/ml polymer) and deoxygenated KI (1 vol% from a 3 wt% aq solution) was added. The solution was allowed to equilibrate for 16 hrs before heating at 60 ^{0}C for 2 hrs. The resulting solution was dialysed against deionised water (nMWCO 3.5 KDa) to remove the electrolytes for no longer than 24 hrs and changing the water 4 times. The crosslinked particles were isolated by lyophilisation to obtain the particles as white solids in 90-98 % yield. The particles were all readily re-dispersed in H_2O.

General procedure for particle stability and disassembly.

Polymer nanoparticles **NP_{As-10}**, **NP_{As-15}**, **NP_{As-20}**, were dissolved separately in deionised water, glutathione (5 mM) and H_2O_2 (5 mM) (1 mg/ml). The solutions were filtered through (450 µm nylon filters) into separate plastic cuvettes (with a lid) and incubated at 37 ^{0}C in water bath. Disassembly was monitored through the measurement of changes in particle size (D_h) as a function of time by DLS.



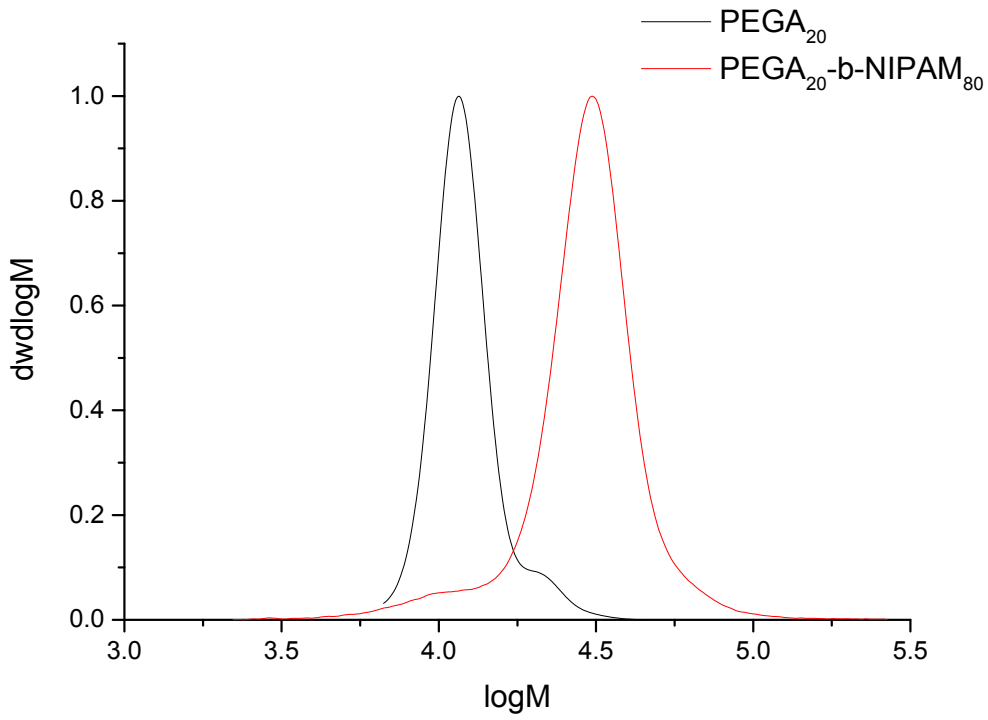
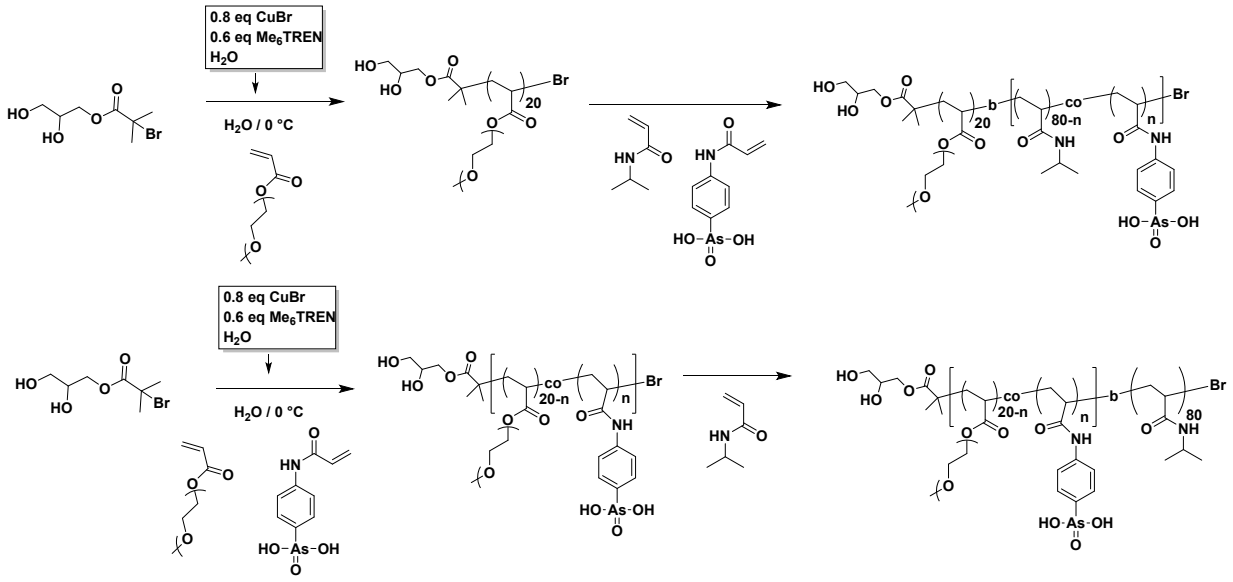
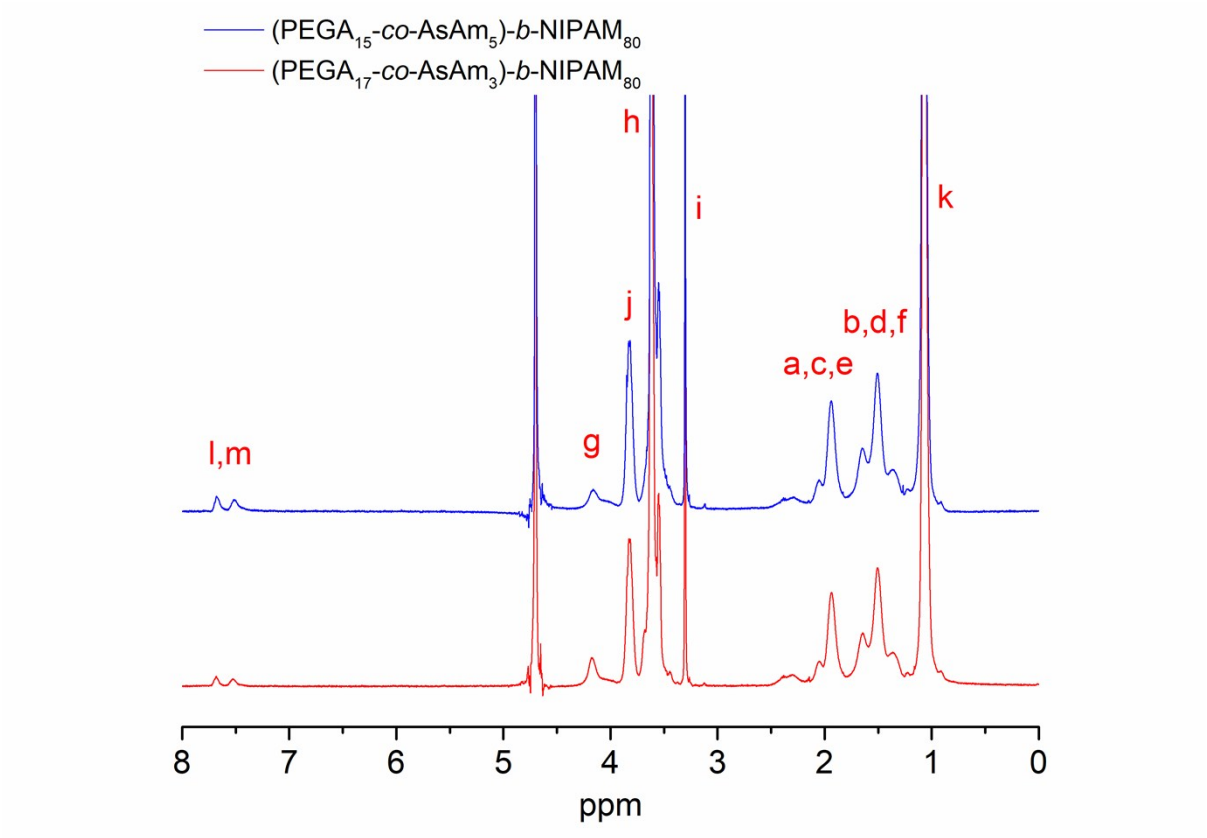


Figure S1. ^{1}H NMR spectrum (top) and GPC (DMF, bottom) chromatogram of $PEGA_{20}$-*b*-$NIPAm_{80}$; **P1**, $M_{n,th}$ = 19400 gmol^{-1}, $M_{n,SEC}$ =25400 gmol^{-1}, $Đ$ = 1.27



Scheme S1. Synthesis of As-functional block copolymers by aqueous SET-LRP



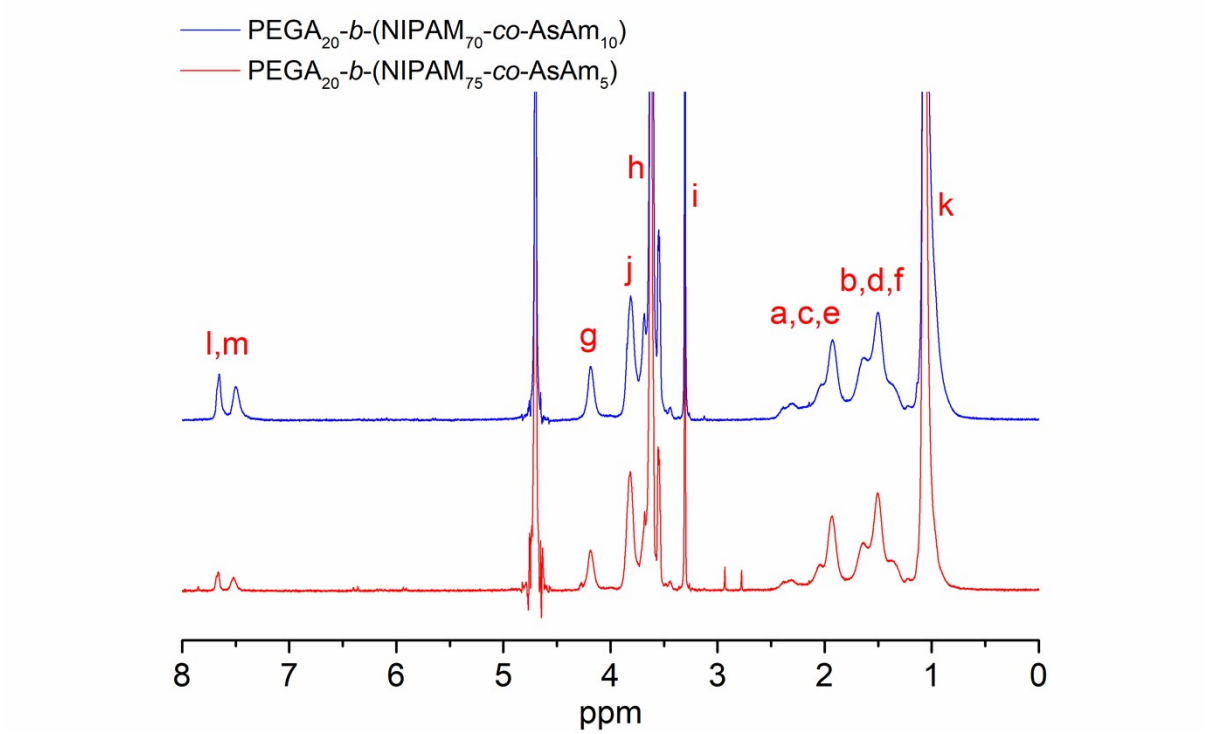
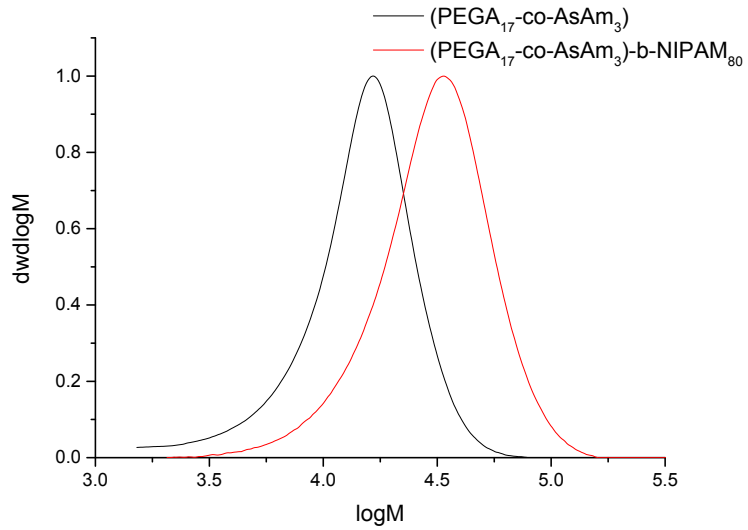
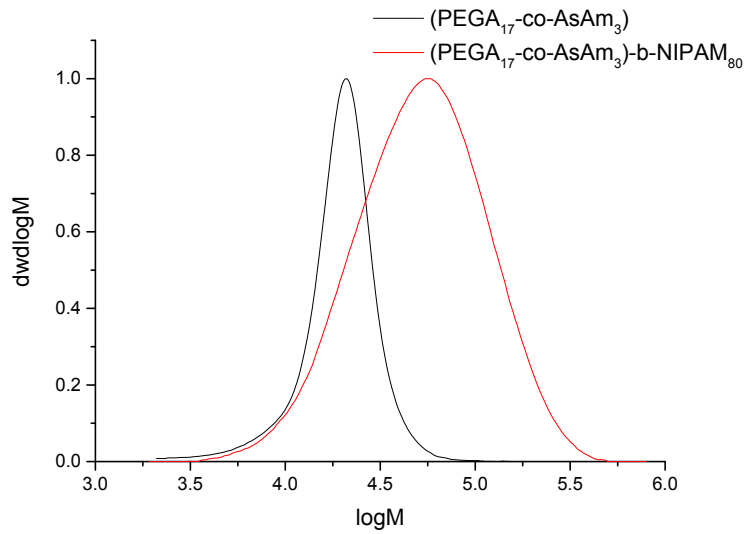


Figure S2. ^{1}H NMR of (PEGA$_{20\text{-}n}$-*co*-AsAm$_n$)-*b*-NIPAm$_{80}$ (**P2**, n = 3; **P3** n = 5) (top) and PEGA$_{20}$-*b*-(NIPAm$_{80\text{-}n}$-*co*-AsAm$_n$) (**P4**, n = 5; **P5**, n = 10)

Table S1. Experimental polymer composition based on ^{1}H NMR (Figure S2)

	PEGA		NIPAM		AsAm	
Entry	**Theoretical**	**^{1}H NMR**	**Theoretical**	**^{1}H NMR**	**Theoretical**	**^{1}H NMR**
P1	20	15.1	80	84.9	0	0
P2	17	15.3	80	82.4	3	2.3
P3	15	13.7	80	83.6	5	2.7
P4	20	13.7	75	82.2	5	4.1
P5	20	15.9	70	74.6	10	9.5
P6	20	18.3	65	71.5	15	14.3
P7	20	22.8	60	92.6	20	26.3


(PEGA17-co-AsAm3)
(PEGA17-co-AsAm3)-b-NIPAM80
dwdlogM
logM
0.0
0.2
0.4
0.6
0.8
1.0
3.0
3.5
4.0
4.5
5.0
5.5


(PEGA17-co-AsAm3)
(PEGA17-co-AsAm3)-b-NIPAM80
dwdlogM
logM
0.0
0.2
0.4
0.6
0.8
1.0
3.0
3.5
4.0
4.5
5.0
5.5
6.0

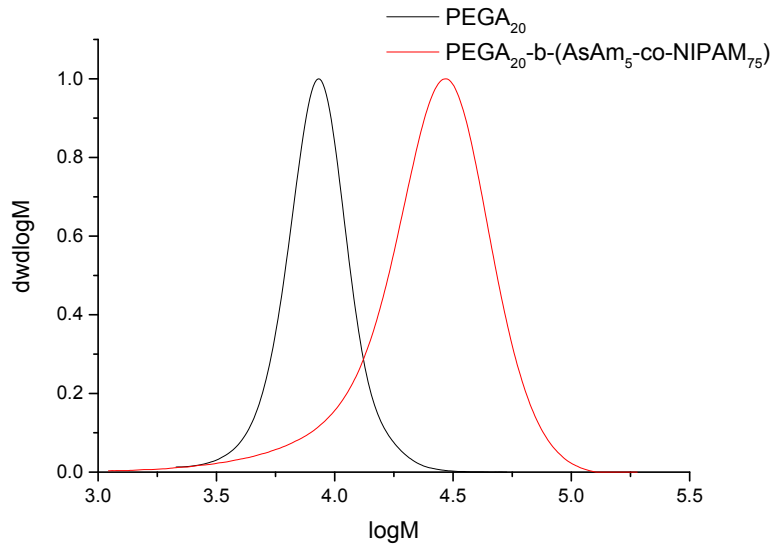
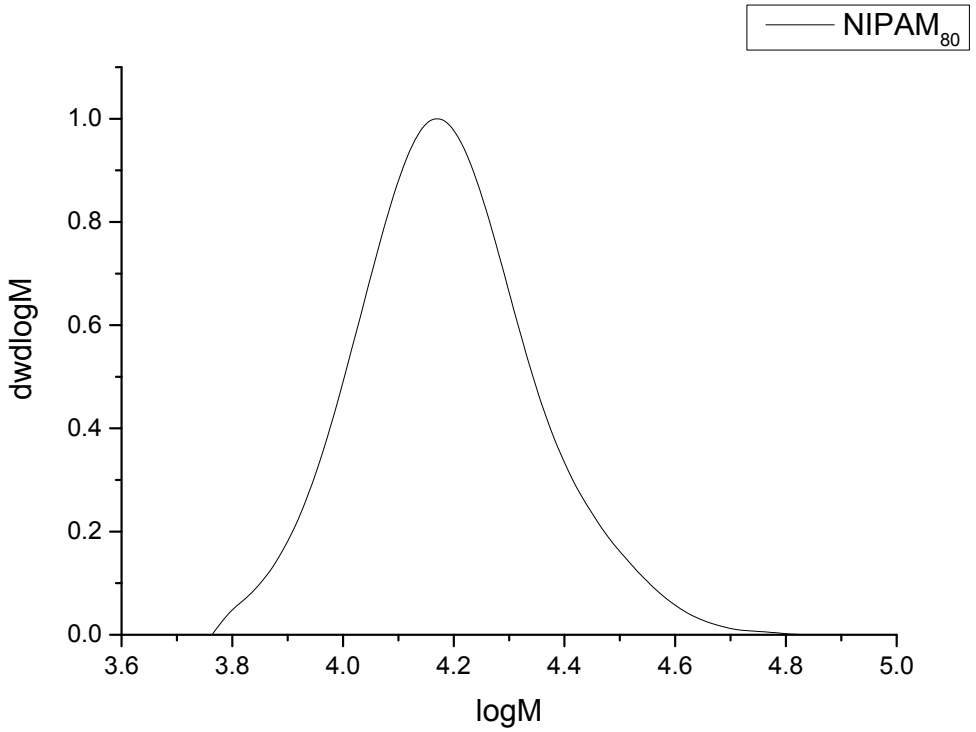

PEGA20
PEGA20-b-(AsAm5-co-NIPAM75)
dwdlogM
logM
0.0
0.2
0.4
0.6
0.8
1.0
3.0
3.5
4.0
4.5
5.0
5.5

Figure S3. GPC (DMF) chromatogram (top) $PEGA_{17}$-*co*-$AsAm_3$: $\boldsymbol{M_{n,th}}$ = 9200 $gmol^{-1}$, $\boldsymbol{M_{n,SEC}}$ =11100 $gmol^{-1}$, $\boldsymbol{Đ}$ = 1.51 (black) and ($PEGA_{17}$-*co*-$AsAm_3$)-*b*-$NIPAM_{80}$ (**P2**) $\boldsymbol{M_{n,th}}$ = 19400 $gmol^{-1}$, $\boldsymbol{M_{n,SEC}}$ =25100 $gmol^{-1}$, $\boldsymbol{Đ}$ = 1.41 (red); (middle) $PEGA_{15}$-*co*-$AsAm_5$ $\boldsymbol{M_{n,th}}$ = 8800 $gmol^{-1}$, $\boldsymbol{M_{n,SEC}}$ =16500 $gmol^{-1}$, $\boldsymbol{Đ}$ = 1.51 (black) and ($PEGA_{15}$-*co*-$AsAm_5$)-*b*-$NIPAM_{80}$ (**P3**) $\boldsymbol{M_{n,th}}$ = 19000 $gmol^{-1}$, $\boldsymbol{M_{n,SEC}}$ =37500 $gmol^{-1}$, $\boldsymbol{Đ}$ = 1.81 (red); (bottom) P($PEGA_{20}$) $\boldsymbol{M_{n,th}}$ = 9800 $gmol^{-1}$, $\boldsymbol{M_{n,SEC}}$ =10100 $gmol^{-1}$, $\boldsymbol{Đ}$ = 1.16 (black) and $PEGA_{20}$-*b*-($NIPAM_{70}$-*co*-$AsAm_{10}$) (**P5**), $\boldsymbol{M_{n,th}}$ = 21500 $gmol^{-1}$, $\boldsymbol{M_{n,SEC}}$ =26000 $gmol^{-1}$, $\boldsymbol{Đ}$ = 1.19 (red);



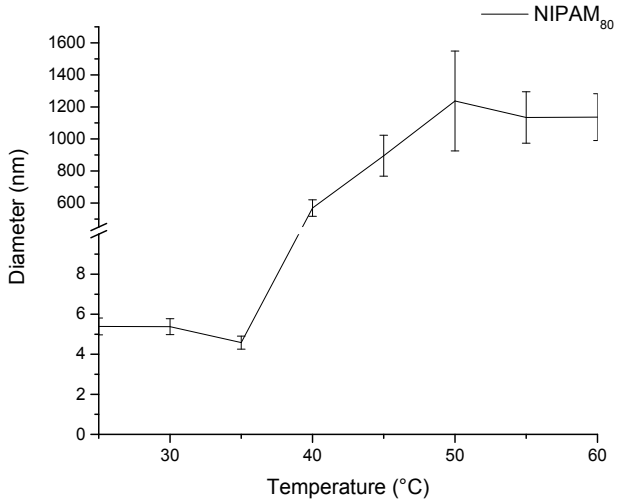
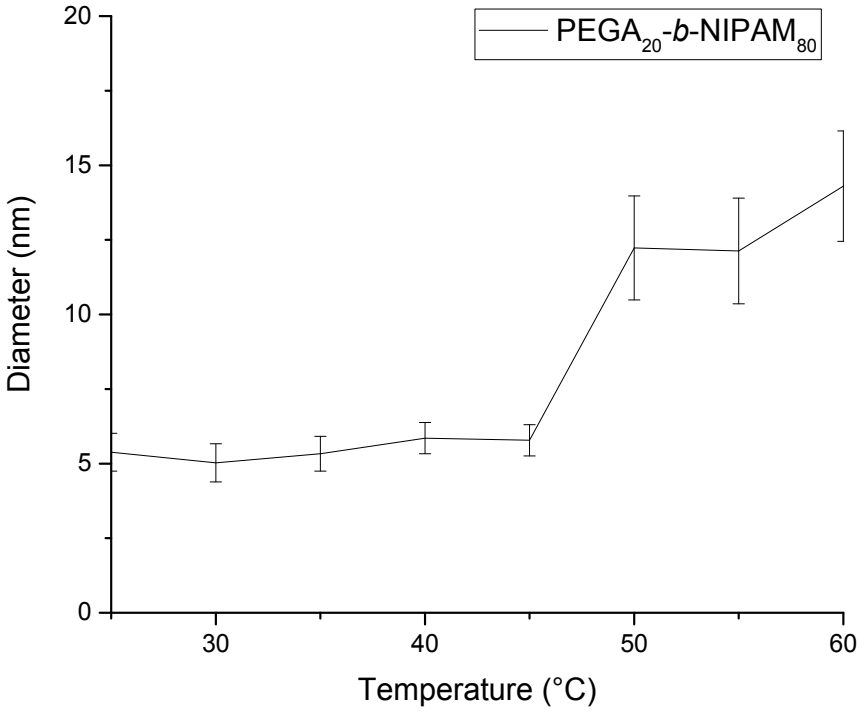


Figure S4. GPC (DMF) chromatogram (top) and thermoresponsive behaviour by DLS (bottom) of $P(NIPAM)_{80}$, $\boldsymbol{M_{n,th}}$ = 9300 $gmol^{-1}$ $\boldsymbol{M_{nSEC}}$ = 14500 $gmol^{-1}$, $\boldsymbol{Đ}$ = 1.15 in aqueous solution (1 mg/ml).



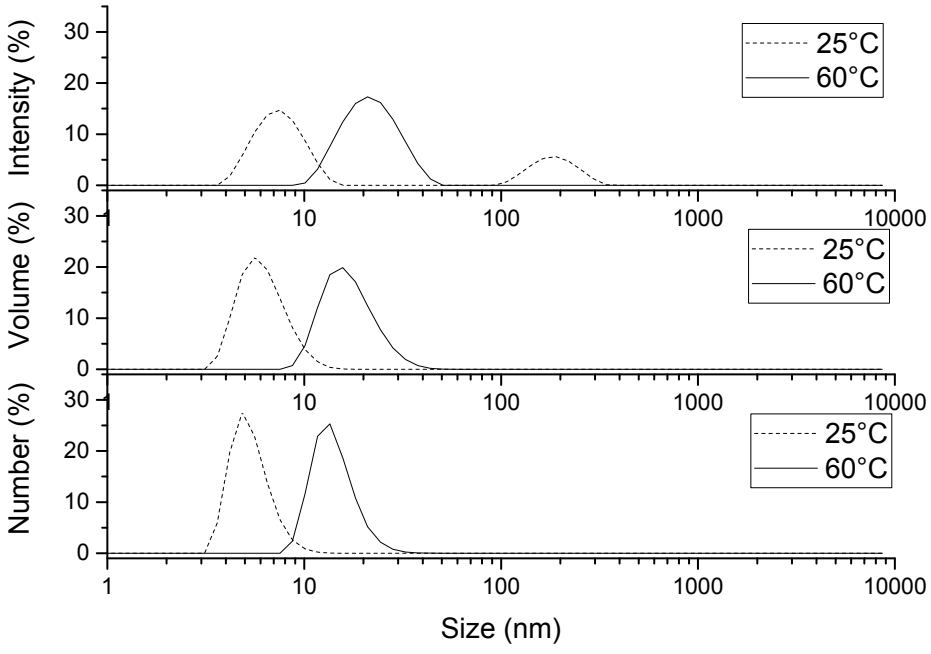


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Figure S5. Hydrodynamic diameter (number %) as a function of temperature (top) and intensity, number and volume distributions of **P1**, $PEGA_{20}$-*b*-$NIPAM_{80}$ in aqueous solution (1 mg/ml).

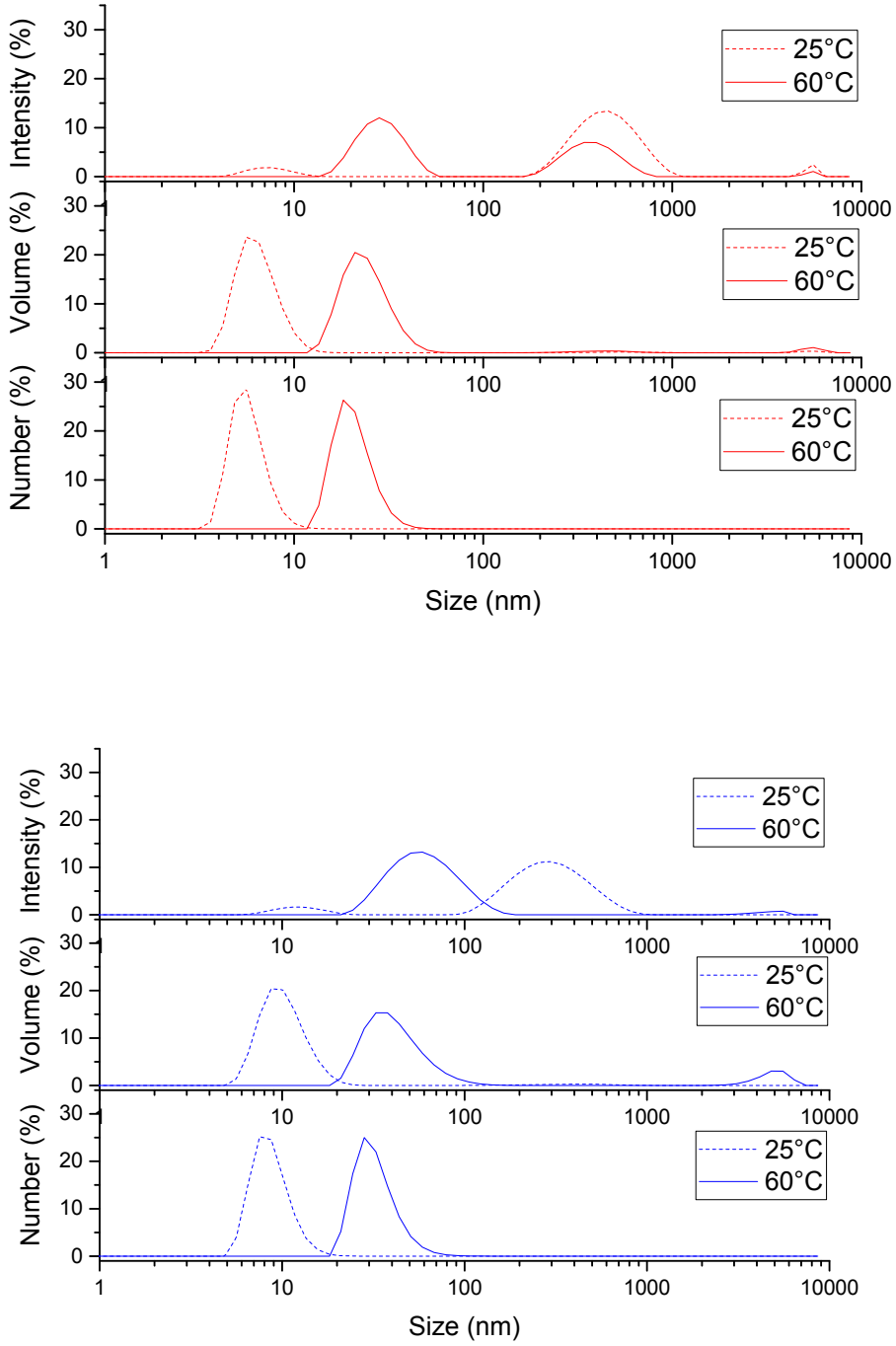


Figure S6. DLS, particle size as a function of temperature of **P2**, ($PEGA_{17}$-*co*-$AsAm_3$)-*b*-$NIPAM_{80}$ (top) and **P3**, ($PEGA_{15}$-*co*-$AsAm_5$)-*b*-$NIPAM_{80}$ in aqueous solution (1 mg/ml).

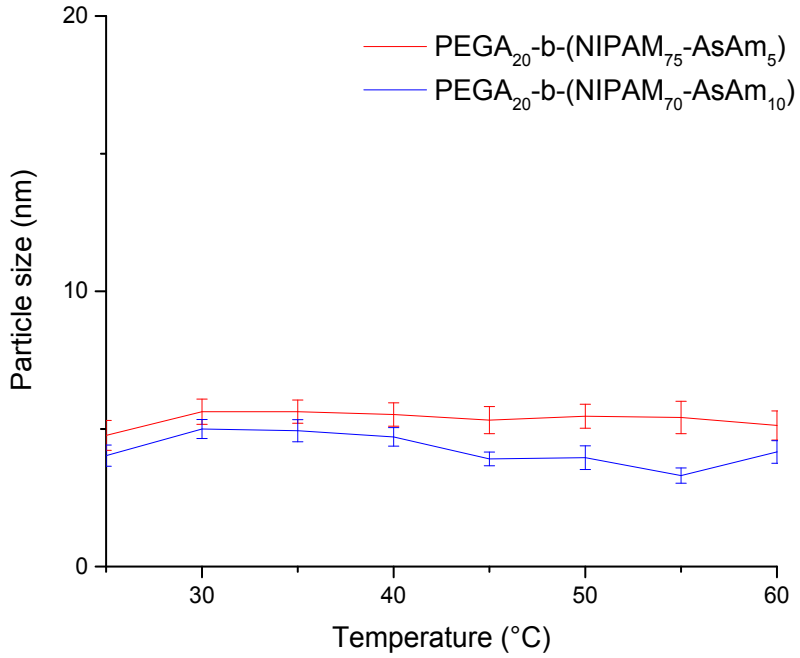


Figure S7. Particle size as a function of temperature for $PEGA_{20}$-*b*-($NIPAM_{80-n}$-*co*-$AsAm_n$) in aqueous solution (1 mg/ml)

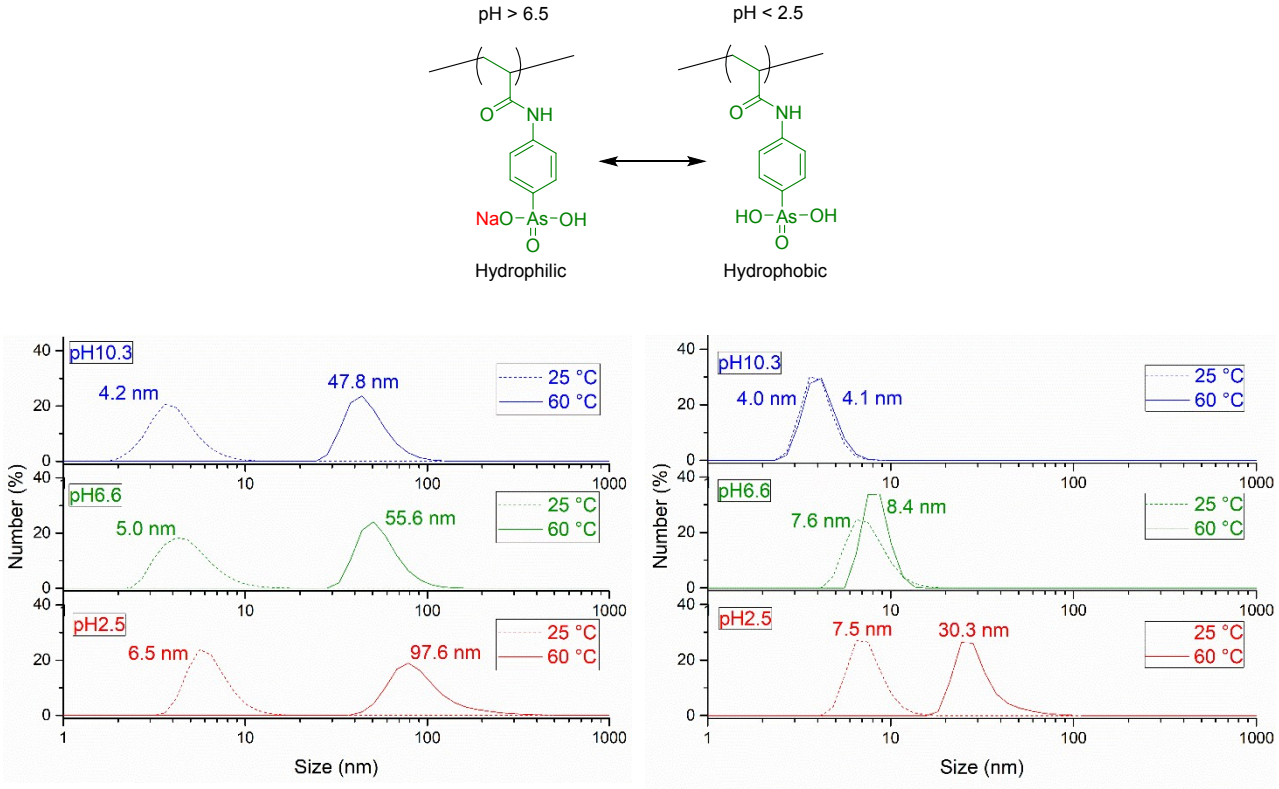


Figure S8. Changes in hydrodynamic diameter of ($PEGA_{15}$-*co*-$AsAm_5$)-*b*-$NIPAM_{80}$ (**P3,** left) and $PEGA_{20}$-*b*-($NIPAM_{70}$-*co*-$AsAm_{10}$) (**P5**, right) between 25 °C and 60 °C as a function of pH in aqueous solution (1 mg/ml)

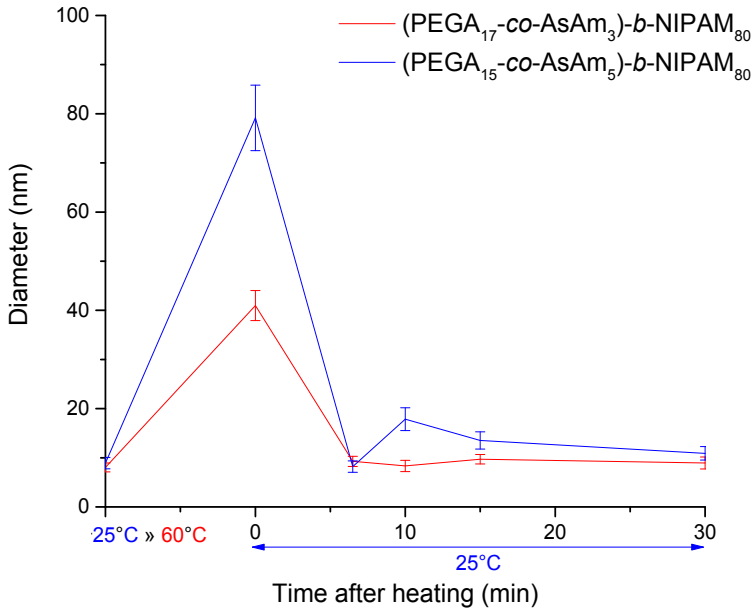


Figure S9. Temporal changes in the particle size of the cross-linked particles of ($PEGA_{20-n}$-*co*-$AsAm_n$)-*b*-$NIPAM_{80}$ (**P2, P3**) after heating in hypophosphorous solution (10 mins, 10 mg/ml). DLS cell was heated from 25 – 60 °C over 120 secs followed by 60 secs equilibration time before being held at 60 °C for 10 – 90 mins. Cooling of the cell occurred over 120 secs followed by 60 secs equilibration after which measurement of stability commenced (t = 0, 25 °C).

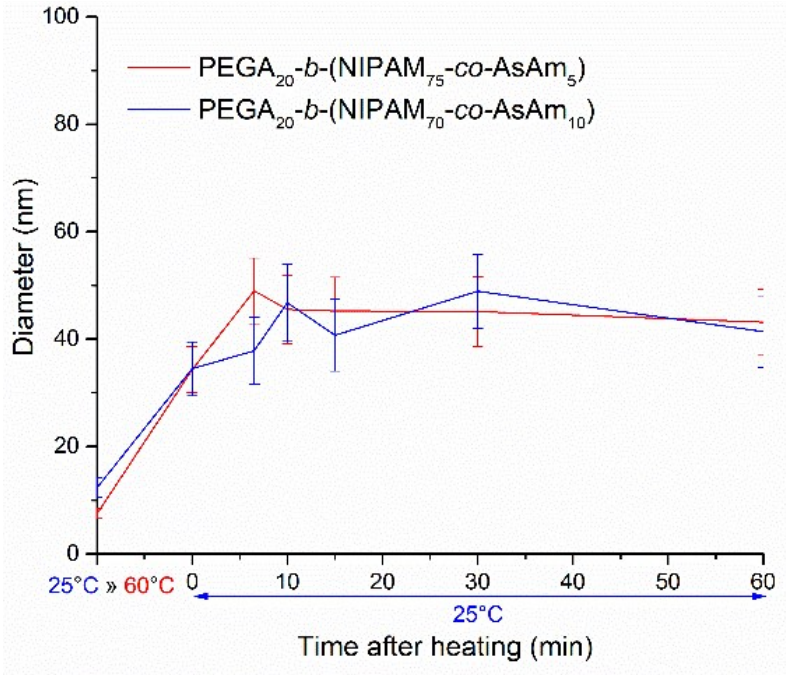


Figure S10. Temporal changes in the particle size of the cross-linked particles of $PEGA_{20}$-*b*-($NIPAm_{80-n}$-*co*-$AsAm_n$) (**P4, P5**) after heating in hypophosphorous (10 mg/ml). DLS cell was heated from 25 – 60 °C over 120 secs followed by 60 secs equilibration time before being held at 60 °C for 30 mins (**P4**, red) and 10 mins (**P5**, blue) respectively. Cooling of the cell occurred over 120 secs followed by 60 secs equilibration after which measurement of stability commenced (t = 0, 25 °C).

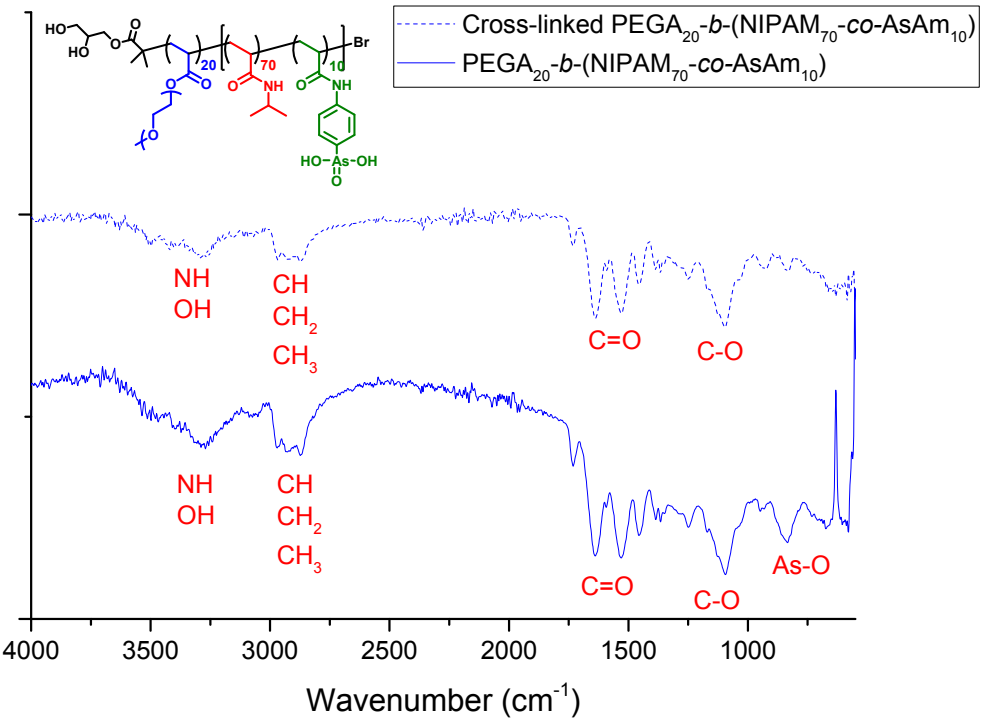


Figure S11. IR spectrum of purified $PEGA_{20}$-*b*-($NIPAm_{70}$-*co*-$AsAm_{10}$) (**P5**) showing disappearance of the As-O signals upon crosslinking via reductive coupling in H_3PO_2.

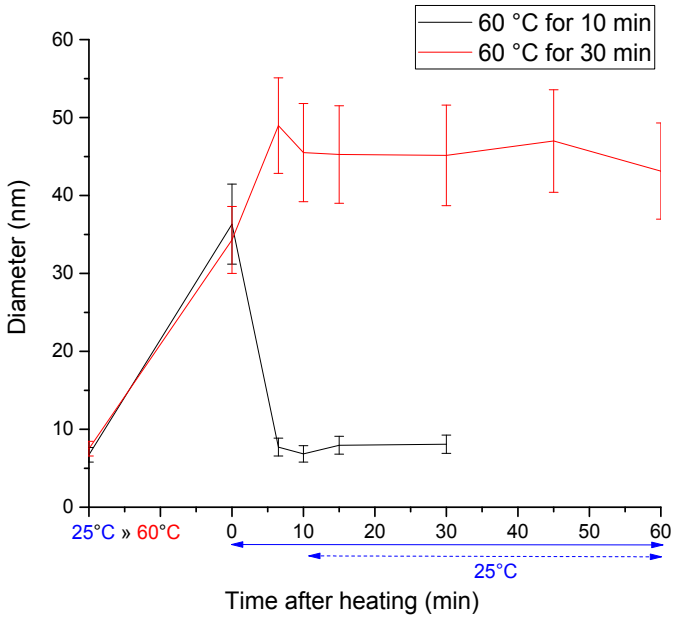


Figure S12. Stability of particles derived from $PEGA_{20}$-*b*-($NIPAM_{75}$-*co*-$AsAm_5$) (**P4**) after heating at 60 °C in aqueous H_3PO_2 for 10 mins and 30 mins. DLS cell was heated from 25 – 60 °C for 120 secs followed by 60 secs equilibration time before being held at 60 °C for 10 mins (black) and 30 mins (red) respectively. Cooling of the cell occurred over 120 secs followed by 60 secs equilibration after which measurement of stability commenced (t = 0, 25 °C).

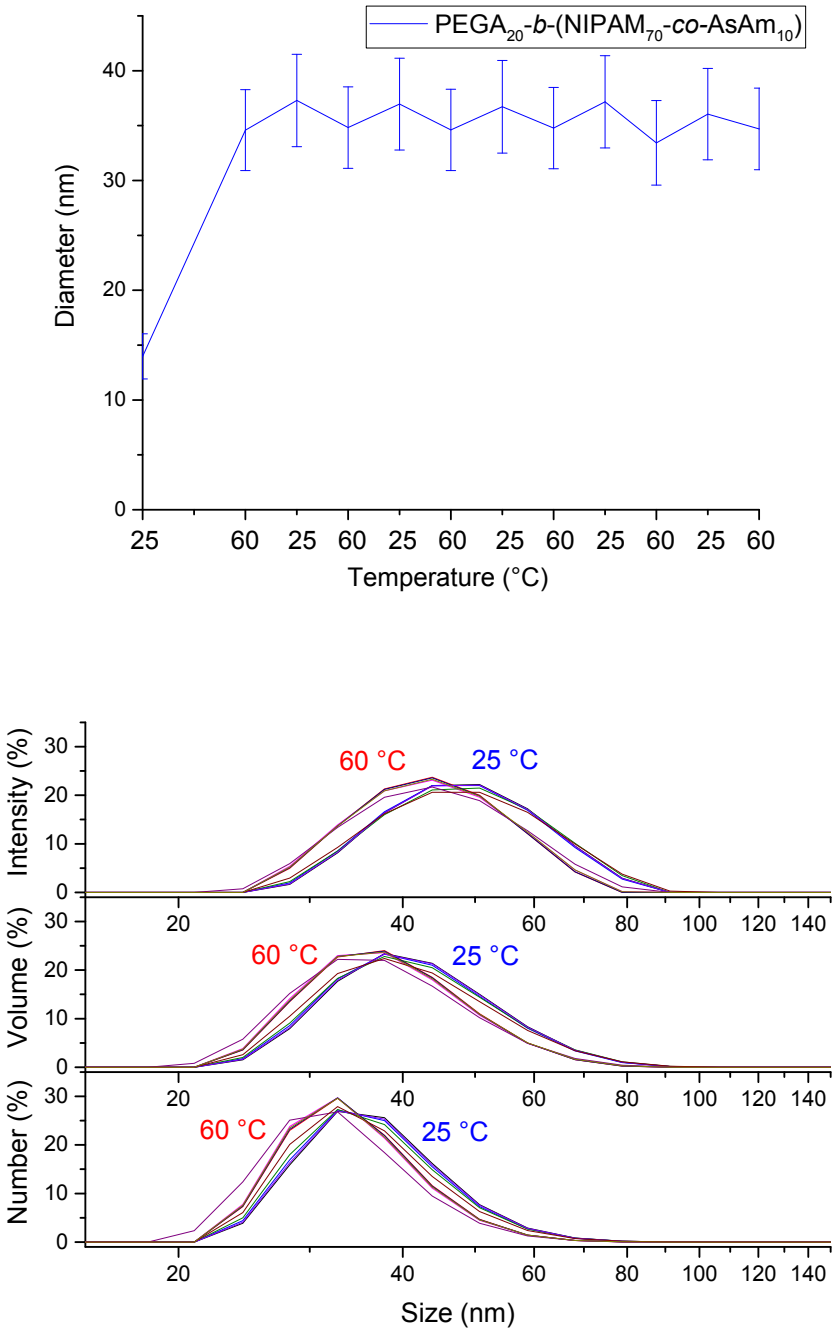


Figure S13. Reversible contracting and swelling of particles derived from $PEGA_{20}$-*b*-($NIPAM_{70}$-*co*-$AsAm_{10}$) (**P5**) at 60 °C and 25 °C respectively in aqueous H_3PO_2 (10 mg/ml).

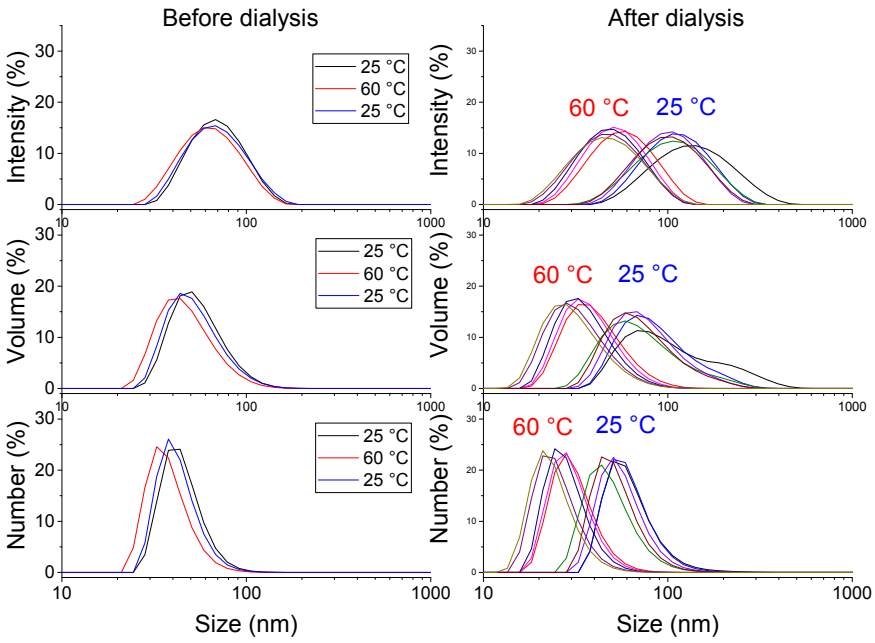


Figure S14. The size distribution curves of the cross-linked nanoparticles formed from $PEGA_{20}$-*b*-($NIPAM_{70}$-*co*-$AsAm_{10}$) (**P5**) in aqueous H_3PO_2 before dialysis (left) and in deionised water after dialysis (right) at the temperatures of 25 °C and 60 °C.

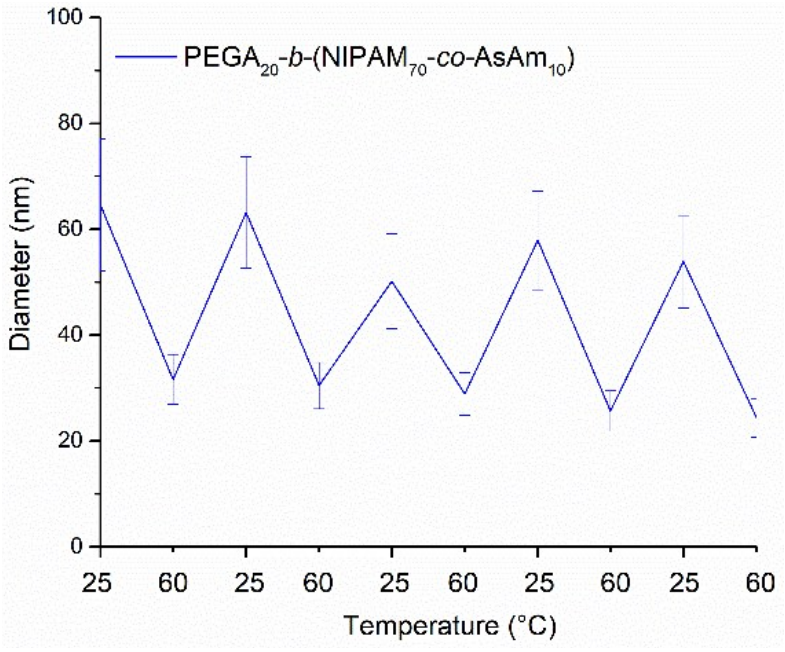


Figure S15. Reversible contracting and swelling of the purified particles derived from $PEGA_{20}$-*b*-($NIPAM_{70}$-*co*-$AsAm_{10}$) (**P5**) at 60 °C and 25 °C respectively in aqueous solution (1 mg/ml).

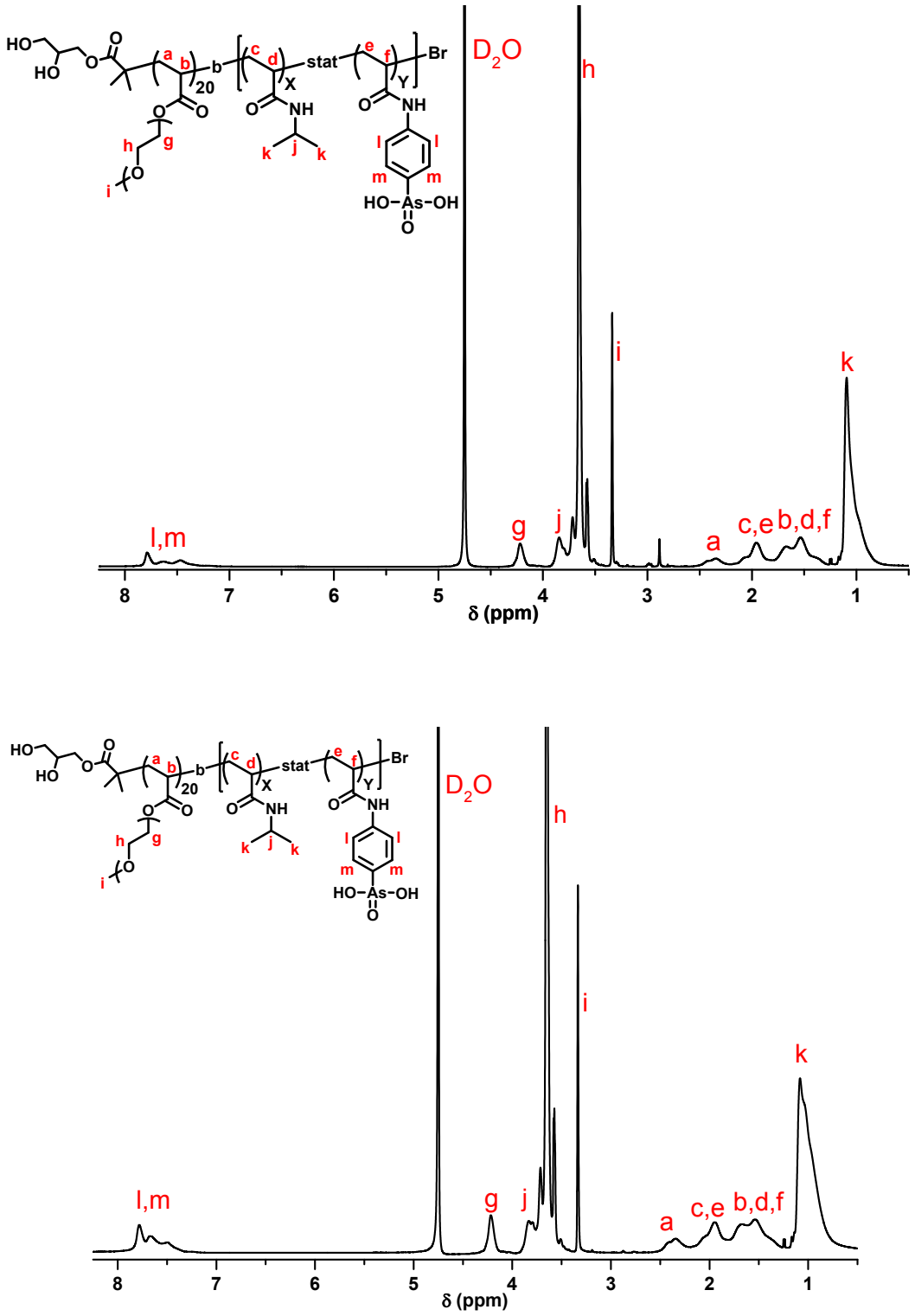
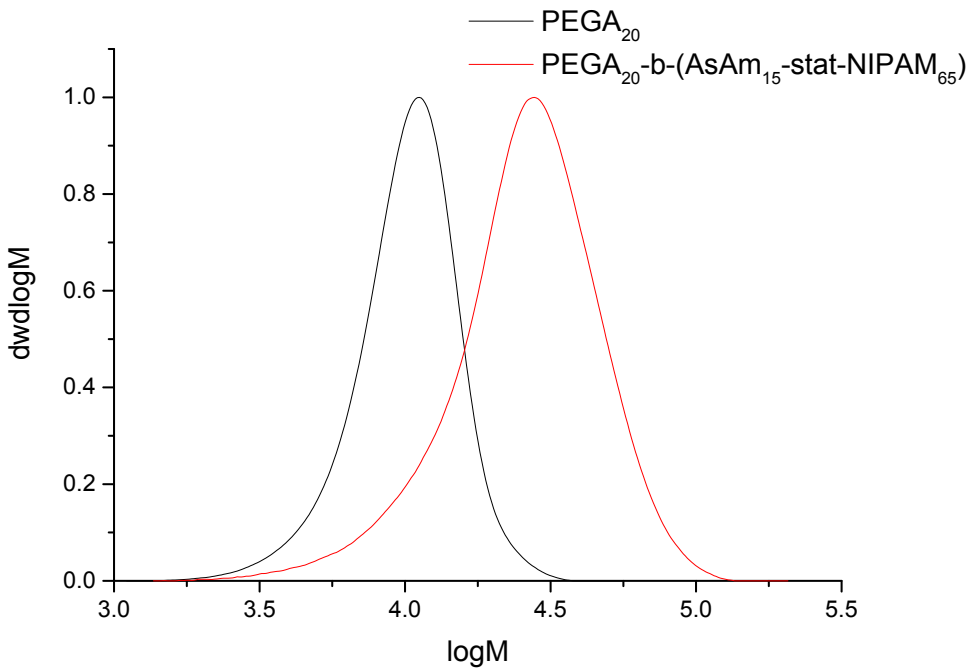


Figure S16. ^{1}H NMR spectrum of PEGA$_{20}$-*b*-(NIPAM$_{65}$-*co*-AsAm$_{15}$) (**P6**, top) and PEGA$_{20}$-*b*-(NIPAM$_{65}$-*co*-AsAm$_{15}$) (**P7**, bottom)



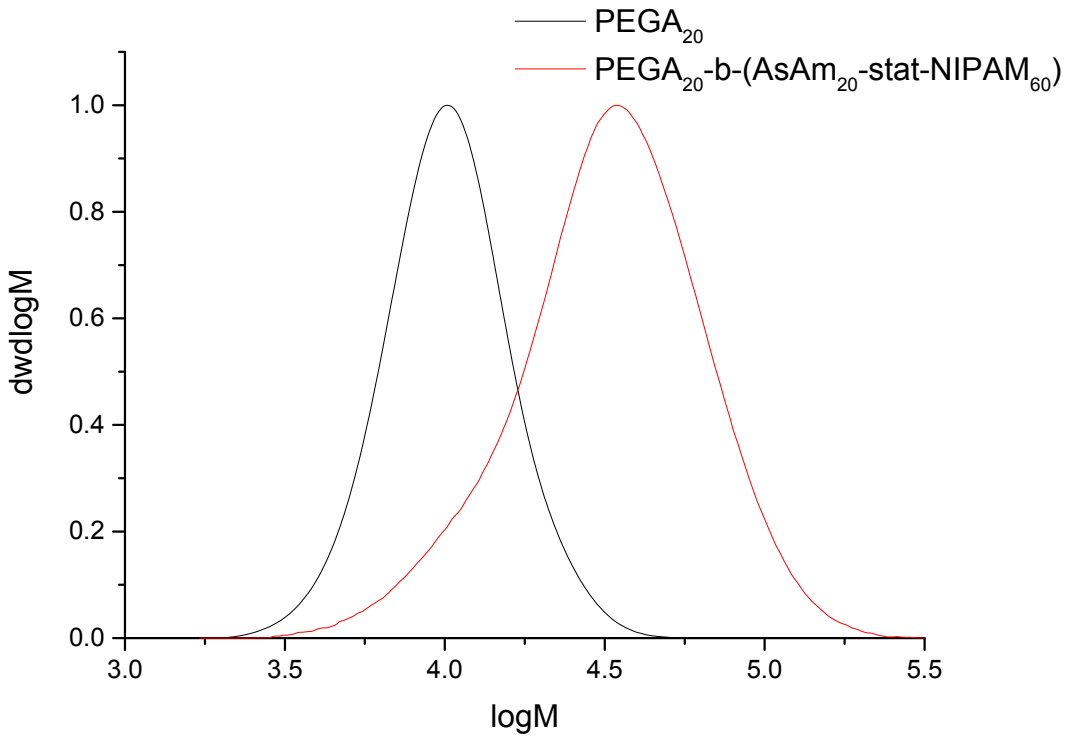


Figure S17. GPC (DMF) chromatogram of P($PEGA_{20}$) $M_{n,th}$ = 9800 $gmol^{-1}$, $M_{n,SEC}$ = 9200 $gmol^{-1}$, $Đ$ = 1.18 and $PEGA_{20}$-*b*-($NIPAM_{65}$-*co*-$AsAm_{15}$) $M_{n,th}$ = 22200 $gmol^{-1}$, $M_{n,SEC}$ =21000 $gmol^{-1}$, $Đ$ = 1.42 (**P6**, top); P($PEGA_{20}$) $M_{n,th}$ = 9800 $gmol^{-1}$, $M_{n,SEC}$ =9200 $gmol^{-1}$, $Đ$ = 1.22 and ($PEGA_{20}$-*b*-($NIPAM_{60}$-*co*-$AsAm_{20}$) $M_{n,th}$ = 22900 $gmol^{-1}$, $M_{n,SEC}$ =25600 $gmol^{-1}$, $Đ$ = 1.57 (**P7**, bottom).

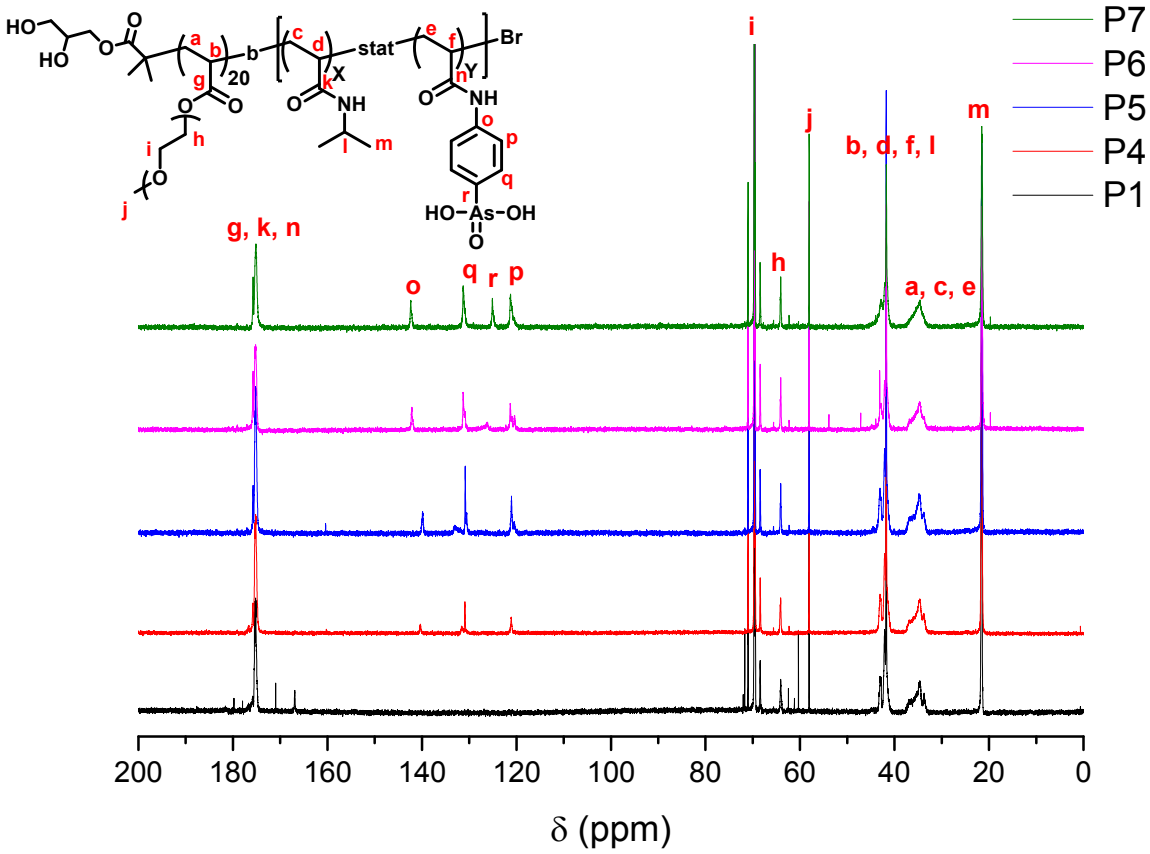
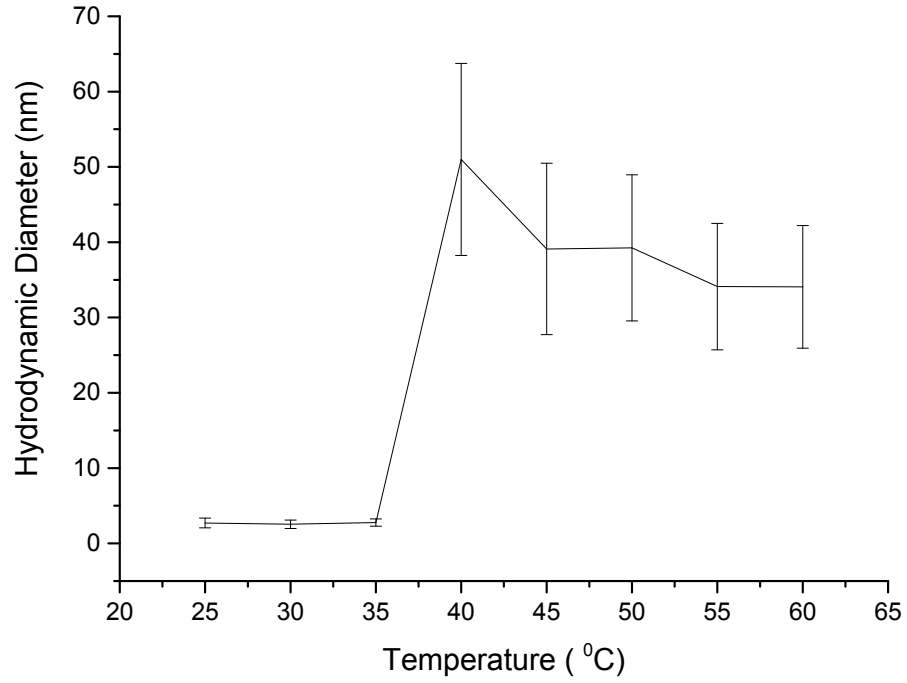


Figure S18. Cryoprobe ^{13}C NMR spectrum of $PEGA_{20}$-*b*-$NIPAm_{80}$ (**P1**) and $PEGA_{20}$-*b*-($NIPAm_{80-n}$-*co*-$AsAm_n$) (**P4** n = 5; **P5** n = 10; **P6** n = 15; **P7** n = 20)

Table S2: Experimental polymer composition based on cryoprobe ^{13}C NMR (Figure S15)

	AsAm content %			NIPAM content %			PEGA content %		
	Theoretical	∫ o	∫ p	Theoretical	∫ m	∫ l	Theoretical	∫ h	∫ j
P1	0	0	0	80	89	97	20	16	23
P4	5	3	4	75	78	83	20	13	17
P5	10	9	9	70	76	72	20	14	16
P6	15	14	14	65	68	68	20	19	26
P7	20	17	20	60	70	74	20	21	24

Monomer % based on integrals of **a,c** and **e** at ∫32.5 – 38.0 ppm as a constant.



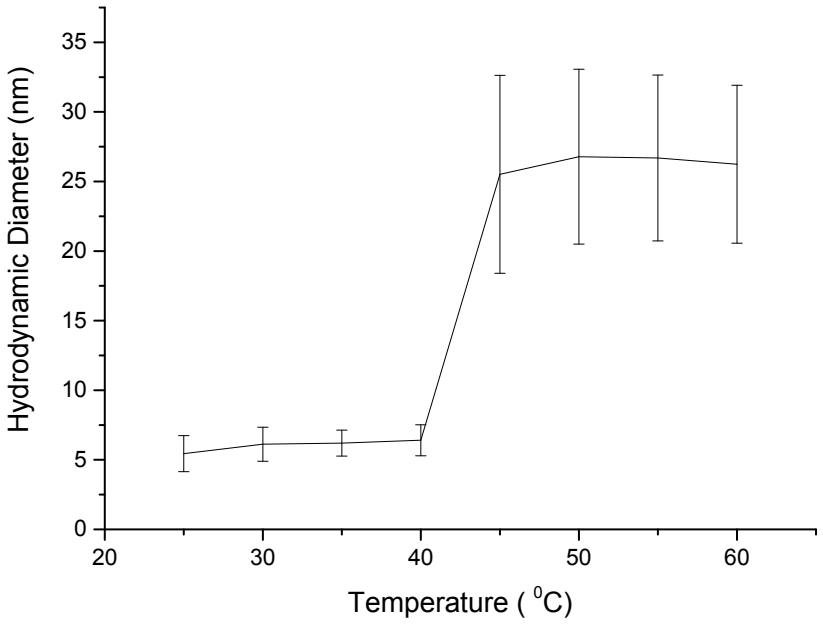
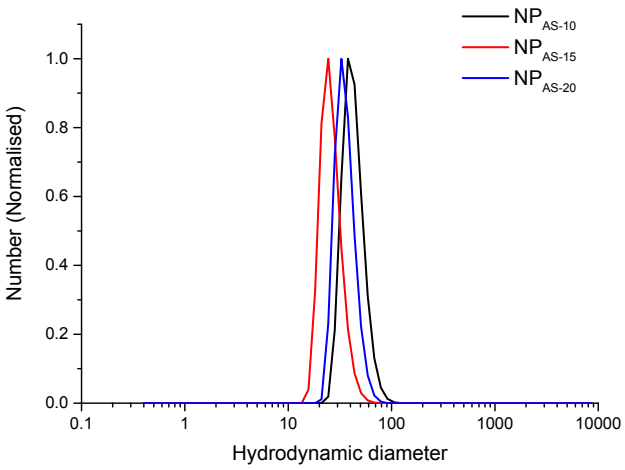
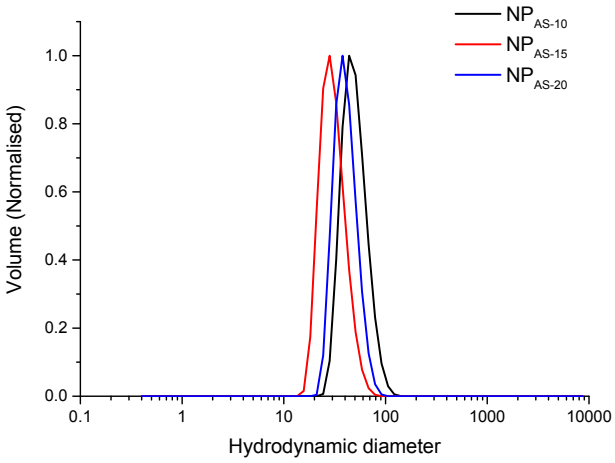


Figure S19. Thermal-induced self-assembly of $PEGA_{20}$-*b*-($NIPAM_{65}$-*co*-$AsAm_{15}$) (**P6**) and $PEGA_{20}$-*b*-($NIPAM_{60}$-*co*-$AsAm_{20}$) (**P7).** Hydrodynamic diameter (number %) versus temperature plotted.





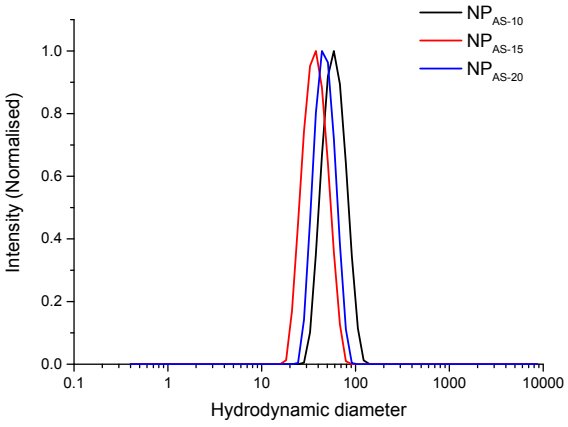


Figure S20. Particle size distribution (DLS) curves for **NP_{As-10}** (black), **NP_{As-15}** (red), **NP_{As-20}** (blue) (Table S3)

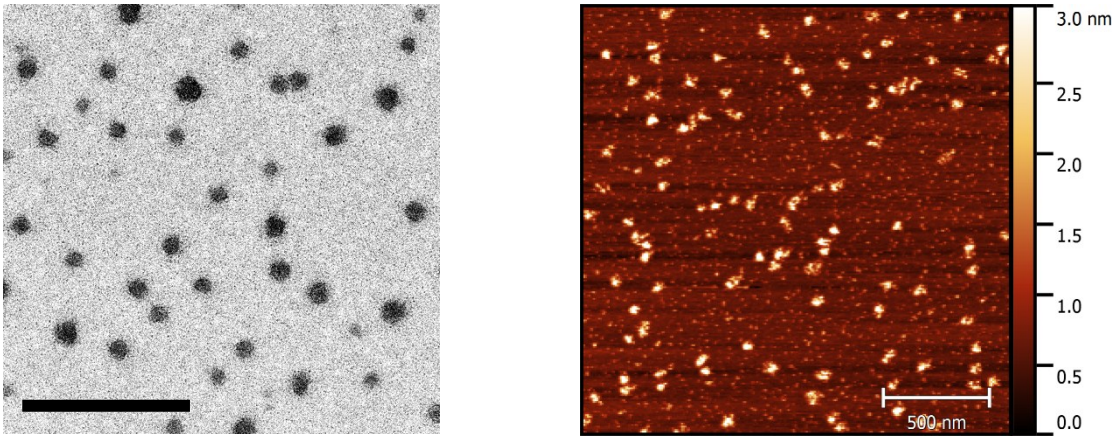


Figure S21. Representative TEM (left) and AFM (right) of $NP_{As\text{-}15}$. TEM stained with uranyl acetate. Scale = 500 nm

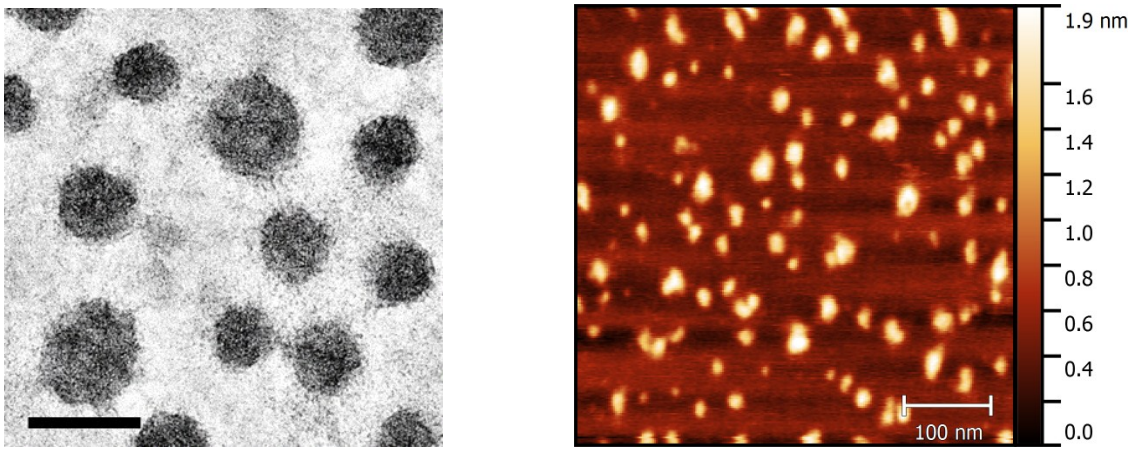


Figure S22. Representative TEM (left) and AFM (right) of $NP_{As\text{-}20}$. TEM stained with uranyl acetate. Scale = 100 nm

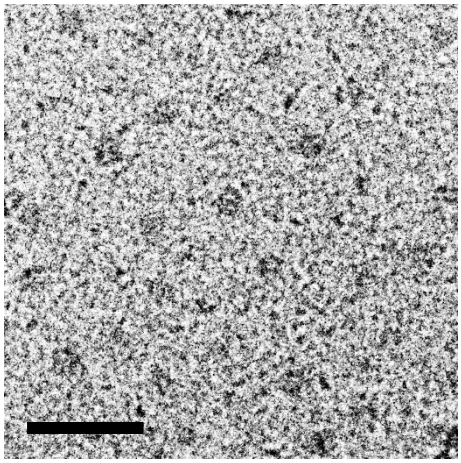


Figure S23. Representative TEM without staining (left) of $NP_{As\text{-}20}$. Scale = 100 nm

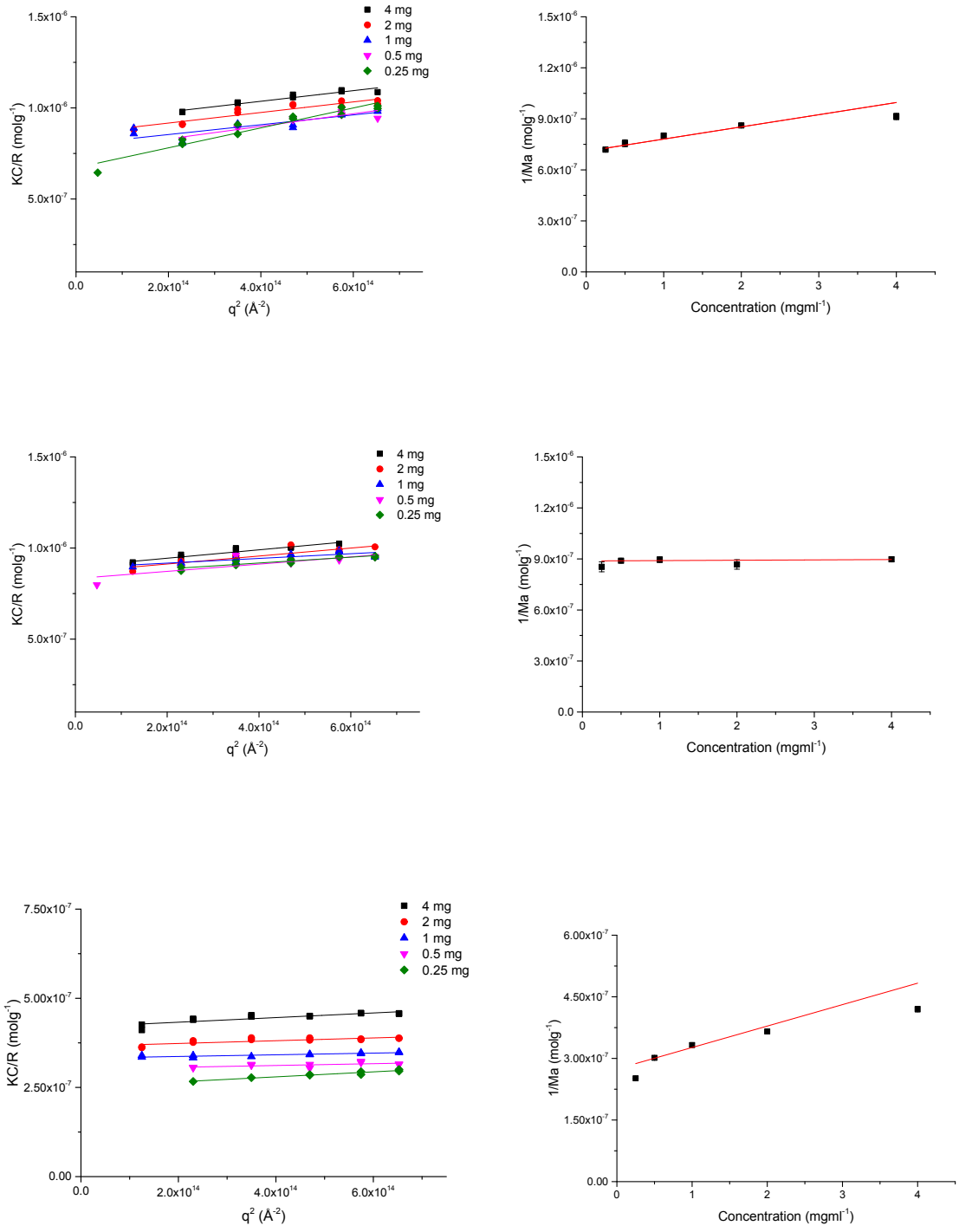


Figure S24. Evolution of KC/R in water as function of q^2 and concentration for **NP_{As-10}** (top), **NP_{As-15}** (middle), **NP_{As-20}** (bottom), obtained by SLS.

Table S3. Light scattering (DLS, SLS) of **NP_{As-10}**, **NP_{As-15}**, **NP_{As-20}**. DLS measured in aqueous solution (1 mg/ml). SLS measured at variable concentration (Figure S18). $M_{w,NP}$ was determined using Eg 2-4. N_{agg} = $M_{w,NP}/M_{n,SEC}$. R_g is the gradient of Zimm plots (Figure S18, left) using [**NP_{As-n}**] = 1 mg/ml.

Polymer	NP	*dn/dC* (mL/g)	SLS $M_{w,NP}$ (g/mol)	SLS N_{agg}	SLS R_g (nm)	DLS D_h (nm)	DLS PDi
P5	**NP_{As-10}**	0.144	1.33×10^6	62	32	43	0.06
P6	**NP_{As-15}**	0.176	1.13×10^6	51	28	26	0.06
P7	**NP_{As-20}**	0.129	4.00×10^6	148	15	36	0.05

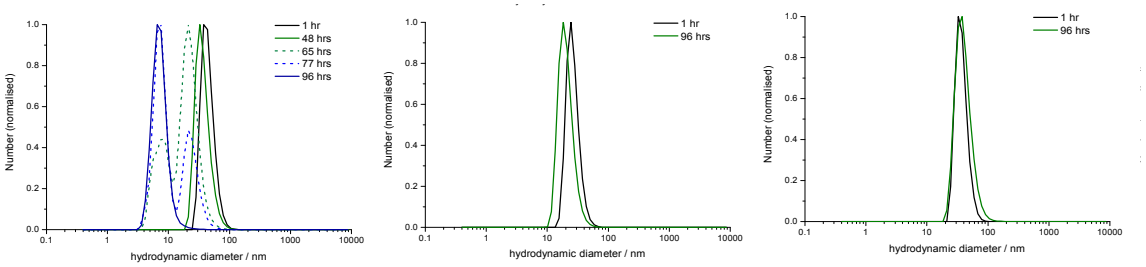


Figure S25. Particle size distribution curves (DLS) illustrating the relative stability of **NP_{As-10}** (left), **NP_{As-15}** (centre), **NP_{As-20}** (right) in aqueous solution (1 mg/ml)

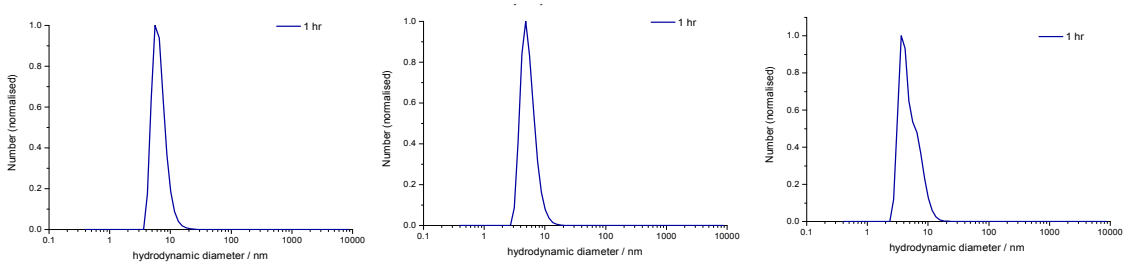


Figure S26. Particle size distribution curves of **NP_{As-10}** (left), **NP_{As-15}** (centre), **NP_{As-20}** (right) as a function of time in aqueous H_2O_2 (5 mM, 1 mg/ml)

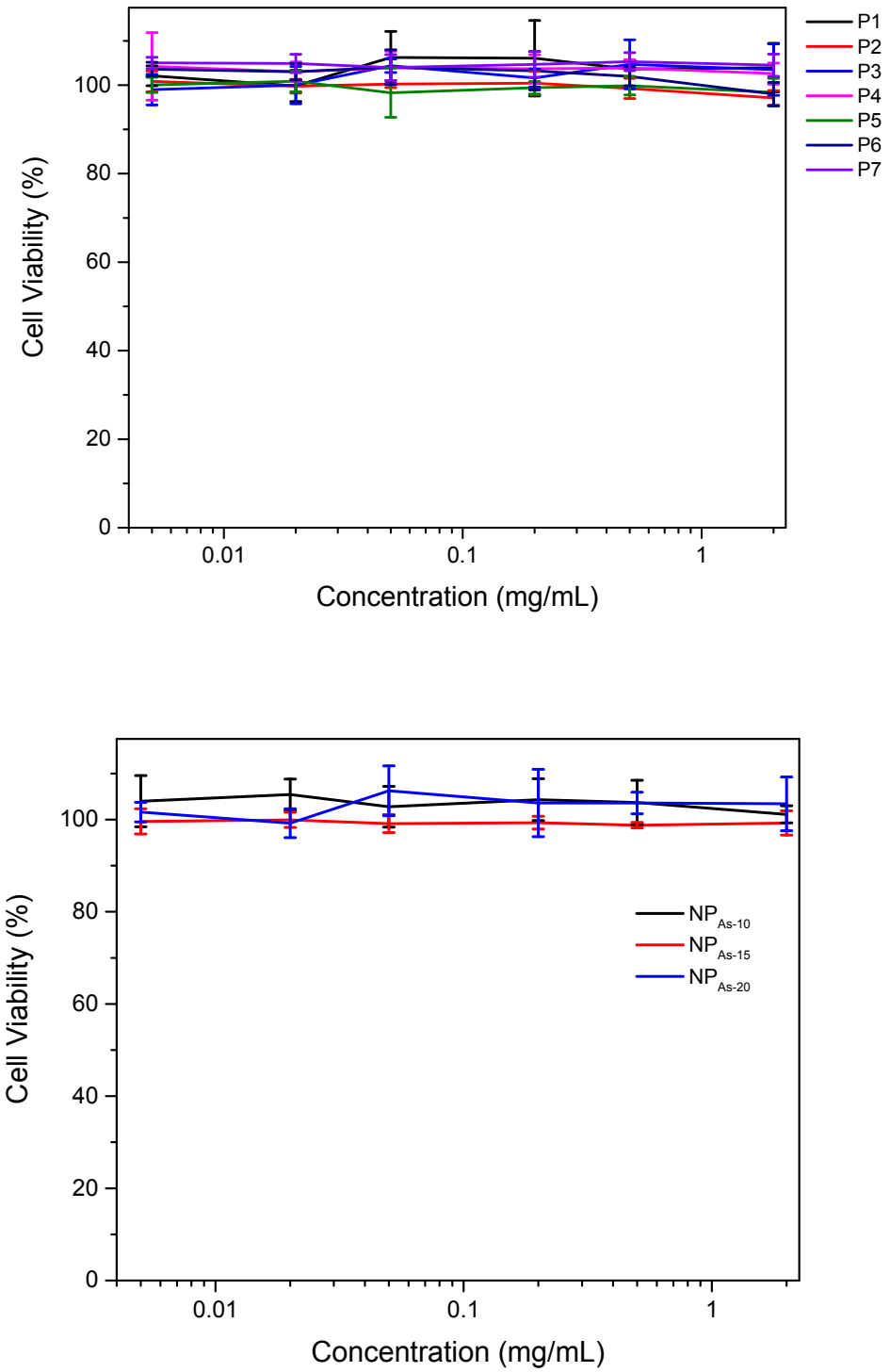


Figure S27. In vitro cell viability of polymers **P1-P7** (top) and nanoparticles **NP_{As-10}**, **NP_{As-15}**, **NP_{As-20}**, (bottom) (XTT viability assay using PC3 cell line).

1. Ciampolini, M.; Nardi, N. *Inorg. Chem.* **1966**, *5*, 41.
2. Perrier, S.; Armes, S. P.; Wang, X. S.; Nguyen, N. H.; Malet, F.; Haddleton, D. M. *J. Pol. Sci. Part A, Polym. Chem.* **2001**, *39*, 1696.
3. García-Serrano, J.; Herrera, A. M.; Pérez-Moreno, F.; Valdez, M. A.; Pal, U., Synthesis of novel ionic polymers containing arsonic acid group. *J. Polym. Sci. Part B: Poly. Phys.* **2006,** *44*, 1627-1634.
4. García-Serrano, J.; Pal, U.; Herrera, A. M.; Salas, P.; Ángeles-Chávez, C., One-Step "Green" Synthesis and Stabilization of Au and Ag Nanoparticles Using Ionic Polymers. *Chem. Mater.* **2008,** *20*, 5146-5153.