Supplementary Information

Miktoarm Star Polymers via Cyclodextrin-Driven Supramolecular Self-Assembly

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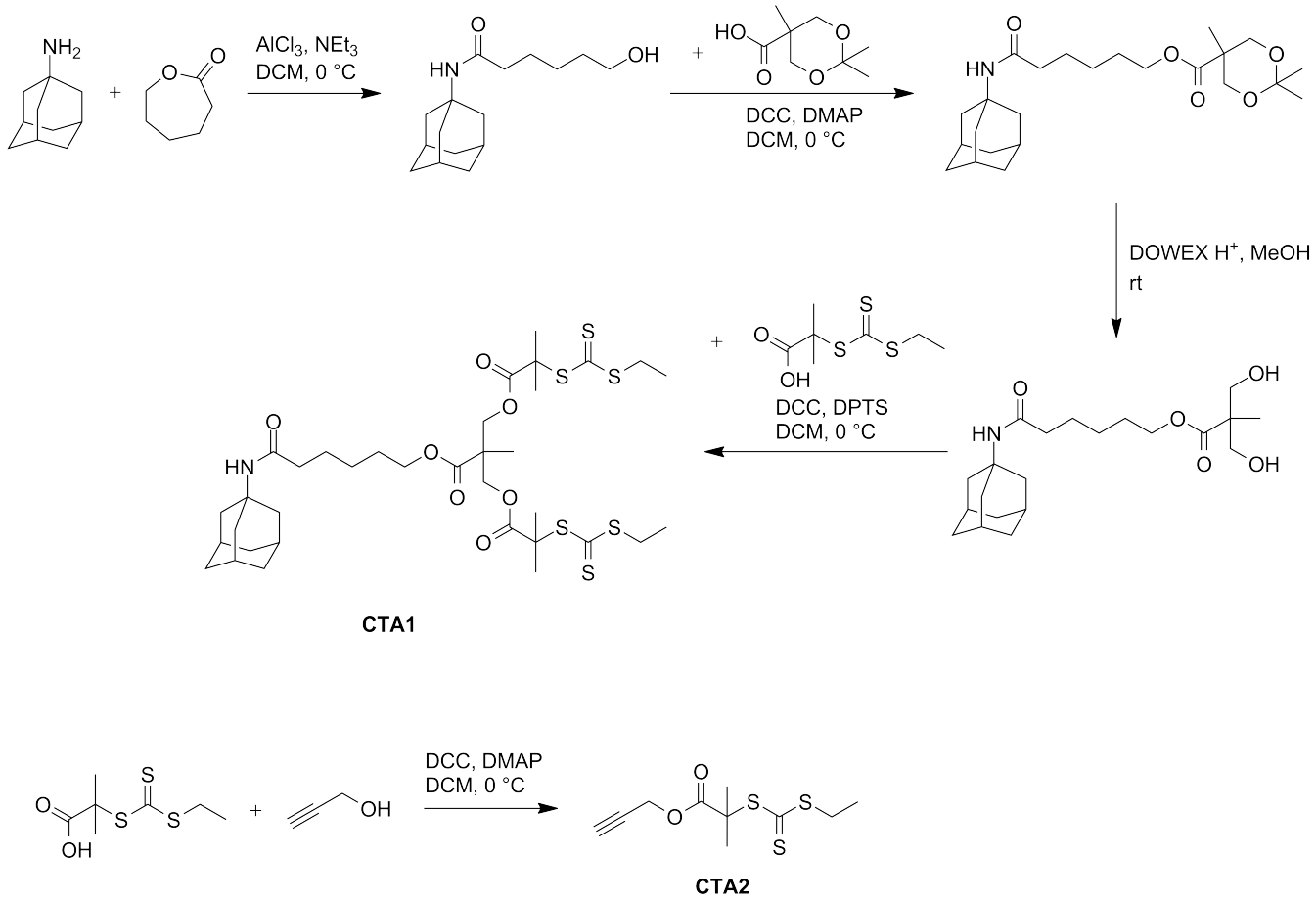

Scheme S1. Synthesis of the utilized chain transfer agents (CTAs).

Materials

1-Adamantylamine hydrochloride (ABCR, 99%), 2-bromoisobutyric acid (Sigma Aldrich, 98%), aluminium chloride (ABCR, 99%), β-cyclodextrin (β-CD; Wacker, pharmaceutical grade), 2,2-bis(hydroxymethyl)propionic acid (Sigma Aldrich, 98%), carbon disulfide (Acros, 99.9%), copper bromide (Sigma Aldrich, 99%), *N*,*N*'-dicyclohexylcarbodiimide (DCC; ABCR, 99%), *N*,*N*-dimethylaminopyridine (DMAP; Sigma Aldrich, 99%), *N*,*N*-dimethylformamide (DMF; ABCR, 99%), Dowex 50WX2-100 ion-exchange resin (Sigma Aldrich), ε-caprolacton (Alfa Aesar, 99%), ethanethiol (Acros, 99%), ethylenediaminetetraacetic acid disodium salt (EDTA; ABCR, 99%), *p*-toluenesulfonic acid monohydrate (Sigma Aldrich, 99%), *p*-toluenesulfonyl chloride (ABCR, 98%), *N*,*N*,*N*',*N*'',*N*''-pentamethyldiethyltriamine （PMDETA; Merck, 99.9%), potassium phosphate monohydrate (Sigma

Aldrich, puriss.), propargylalcohol (Alfa Aesar, 99%), silica gel (Merck, Geduran SI60. 0.063 – 0.200 mm), sodium azide (Acros, 99%), sodium hydroxide (Roth, 99%), triethylamine (Acros, 99%) were used as received. Anhydrous dichloromethane (DCM) was purchased from Acros (extra dry over molecular sieves) and used as received. All other solvents were of analytical grade and used as received. 2,2'-Azobis(2-methylpropionitrile) (AIBN; Fluka, 99%) was recrystallized twice from methanol. *N*,*N*-Diethylacrylamide (DEAAm; TCI, 98%) and *N*,*N*-dimethylacrylamide (DMAAm; TCI, 99%) were passed over a short column of basic alumina prior to use. Milli-Q water was obtained from a Milli-Q Advantage A10 Ultrapure Water Purification System (Millipore, USA). Mono-(6-azido-6-desoxy)-β-CD (β-CD-N_3),[1] 2-(((ethylthio)carbonothioyl)thio)-2-methylpropanoic acid (EMP),[2, 3] 4-(dimethylamino)-pyridinium *p*-toluenesulfonate (DPTS)[4] and isopropylidene-2,2-bis(methoxy)propionic acid[5] were prepared according to the literature.

Synthesis of N-(adamantan-1-yl)-6-hydroxyhexanamide

According to the literature procedure,[6] 11.8 g aluminium chloride (88.50 mmol, 2.2 eq.) were suspended in 100 mL of anhydrous DCM. At 0 °C 17.2 mL triethylamine (124.08 mmol, 3.1 eq.) were added dropwise via a syringe. After stirring for 15 minutes at 0 °C, the mixture was warmed to ambient temperature. Subsequently, a solution of 4.2 mL ε-caprolacton (39.74 mmol, 1.0 eq.), 6.1 mL triethylamine (46.89 mmol, 1.2 eq.) and 8.25 g adamantylamine hydrochloride (43.95 mmol, 1.1 eq.) in 100 mL anhydrous DCM was added dropwise. The mixture was stirred over night and subsequently poured into an ice cold solution of 30 g sodium carbonate in 300 mL ice water. The organic phase was separated and the aqueous phase extracted three times with 200 mL DCM. The combined organic extracts were washed with 500 mL deionized water, 500 mL brine, dried over sodium sulfate, filtered and concentrated in vacuo. The resulting solid was recrystallized from an acetonitrile/methanol mixture to give 7.09 g (26.72 mmol, 67%) of the product as off-white crystals.

^{1}H-NMR (400 MHz, $CDCl_3$): [δ, ppm] = 1.31 – 1.43 (m, 2H, C***H***$_2$-CH_2-CH_2-O), 1.51 – 1.73 (m, 10H, C***H***$_2$-CH_2-O; C***H***$_2$-CH_2-C=O; 3x C***H***$_{2,adamantyl}$), 1.92-2.00 (m, 6H, 3x NH-C-C***H***$_{2,adamantyl}$), 2.01 - 2.12 (m, 5H, 3x C***H***$_{adamantyl}$; C***H***$_2$-C=O-NH), 3.63 (t, 2H, C***H***$_2$-OH), 5.17 (br s, 1H, N***H***).

^{13}C-NMR (100 MHz, $CDCl_3$): [δ, ppm] = 25.4 (***C***H_2-CH_2-C=O; ***C***H_2-CH_2-CH_2-C=O), 29.6 (3x ***C***$H_{adamantyl}$), 32.4 (***C***H_2-CH_2-OH), 36.5 (3x ***C***$H_{2,adamantyl}$), 37.7 (***C***H_2-C=O), 41.8 (3x ***C***$H_{2,adamantyl}$-C-NH), 51.9 (***C***-NH), 62.6 (***C***H_2-OH), 172.3 (***C***=O).

ESI-MS: $[M + Na^+]_{exp}$ = 288.36 *m*/*z* and $[M + Na^+]_{calc}$ = 288.1939 *m*/*z*.

Synthesis of 6-(adamantan-1-ylamino)-6-oxohexyl 2,2,5-trimethyl-1,3-dioxane-5-carboxylate

In a 50 mL Schlenk-flask 1.40 g isopropylidene-2,2-bis(methoxy)propionic acid (8.04 mmol, 1.2 eq.), 1.78 g *N*-(adamantan-1-yl)-6-hydroxyhexanamide (6.72 mmol, 1.0 eq.) and 0.16 g DMAP (1.31 mmol, 0.2 eq.) were dissolved in 14 mL anhydrous DCM. At 0 °C a solution of 1.66 g DCC (8.04 mmol, 1.2 eq.) in 8 mL anhydrous DCM was added. After one hour the solution was warmed to ambient temperature, stirred overnight, filtered and concentrated under reduced pressure. The residual oil was purified via column chromatography on silica-gel with a mixture of *n*-hexane:ethylacetate as eluent that was gradually changed from 5:1 to 4:1. The product was obtained as colorless oil (2.70 g, 6.41 mmol, 95%).

^{1}H-NMR (400 MHz, $CDCl_3$): [δ, ppm] = 1.18 (s, 3H, C***H***$_3$-C-C=O), 1.30 – 1.50 (m, 8H, 2x C-C***H***$_3$, C***H***$_2$-CH_2-C-O), 1.56 – 1.73 (m, 10H, 2x C***H***$_{2,alkyl}$; 3x C***H***$_{2,adamantyl}$), 1.97 (d, 6H, 3x NH-C-C***H***$_{2,adamantyl}$), 2.02 – 2.12 (m, 5H, 3x C***H***$_{adamantyl}$; C***H***$_2$-C=O-NH), 3.62 (d, 2H, C***H***$_2$-O-C), 3.98 – 4.36 (m, 4H, 2x C***H***$_2$-O-C), 5.10 (br s, 1H, N***H***).

^{13}C-NMR (100 MHz, $CDCl_3$): [δ, ppm] = 18.9 (C-***C***H_3), 23.0 and 24.6 (2x ***C***H_3-C-O), 25.4 and 25.6 (***C***H_2-CH_2-C=O; ***C***H_2-CH_2-CH_2-C=O), 28.5 (***C***H_2-CH_2-C=O-NH), 29.6 (3x ***C***$H_{adamantyl}$), 36.5 (3x ***C***$H_{2,adamantyl}$), 37.7 (***C***H_2-C=O-NH), 41.8 (3x ***C***$H_{2,adamantyl}$-C-NH), 41.9 (O-CH_2-***C***-C=O), 51.9 (***C***-NH),

64.9 (CH_2-***C***H_2-O), 66.2 (2x C-***C***H_2-O), 98.2 (CH_2-O-***C***$(CH_3)_2$-O-CH_2), 172.0 (NH-***C***=O), 174.4 (O-***C***=O).

ESI-MS: $[M + Na^+]_{exp}$ = 444.48 *m*/*z* and $[M + Na^+]_{calc}$ = 444.2726 *m*/*z*.

Synthesis of 6-(adamantan-1-ylamino)-6-oxohexyl 3-hydroxy-2-(hydroxymethyl)-2-methylpropanoate

2.50 g of 6-(adamantan-1-ylamino)-6-oxohexyl 2,2,5-trimethyl-1,3-dioxane-5-carboxylate (5.94 mmol) were dissolved in 20 mL methanol. Subsequently one spoon of Dowex H^+ resin was added and the mixture stirred at ambient temperature over night. The mixture was filtered and washed with methanol. After evaporation of the solvent in vacuo 2.15 g (5.64 mmol, 95%) of the product were obtained as colorless oil.

^{1}H-NMR (400 MHz, $CDCl_3$): [δ, ppm] = 1.06 (s, 3H, C***H***$_3$-C-C=O), 1.29 – 1.50 (m, 2H, C***H***$_2$-CH_2-C-O), 1.52 – 1.77 (m, 10H, 2x C***H***$_{2,alkyl}$; 3x C***H***$_{2,adamantyl}$), 1.97 – 2.14 (m, 11H, 3x C***H***$_{adamantyl}$; C***H***$_2$-C=O-NH; 3x NH-C-C***H***$_{2,adamantyl}$), 2.83 (br s, 2H, O***H***), 3.72 (d, 2H, C***H***$_2$-O-C), 3.87 (d, 2H, C***H***$_2$-O-C), 4.16 (t, 2H, CH_2-C***H***$_2$-O-C), 5.21 (br s, 1H, N***H***).

^{13}C-NMR (100 MHz, $CDCl_3$): [δ, ppm] = 17.4 (C-***C***H_3), 25.2 and 25.7 (***C***H_2-CH_2-C=O; ***C***H_2-CH_2-CH_2-C=O), 28.3 (***C***H_2-CH_2-C=O-NH), 29.6 (3x ***C***$H_{adamantyl}$), 36.5 (3x ***C***$H_{2,adamantyl}$), 37.5 (***C***H_2-C=O-NH), 41.8 (3x ***C***$H_{2,adamantyl}$-C-NH), 49.4 (O=C-***C***-$(CH_2$-$O)_2$), 52.1 (***C***-NH), 64.9 (CH_2-***C***H_2-O), 68.3 (2x C-***C***H_2-O), 172.3 (NH-***C***=O), 176.2 (O-***C***=O).

ESI-MS: $[M + Na^+]_{exp}$ = 404.44 *m*/*z* and $[M + Na^+]_{calc}$ = 404.4961 *m*/*z*.

*Synthesis of 2-((((6-(adamantan-1-ylamino)-6-oxohexyl)oxy)carbonyl)-2-methylpropane-1,3-diyl bis(2-(((ethylthio)carbonothioyl)thio)-2-methylpropanoate (**CTA1**)*

In a 50 mL round bottom-flask 2.00 g 6-(adamantan-1-ylamino)-6-oxohexyl 3-hydroxy-2-(hydroxymethyl)-2-methylpropanoate (5.25 mmol, 1.0 eq.), 2.47 g EMP (11.02 mmol, 2.1 eq.) and

0.62 g DPTS (2.11 mmol, 0.4 eq.) were dissolved in 20 mL anhydrous DCM. At 0 °C a solution of 3.25 g DCC (15.75 mmol, 3.0 eq.) in 20 mL anhydrous DCM was added. After one hour the solution was warmed to ambient temperature, stirred for 2 days, filtered and concentrated under reduced pressure. The residual oil was purified via column chromatography on silica-gel with a mixture of *n*-hexane:ethylacetate as eluent that was gradually changed from 4:1 to 3:1. The product was obtained as yellow oil (2.25 g, 2.84 mmol, 54%).

^{1}H-NMR (400 MHz, $CDCl_3$): [δ, ppm] = 1.02 – 1.47 (m, 11H, C***H***$_2$-CH_2-C-O; C***H***$_3$-C-C=O; 2x C***H***$_3$-CH_2), 1.51 – 1.85 (m, 22H, 2x C***H***$_{2,alkyl}$; 3x C***H***$_{2,adamantyl}$; 4x C-C***H***$_3$), 1.89 – 2.22 (m, 11H, 3x C***H***$_{adamantyl}$; C***H***$_2$-C=O-NH; 3x NH-C-C***H***$_{2,adamantyl}$), 3.26 (q, 4H, C***H***$_2$-S), 3.31 – 3.90 (m, 6H, C***H***$_2$-O-C, C***H***$_2$-O-C; CH_2-C***H***$_2$-O-C), 5.15 (br s, 1H, N***H***).

^{13}C-NMR (100 MHz, $CDCl_3$): [δ, ppm] = 13.0 (4x CH_2-***C***H_3), 17.9 (C-***C***H_3), 25.4, 25.5 and 25.7 (4x C-***C***H_3; ***C***H_2-CH_2-C=O; ***C***H_2-CH_2-CH_2-C=O), 28.5 (***C***H_2-CH_2-C=O-NH), 29.6 (3x ***C***$H_{adamantyl}$), 31.3 (2x C***H***$_2$-S), 36.5 (3x ***C***$H_{2,adamantyl}$), 37.6 (***C***H_2-C=O-NH), 41.8 (3x ***C***$H_{2,adamantyl}$-C-NH), 46.2 (O=C-***C***-(CH_2-O)$_2$), 52.0 (***C***-NH), 56.0 (***C***-(CH_3)$_2$), 65.3 and 67.0 (CH_2-***C***H_2-O; 2x C-***C***H_2-O), 172.0, 172.4 and 172.6 (3x O-***C***=O, NH-***C***=O), 221.4 (***C***=S).

ESI-MS: $[M + Na^+]_{exp}$ = 816.32 *m*/*z* and $[M + Na^+]_{calc}$ = 816.2200 *m*/*z*.

*Synthesis of prop-2-yn-1-yl 2-(((ethylthio)carbonothioyl)thio)-2-methylpropanoate (**CTA2**)*

In a 250 mL Schlenk-flask 4.00 g EMP (17.86 mmol, 1.0 eq.), 2.1 mL propargyl alcohol (36.34 mmol, 2.0 eq.) and 0.88 g DMAP (7.20 mmol, 0.4 eq.) were dissolved in 80 mL anhydrous DCM. At 0 °C a solution of 7.40 g DCC (35.86 mmol, 2.0 eq.) in 40 mL anhydrous DCM was added. After one hour the solution was warmed to ambient temperature, stirred overnight, filtered and concentrated under reduced pressure. The residual oil was purified via column chromatography on silica-gel with a 20:1 mixture of *n*-hexane:ethylacetate. The product was obtained as yellow oil (3.92 g, 14.94 mmol, 84%).

^{1}H-NMR (400 MHz, $CDCl_3$): [δ, ppm] = 1.32 (t, 3H, C***H***$_3$-CH_2), 1.70 (s, 6H, 2x C-C***H***$_3$), 2.46 (t, 1H, C***H***), 3.28 (q, 2H, CH_3-C***H***$_2$), 4.69 (d, 2H, C***H***$_2$-O).

^{13}C-NMR (100 MHz, $CDCl_3$): [δ, ppm] = 13.0 (CH_2-***C***H_3), 25.3 (2x C-***C***H_3), 31.4 (***C***H_2-CH_3), 53.5 (***C***-CH_3), 55.7 (***C***H_2-O), 75.2 (***C***H), 77.4 (***C***-CH), 172.5 (***C***=O), 221.0 (***C***=S).

ESI-MS: $[M + Na^+]_{exp}$ = 284.88 *m*/*z* and $[M + Na^+]_{calc}$ = 285.0054 *m*/*z*.

Exemplary Synthesis of Mid-Chain Adamantyl-Functionalized Poly(DMAAm)

CTA1 (60.0 mg, 0.076 mmol, 1.0 eq.), DMAAm (1.50 g, 15.14 mmol, 199.2 eq.), AIBN (2.5 mg, 0.015 mmol, 0.2 eq.), DMF (15.0 mL) and a stirring-bar were added into a Schlenk-tube. After three freeze-pump-thaw cycles the tube was backfilled with Argon, sealed, placed in an oil bath at 60 °C and removed after 24 h. The tube was subsequently cooled with liquid nitrogen to stop the reaction. A NMR-sample was withdrawn for the determination of conversion, inhibited with a pinch of hydroquinone (approx. 5 mg) and $CDCl_3$ was added. A conversion of 90 % was calculated based on the NMR data (see Characterization Methods for details of the calculation). The residue was dialysed against deionized water with a SpectraPor3 membrane (MWCO = 1000 Da) for 3 days at ambient temperature. The solvent was removed in vacuo to yield the polymer as a yellow solid (1.40 g, 99 %, M_{ntheo} = 18500 g·mol^{-1}, GPC(DMAc): M_{nGPC} = 15800 g·mol^{-1}, *PDI* = 1.41).

Exemplary Synthesis of Alkyne-Functionalized Poly(DEAAm)

CTA2 (269.0 mg, 1.03 mmol, 1.0 eq.), DEAAm (10.00 g, 78.62 mmol, 76.3 eq.), AIBN (15.0 mg, 0.091 mmol, 0.1 eq.), DMF (45 mL) and a stirring-bar were added into a Schlenk-tube. After three freeze-pump-thaw cycles the tube was backfilled with Argon, sealed, placed in an oil bath at 60 °C and removed after 6 h. The tube was subsequently cooled with liquid nitrogen to stop the reaction. A NMR-sample was withdrawn for the determination of conversion, inhibited with a pinch of hydroquinone

(approx. 5 mg) and $CDCl_3$ was added. A conversion of 82 % was calculated based on the NMR data (see Characterization Methods for details of the calculation). The residue was dialysed against deionized water with a SpectraPor3 membrane (MWCO = 1000 Da) for 3 days at ambient temperature. The solvent was removed in vacuo to yield the polymer as yellow solid (7.34 g, 87 %, M_{ntheo} = 8200 g·mol^{-1}, GPC(DMAc): M_{nGPC} = 7500 g·mol^{-1}, *PDI* = 1.14).

Exemplary Click-Reaction of Alkyne-Functionalized Poly(DEAAm) with β-CD-N_3

Alkyne functionalized poly(DEAAm) (M_{nGPC} = 7500 g·mol^{-1}; 2.00 g, 0.27 mmol, 1.0 eq.), β-CD-N_3 (1.25 g, 1.08 mmol 4.0 eq.), PMDETA (56 µL, 0.27 mmol, 1.0 eq.), DMF (25 mL) and a stirring-bar were introduced into a Schlenk-tube. After three freeze-pump-thaw cycles the tube was filled with Argon and CuBr (38.0 mg, 0.27 mmol, 1.0 eq.) was added under a stream of Argon. Subsequently two freeze-pump-thaw cycles were performed, the tube backfilled with Argon and the mixtures stirred at ambient temperature for 24 h. EDTA-solution (5 wt. %, 1 mL) was added and the residue was dialysed against deionized water with a SpectraPor3 membrane (MWCO = 2000 Da) for 3 days at ambient temperature. The solvent was removed in vacuo to yield the cyclodextrin functionalized polymer as a yellow solid (1.58 g, 68 %, GPC(DMAc): M_{nGPC} = 10300 g·mol^{-1}, *PDI* = 1.12).

Exemplary Supramolecular Miktoarm Star Polymer-Formation via Cyclodextrin/Guest Interaction

Mid-chain adamantyl functionalized poly(DMAAm) (M_{nGPC} = 15800 g·mol^{-1}; 100.0 mg, 0.006 mmol, 1.0 eq.) was dissolved in 2 mL THF and added dropwise to a solution of cyclodextrin functionalized poly(DEAAm) (M_{nGPC} = 8000 g·mol^{-1}; 50.6 mg, 0.006 mmol, 1.0 eq.) under vigorous stirring. The resulting solution was dialysed against a deionized water/THF-mixture. The water-content was gradually changed from 70 % to 100 % over 1 day and the dialysis was continued for 3 days with deionized water at ambient temperature. The solvent was removed in vacuo to yield the supramolecular complex in

quantitative yield. In a similar manner a control sample was prepared consisting of a cyclodextrin functionalized poly(DEAAm) (M_{nGPC} = 8000 g·mol^{-1}; 25.0 mg, 0.003 mmol, 1.0 eq.) and non-adamantyl functionalized poly(DMAAm) (M_{nGPC} = 12300 g·mol^{-1}; 38.4 mg, 0.003 mmol, 1.0 eq.) that was polymerized with EMP.

Characterization Methods

Nuclear magnetic resonance (NMR) measurements were carried out on a Bruker AM250 spectrometer at 250 MHz for the determination of monomer conversion and a Bruker AM400 spectrometer at 400 MHz for hydrogen nuclei and at 100 MHz for carbon nuclei for structure verification. 2D ROESY (rotating frame nuclear Overhauser effect spectroscopy) NMR spectra were measured on a Bruker Avance III 600 spectrometer at 600 MHz. For the determination of the conversion of DMAAm the integrals of one vinylic proton (5.78 - 5.89 ppm) and the backbone protons (0.80 – 2.00 ppm) were employed. The conversion of DEAAm was determined with the integral of one vinylic proton (5.57 – 5.73 ppm) and with the integral of the side chain methyl groups and backbone protons (0.81 – 1.97 ppm).

Size exclusion chromatography (SEC) was performed on a Polymer Laboratories PL-GPC 50 Plus Integrated System, comprising an autosampler, a PLgel 5 µm bead-size guard column (50·7.5 mm) followed by three PLgel 5 µm MixedC columns (300·7.5 mm) and a differential refractive index detector using *N*,*N*-dimethylacetamide (DMAc) containing 0.03 wt% LiBr as eluent at 50 °C with a flow rate of 1.0 mL·min^{-1}. The SEC system was calibrated against linear poly(styrene) standards with molecular weights ranging from 160 to 6·10^{6} g·mol^{-1}. All SEC calculations were carried out relative to poly(styrene) calibration (Mark-Houwink-Parameters K = 14.1·10^{-5} dL·g^{-1}; α = 0.7).[7]

Electrospray ionization-mass spectrometry (ESI-MS) spectra were recorded on a LXQmass spectrometer (ThermoFisher Scientific, San Jose, CA) equipped with an atmospheric pressure ionization source operating in the nebulizer-assisted electrospray mode. The instrument was calibrated in the *m*/*z*

range 195-1822 Da using a standard containing caffeine, Met-Arg-Phe-Ala acetate (MRFA), and a mixture of fluorinated phosphazenes (Ultramark 1621) (all from Aldrich). A constant spray voltage of 4.5 kV was used, and nitrogen at a dimensionless sweep gas flow rate of 2 (~3 $L \cdot min^{-1}$) and a dimensionless sheath gas flow rate of 12 (~1 $L \cdot min^{-1}$) were applied. The capillary voltage, the tube lens offset voltage, and the capillary temperature were set to 60 V, 110 V, and 275 °C respectively.

Lower critical solution temperatures (LCSTs) were measured on a Cary 300 Bio UV/VIS spectrophotometer (Varian) at 400 nm under stirring. The heating rate was set to 0.32 $°C \cdot min^{-1}$ and the concentration at 1 $mg \cdot mL^{-1}$. For the determination of the LCST the point of inflection of the transmittance vs. temperature plot was used.

Dynamic light scattering (DLS) was performed on a 380 DLS spectrometer (Particle Sizing Systems, Santa Barbara, USA) with a 90 mW laser diode operating at 658 nm equipped with an avalanche photo diode detector. Every measurement was performed 4 times at 25 °C, 44 °C or 50 °C and the data was evaluated with an inverse Laplace algorithm. The scattered light was recorded at an angle of 90° to the incident beam. For the temperature sequenced measurements the sample was equilibrated at the specific temperature for 3 minutes, then the DLS measurement was performed 2 times for 5 minutes and the temperature changed again. The entire procedure was performed 3 times and the data points were finally averaged. All hydrodynamic diameters (D_h) in the text are the averages of the number weighted distributions. The samples were prepared in Milli-Q water and filtered with a 0.2 µm regenerated cellulose syringe filter (Roth, Rotilabo).

Theoretical molecular weights were calculated with the following equation:

$$M_{ntheo} = conversion \times M_w(\text{Monomer}) \times \frac{[\text{Monomer}]_0}{[\text{CTA}]_0} + M_w(\text{CTA})$$

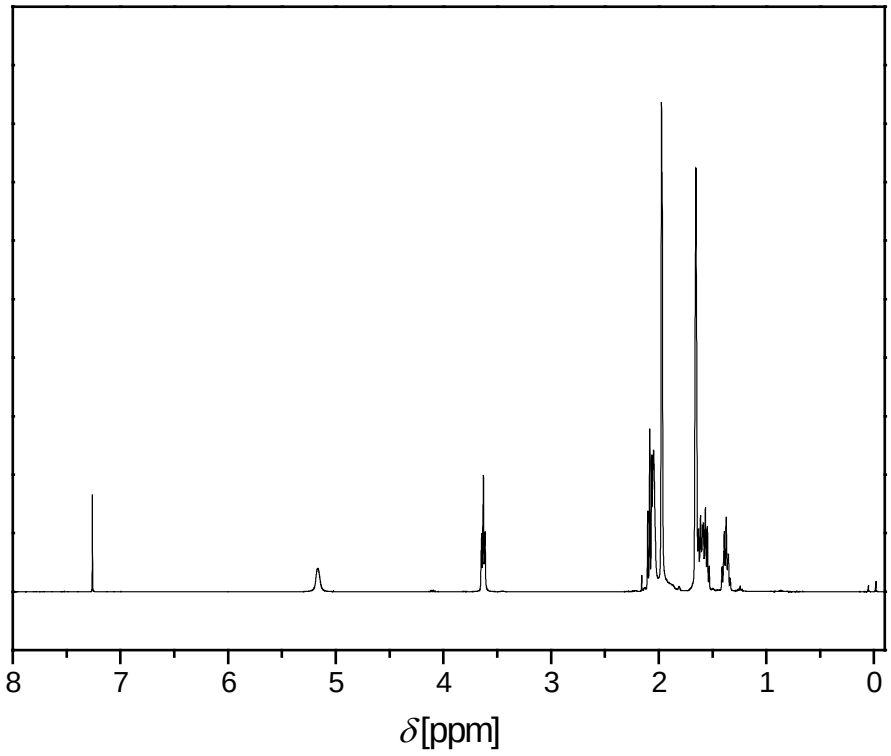

Figure S1. ^{1}H-NMR spectrum of *N*-(adamantan-1-yl)-6-hydroxyhexanamide.

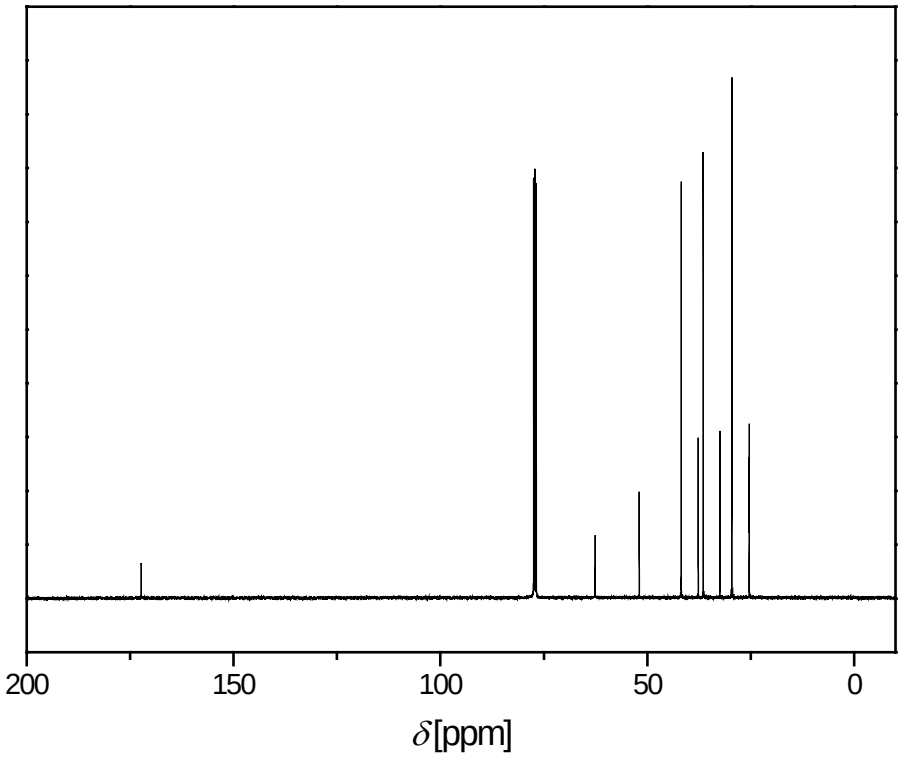

Figure S2. ^{13}C-NMR spectrum of *N*-(adamantan-1-yl)-6-hydroxyhexanamide.

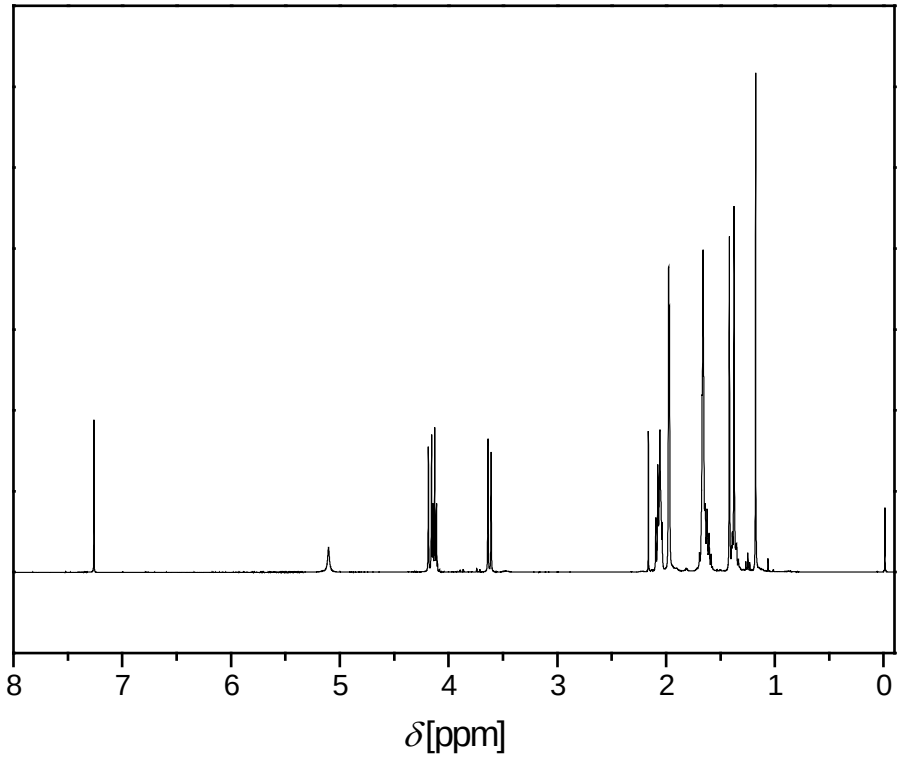

Figure S3. ^{1}H-NMR spectrum of 6-(adamantan-1-ylamino)-6-oxohexyl 2,2,5-trimethyl-1,3-dioxane-5-carboxylate.

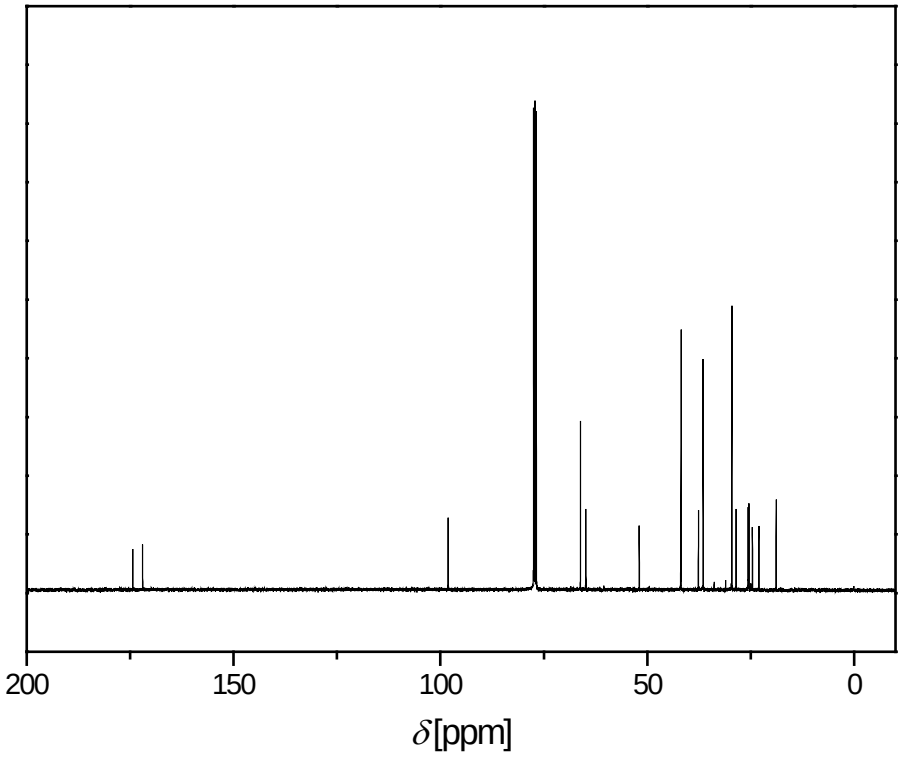

Figure S4. ^{13}C-NMR spectrum of 6-(adamantan-1-ylamino)-6-oxohexyl 2,2,5-trimethyl-1,3-dioxane-5-carboxylate.

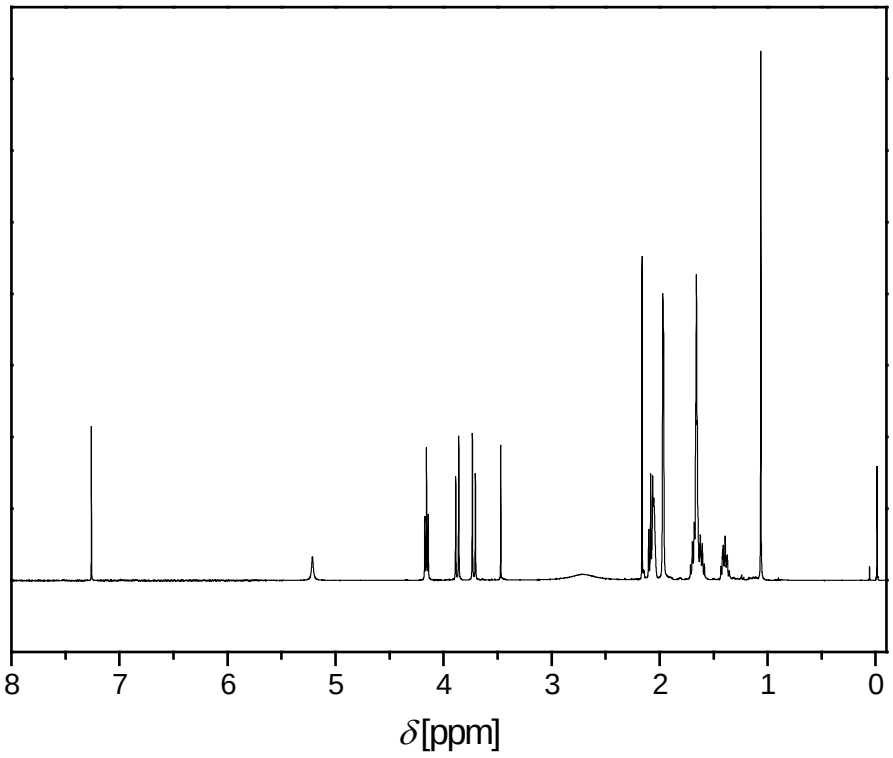

Figure S5. ^{1}H-NMR spectrum of 6-(adamantan-1-ylamino)-6-oxohexyl 3-hydroxy-2-(hydroxymethyl)-2-methylpropanoate.

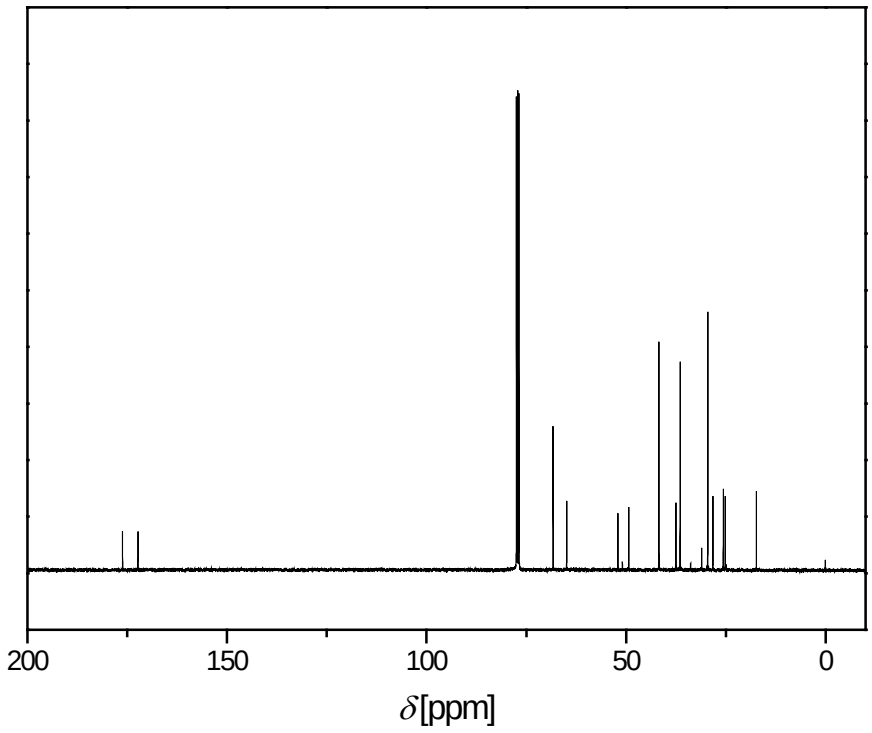

Figure S6. ^{13}C-NMR spectrum of 6-(adamantan-1-ylamino)-6-oxohexyl 3-hydroxy-2-(hydroxymethyl)-2-methylpropanoate.

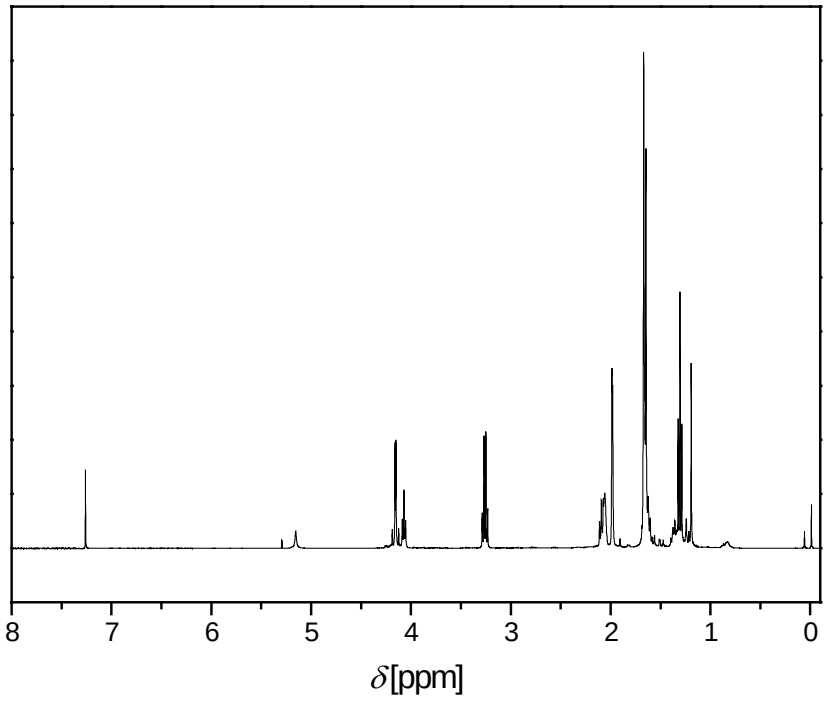

Figure S7. ^{1}H-NMR spectrum of 2-(((6-(adamantan-1-ylamino)-6-oxohexyl)oxy)carbonyl)-2-methylpropane-1,3-diyl bis(2-(((ethylthio)carbonothioyl)thio)-2-methylpropanoate (**CTA1**).

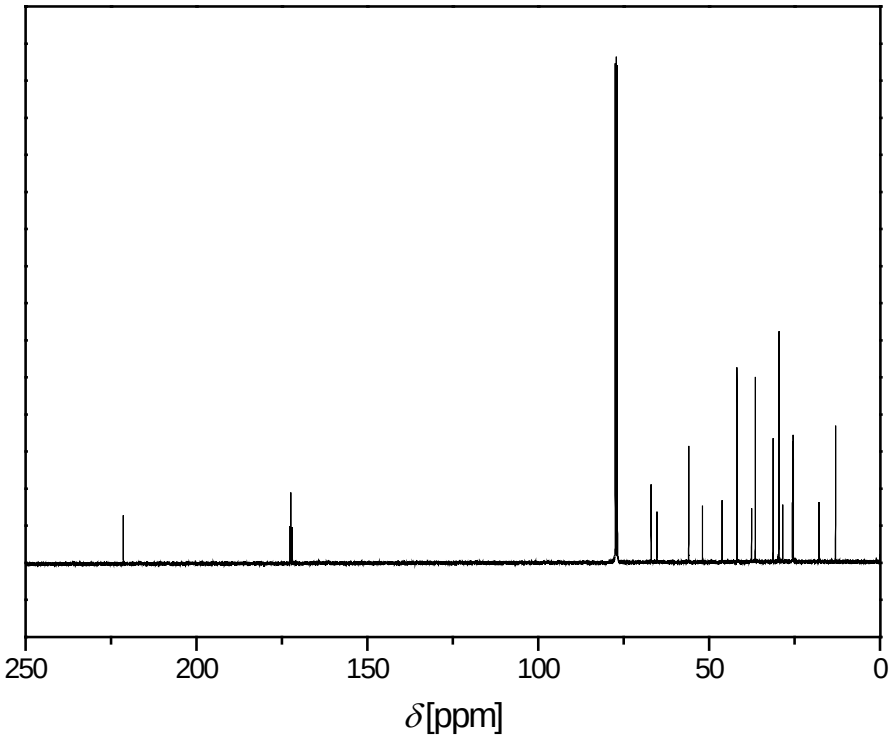

Figure S8. ^{13}C-NMR spectrum of 2-(((6-(adamantan-1-ylamino)-6-oxohexyl)oxy)carbonyl)-2-methylpropane-1,3-diyl bis(2-(((ethylthio)carbonothioyl)thio)-2-methylpropanoate (**CTA1**).

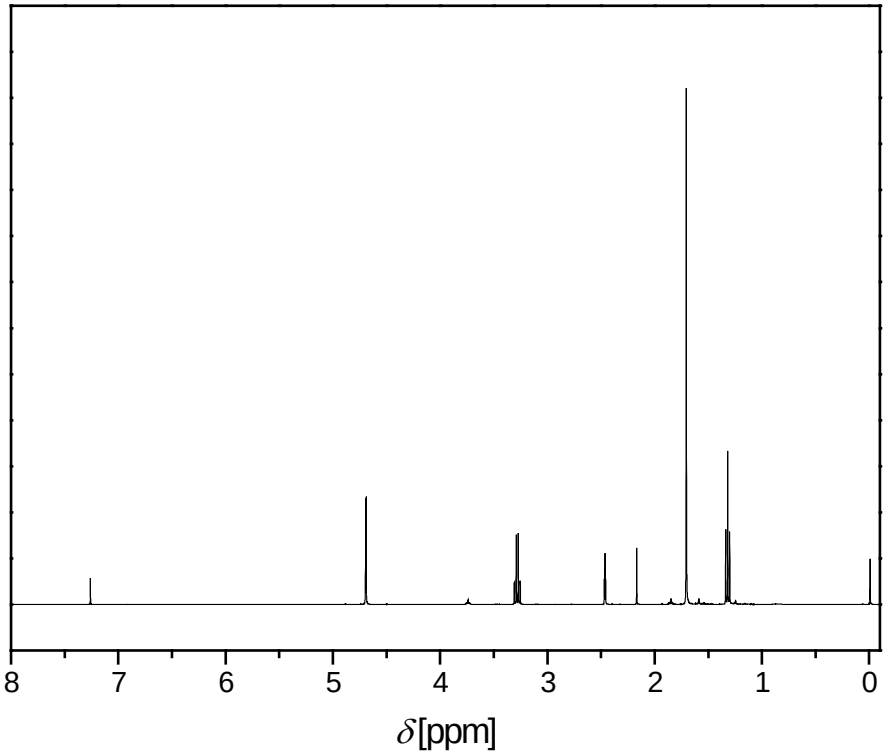

Figure S9. ^{1}H-NMR spectrum of prop-2-yn-1-yl 2-(((ethylthio)carbonothioyl)thio)-2-methylpropanoate (**CTA2**).

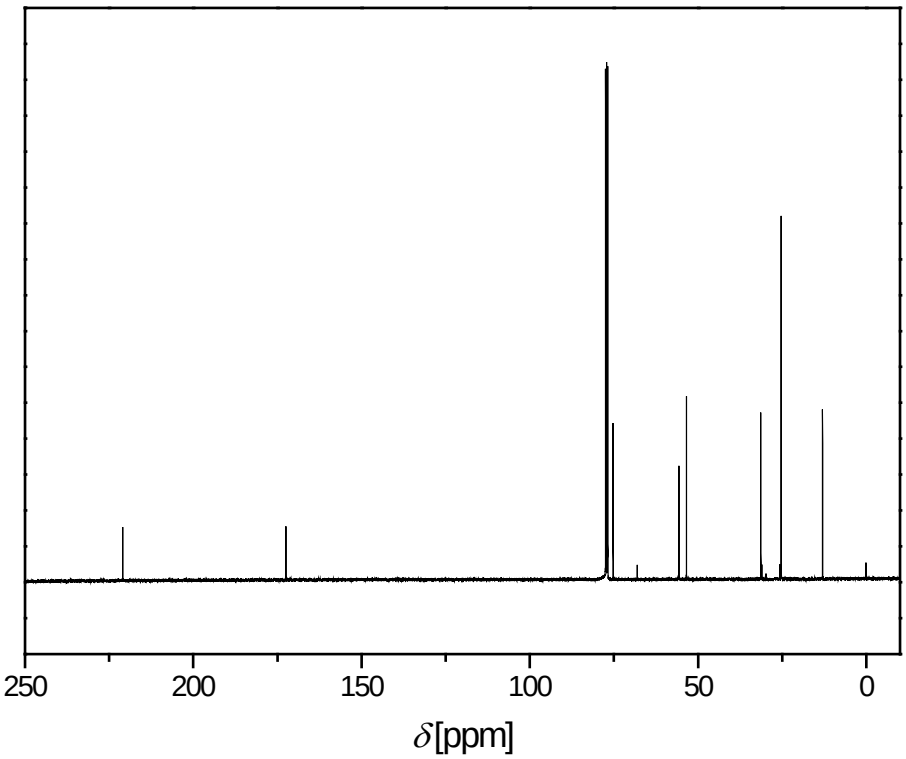

Figure S10. ^{13}C-NMR spectrum of prop-2-yn-1-yl 2-(((ethylthio)carbonothioyl)thio)-2-methylpropanoate (**CTA2**).

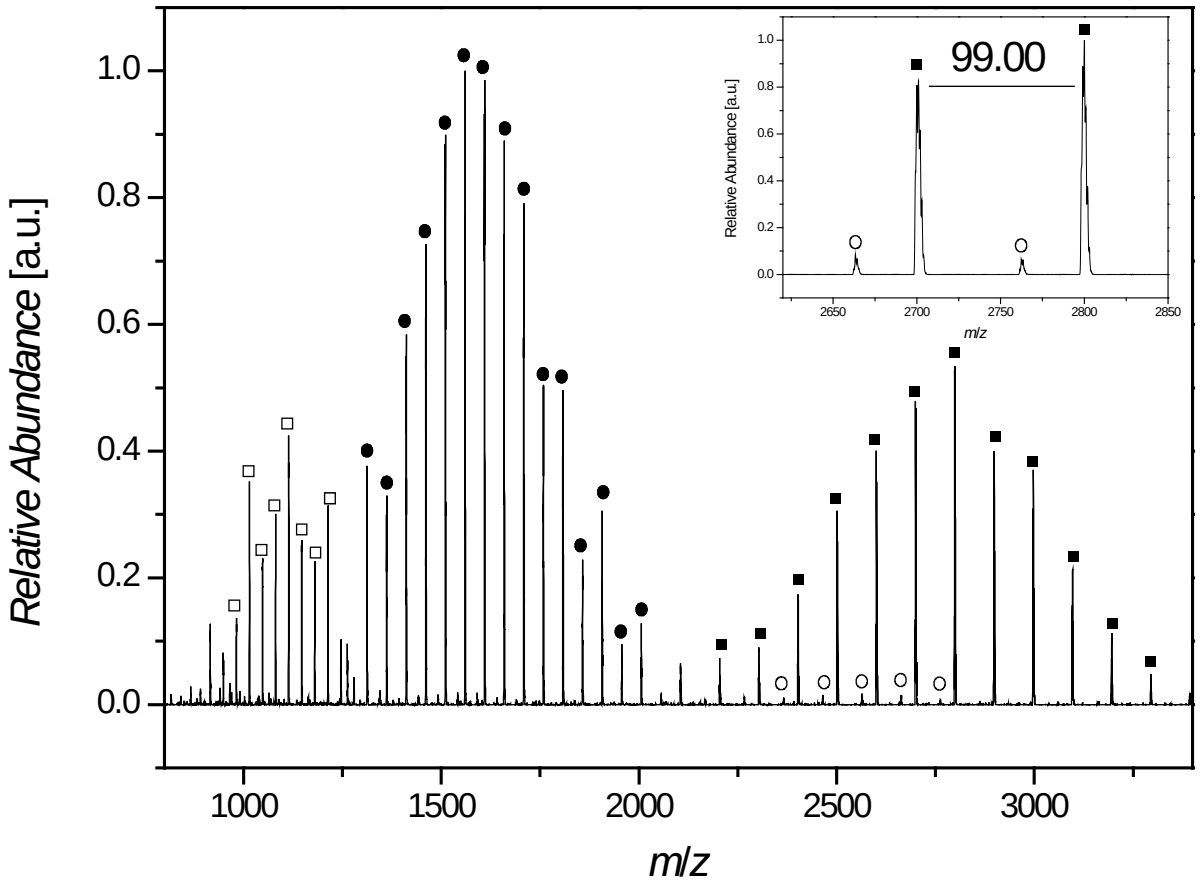

Figure S11. ESI-MS-spectrum of a mid-chain adamantyl-functionalized poly(DMAAm) (M_{nGPC} = 4000 g·mol^{-1}, *PDI* = 1.09) polymerized with **CTA1**.

Table S1. Theoretical and experimental *m*/*z* of poly(DMAAm) polymerized with **CTA1**.

Species	m/z_{theo}	$m/z_{exp.}$	$\Delta m/z$
■ [**CTA1**(DMAAm)$_{20}$+Na]$^{+}$	2798.59	2799.09	0.50
● [**CTA1**(DMAAm)$_{23}$+2Na]$^{2+}$	1559.39	1559.73	0.34
□ [**CTA1**(DMAAm)$_{25}$+3Na]$^{3+}$	1113.30	1113.91	0.61
○ [**CTA1**(DMAAm)$_{20}$-Adamantyl+Na]$^{+}$	2663.47	2663.27	0.20

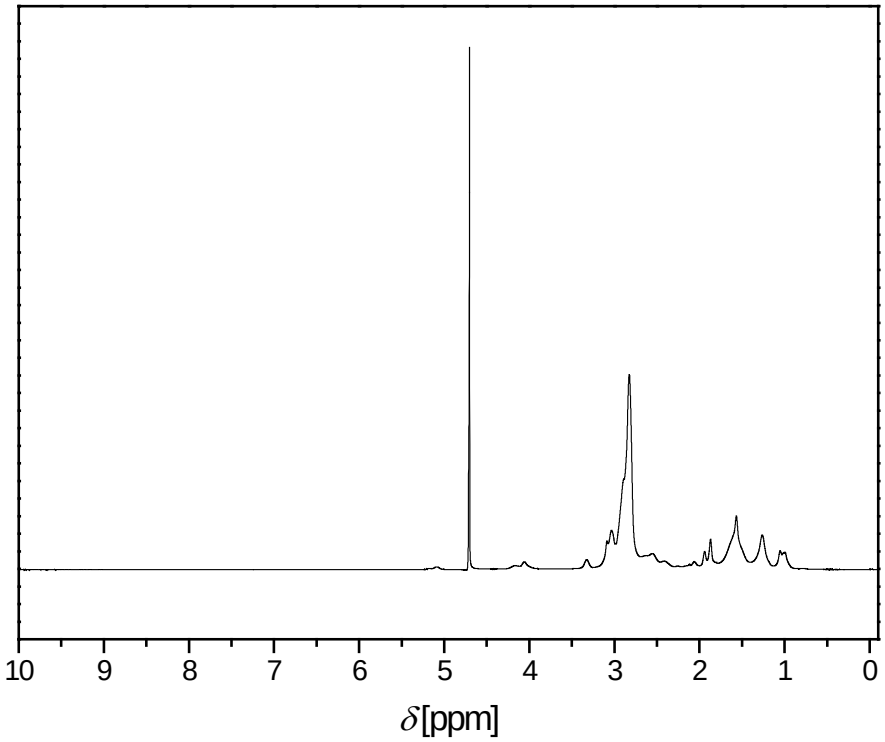

Figure S12. ^{1}H-NMR spectrum of a mid-chain adamantyl-functionalized poly(DMAAm) (M_{nGPC} = 4000 g·mol^{-1}, *PDI* = 1.09) recorded in D_2O at 25 °C.

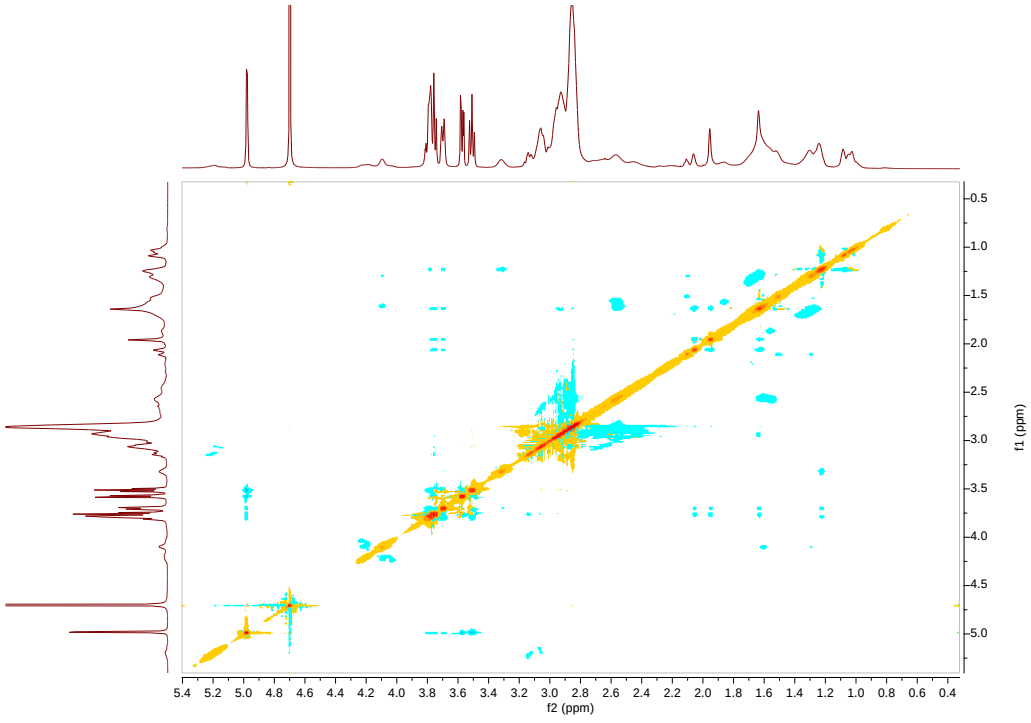

Figure S13. 2D ROESY NMR spectrum of a 1:1.1 molar mixture of a mid-chain adamantyl-functionalized poly(DMAAm) (M_{nGPC} = 4000 g·mol^{-1}, *PDI* = 1.09) polymerized with **CTA1** and β-CD in D_2O at 25 °C.

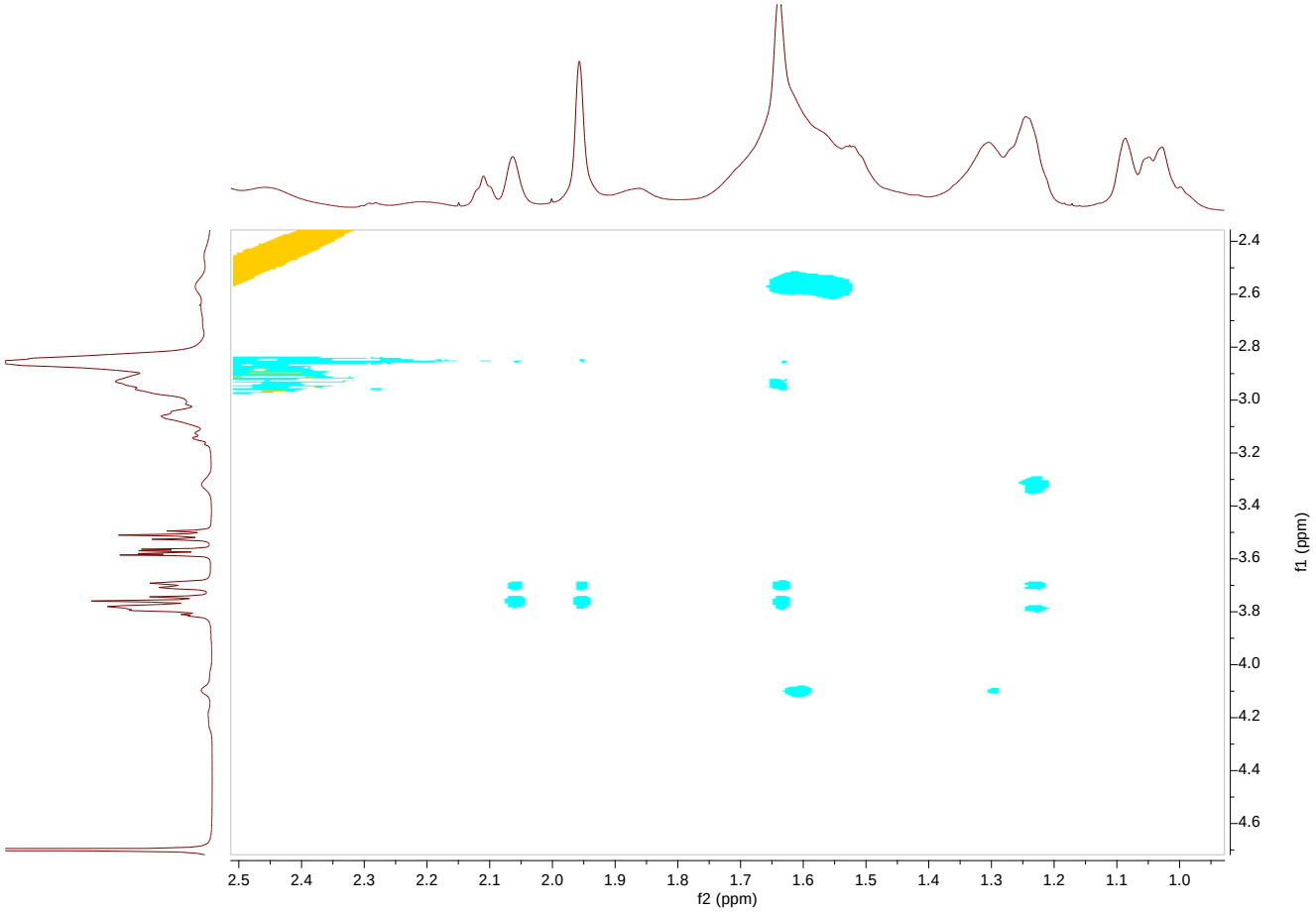

Figure S14. Magnification of the 2D ROESY NMR spectrum of a 1:1.1 molar mixture of a mid-chain adamantyl-functionalized poly(DMAAm) (M_{nGPC} = 4000 g·mol^{-1}, *PDI* = 1.09) polymerized with **CTA1** and β-CD in D_2O at 25 °C.

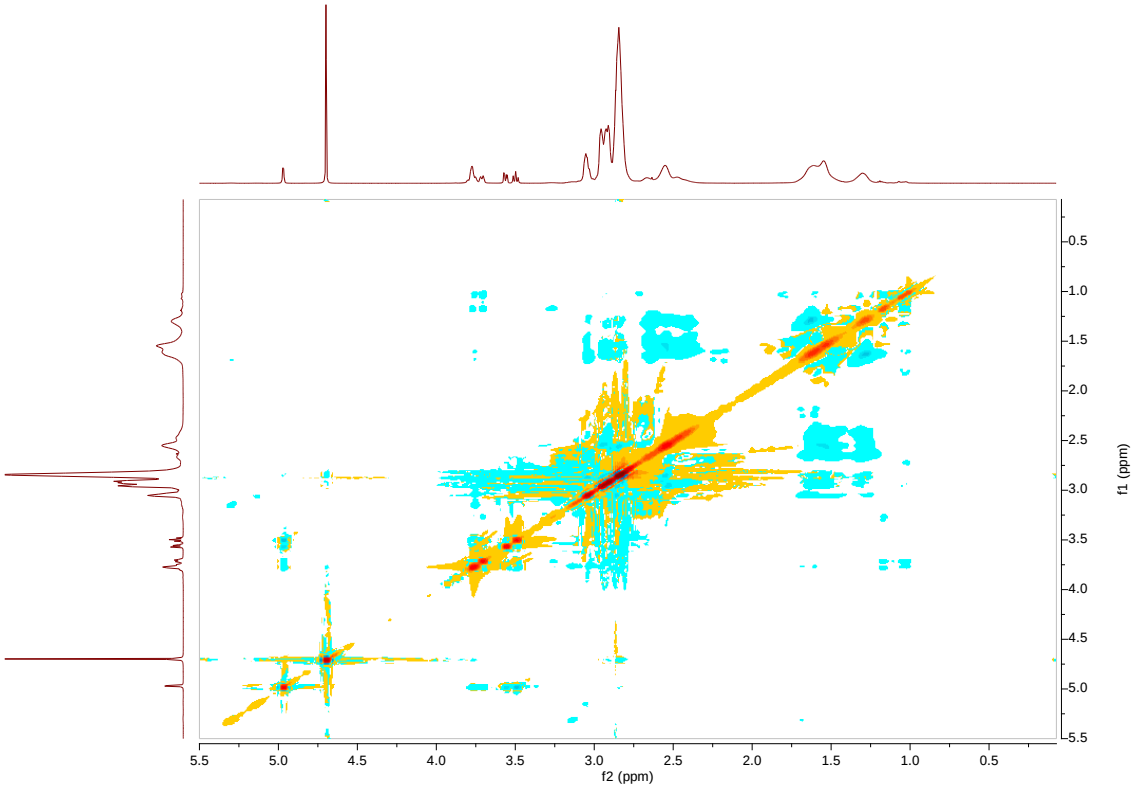

Figure S15. 2D ROESY NMR spectrum of a 1:1.1 molar mixture of poly(DMAAm) (M_{nGPC} = 12800 g·mol^{-1}, *PDI* = 1.10) polymerized with EMP and β-CD in D_2O at 25 °C.

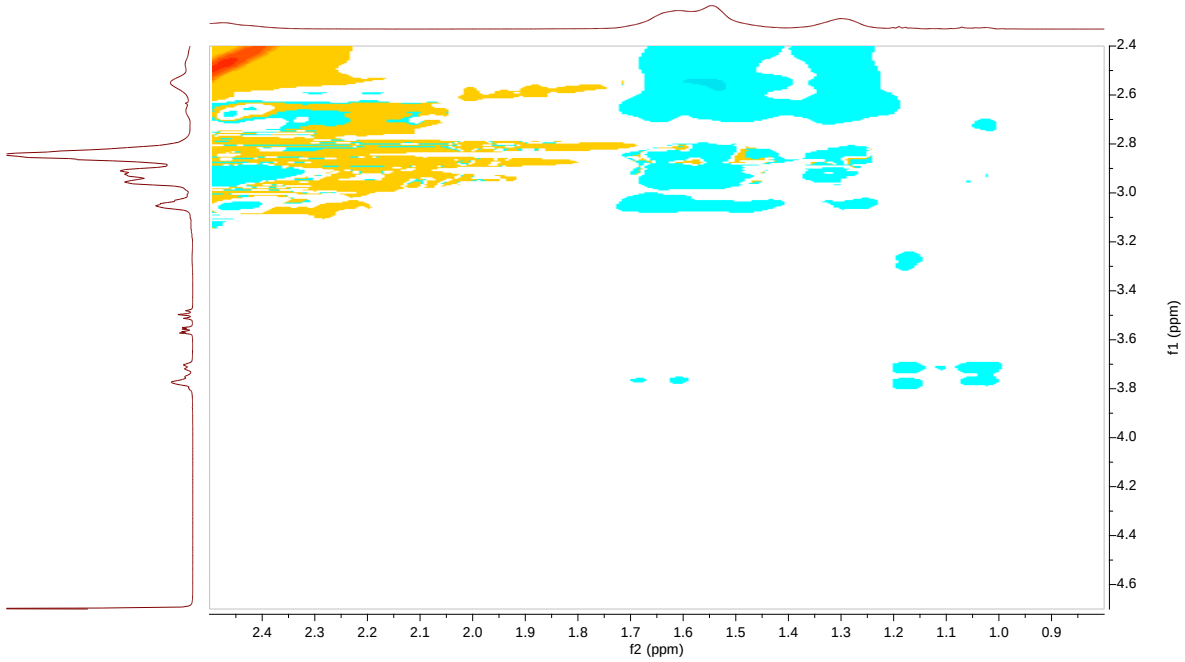

Figure S16. Magnification of the 2D ROESY NMR spectrum of a 1:1.1 molar mixture of poly(DMAAm) (M_{nGPC} = 12800 g·mol^{-1}, *PDI* = 1.10) polymerized with EMP and β-CD in D_2O at 25 °C.

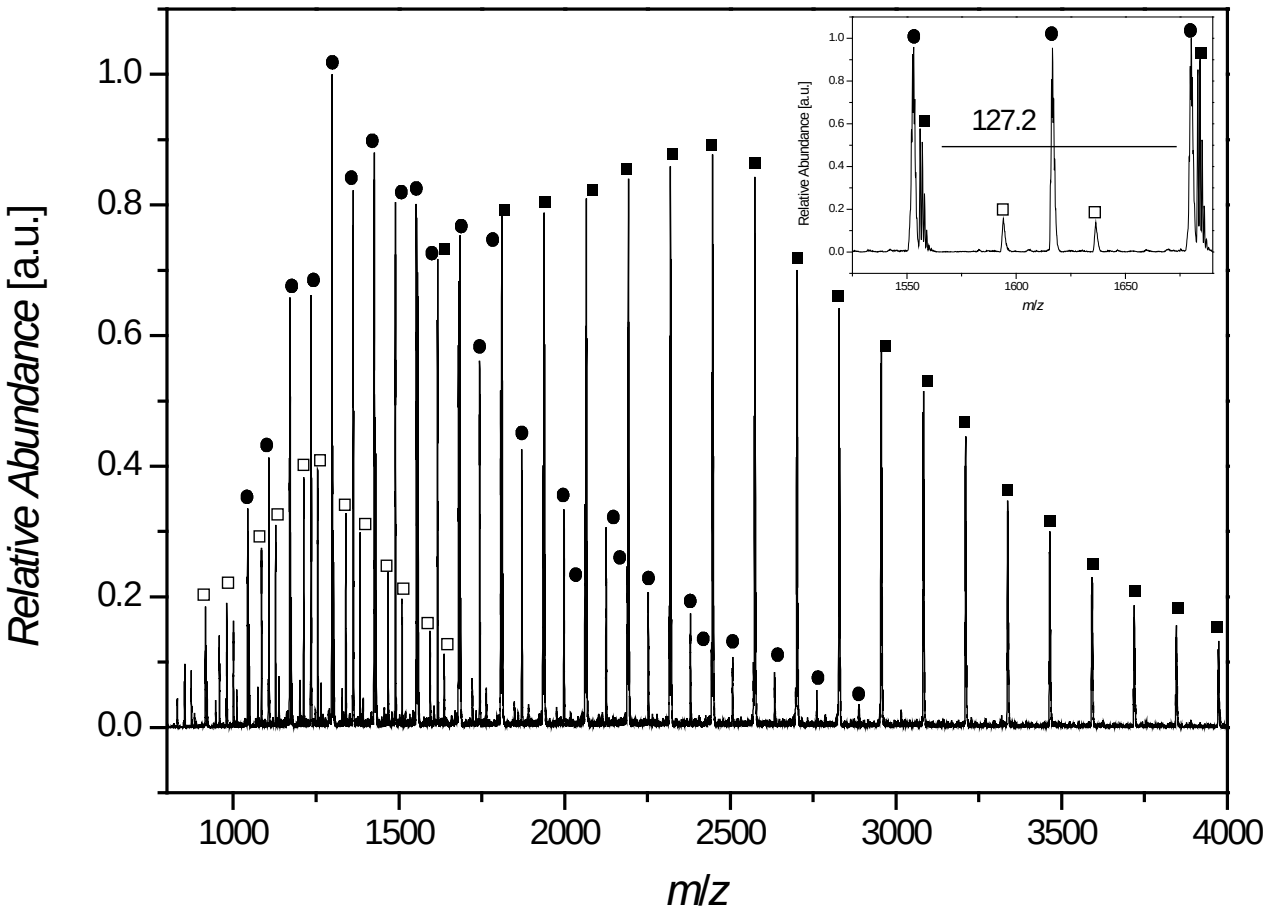

Figure S17. ESI-MS-spectrum of the alkyne-functionalized poly(DEAAm) (M_{nGPC} = 2400 g·mol^{-1}, *PDI* = 1.14) polymerized with **CTA2**.

Table S2. Theoretical and experimental *m*/*z* of poly(DEAAm) polymerized with **CTA2**.

Species	m/z_{theo}	$m/z_{exp.}$	$\Delta\ m/z$
■ [**CTA2**(DEAAm)$_{11}$+Na]$^{+}$	1683.10	1683.18	0.08
● [**CTA2**(DEAAm)$_{22}$+2Na]$^{2+}$	1552.60	1552.55	0.05
□ [**CTA2**(DEAAm)$_{35}$+3Na]$^{3+}$	1593.83	1594.09	0.26

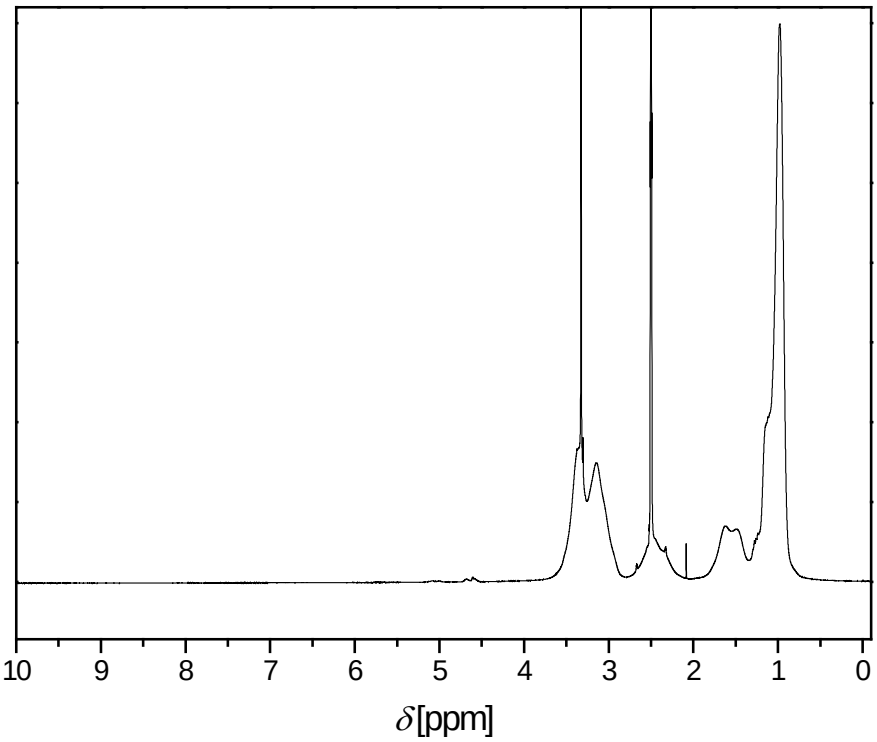

Figure S18. ^{1}H-NMR spectrum of the alkyne-functionalized poly(DEAAm) (M_{nGPC} = 6800 g·mol^{-1}, *PDI* = 1.13) recorded in DMSO-d$_6$ at 25 °C.

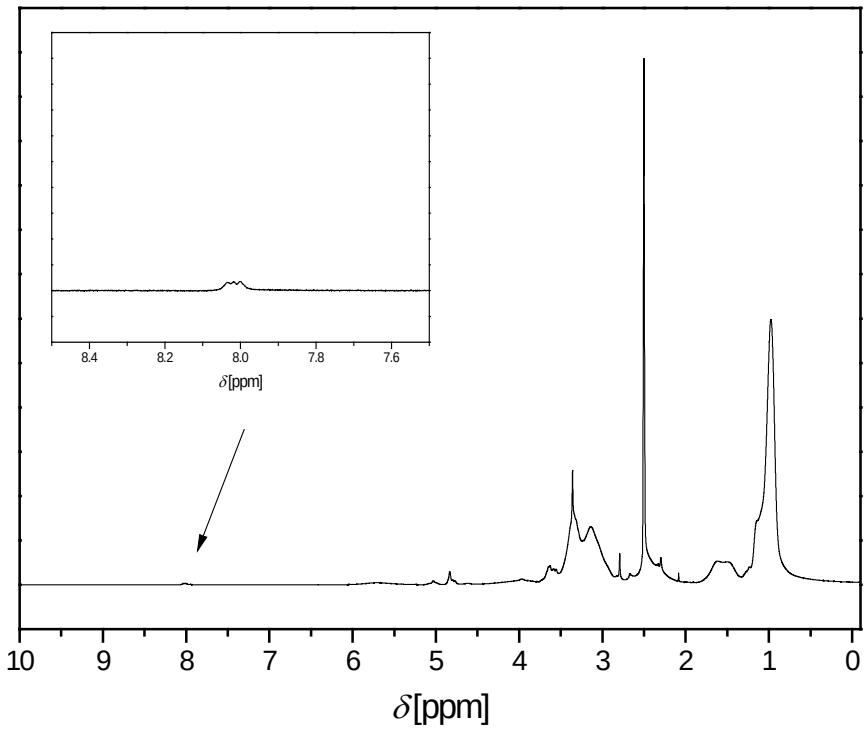

Figure S19. ^{1}H-NMR spectrum of the β-CD functionalized poly(DEAAm) click-product (M_{nGPC} = 8000 g·mol^{-1}, *PDI* = 1.27) recorded in DMSO-d$_6$ at 25 °C. The inset shows a magnification of the triazole-proton signal.

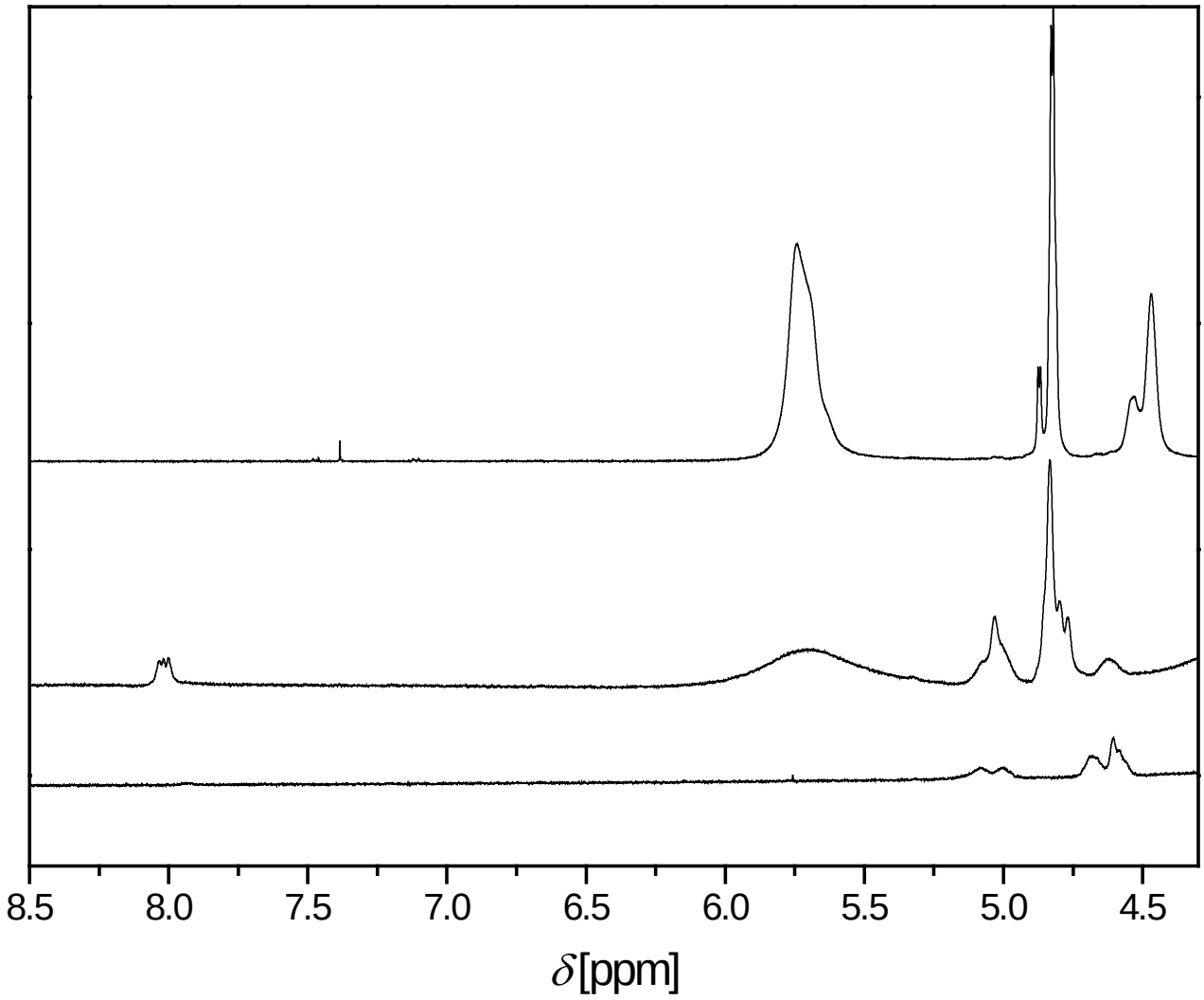

Figure S20. Comparison of the ^{1}H-NMR region from 4.3 ppm to 8.5 ppm of β-CD-N_3 (top), the β-CD-functionalized poly(DEAAm) click-product (middle; M_{nGPC} = 8000 g·mol^{-1}, *PDI* = 1.27) and the alkyne-functionalized poly(DEAAm) (bottom; M_{nGPC} = 6800 g·mol^{-1}, *PDI* = 1.13).

Table S3. SEC-data of the utilized polymers for self-assembly leading to the supramolecular miktoarm star polymer **P3** (**P1**+**P2**) and the control sample **P4** (**P2**+**P5**).

Sample	*Type*	M_{ntheo} [g·mol^{-1}]	M_{nGPC} [g·mol^{-1}]	*PDI*
P1	Mid-chain adamantyl-functionalized poly(DMAAm)	18500	15800	1.41
P2	β-CD-functionalized poly(DEAAm)	9400	10300	1.12
P5	Non adamantyl-functionalized poly(DMAAm)	11700	12300	1.13

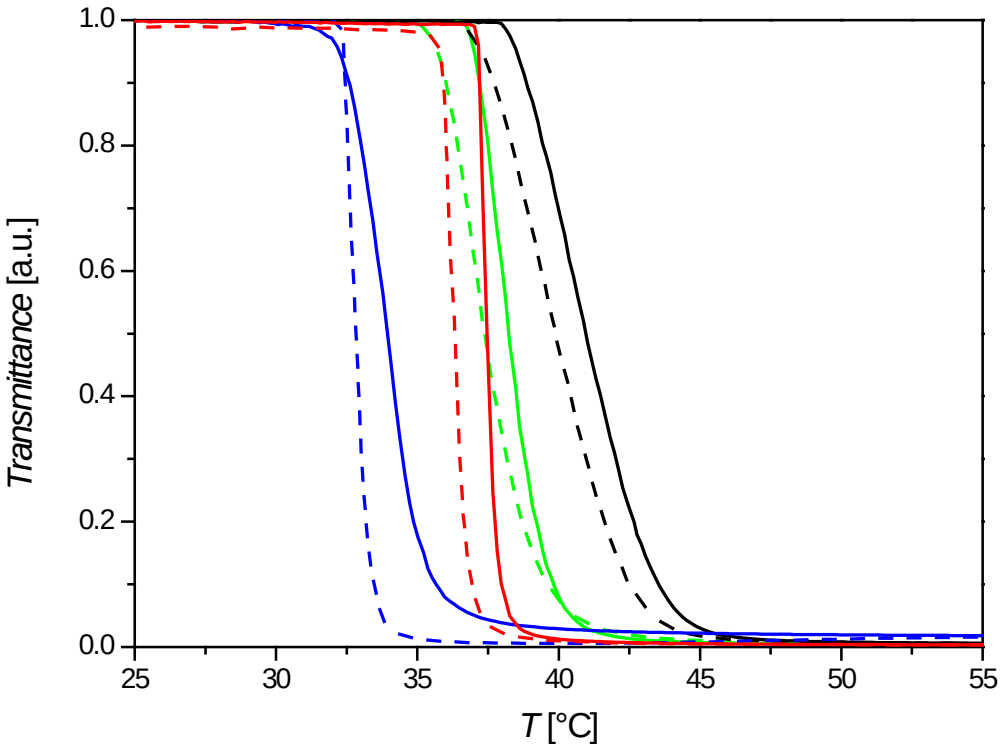

Figure S21. LCST measurement (cooling: dotted line; heating: straight line) of the supramolecular miktoarm star complex **P3** (black curves), the β-CD-functionalized poly(DEAAm) (green curves; M_{nGPC} = 10300 g·mol^{-1}, *PDI* = 1.12); alkyne-functionalized poly(DEAAm) (blue curves; M_{nGPC} = 7500 g·mol^{-1}, *PDI* = 1.14) and acid-functionalized poly(DEAAm) (red curves; M_{nGPC} = 7900 g·mol^{-1}, *PDI* = 1.20) at a concentration of 1 mg·mL^{-1}.

Table S4. LCST-values of the supramolecular miktoarm star polymer **P3**, the β-CD-functionalized poly(DEAAm) (M_{nGPC} = 10300 g·mol^{-1}, *PDI* = 1.12), alkyne-functionalized poly(DEAAm) (M_{nGPC} = 7500 g·mol^{-1}, *PDI* = 1.14) and acid-functionalized poly(DEAAm) (M_{nGPC} = 7900 g·mol^{-1}, *PDI* = 1.20) at a concentration of 1 mg·mL^{-1} and a heating/cooling rate of 0.32 °C·min^{-1}.

Sample	*Temperature sequence*	*LCST [°C]*
P3	heating: 25 – 60 °C	40.4
P3	cooling: 60 – 25 °C	39.8
β-CD-functionalized poly(DEAAm) **P2**	heating: 25 – 60 °C	38.1
β-CD-functionalized poly(DEAAm) **P2**	cooling: 60 – 25 °C	37.1
alkyne-functionalized poly(DEAAm)	heating: 25 – 60 °C	32.5
alkyne-functionalized poly(DEAAm)	cooling: 60 – 25 °C	34.1
acid-functionalized poly(DEAAm)	heating: 25 – 60 °C	37.3
acid-functionalized poly(DEAAm)	cooling: 60 – 25 °C	36.5

Table S5. Hydrodynamic diameters, D_h, (from the number weighted distributions) of the uncomplexed polymers, the supramolecular complex (**P3**) and a control sample (**P4**) in water at a concentration of 1 mg·mL^{-1}.

Sample	T [°C]	D_h [nm]	Std. Dev. [nm]
P1	25 °C	5.6	0.7 (12.0 %)
P1	44 °C	7.5	1.1 (14.0 %)
P1	50 °C	4.0	0.5 (13.4 %)
P2	25 °C	2.1	0.3 (13.2 %)
P2	44 °C	a)	-
P2	50 °C	937.0	154.8 (16.5 %)
P3	25 °C	6.8	0.9 (13.8 %)
P3	44 °C	132.0	26.6 (20.2)
P3	50 °C	274.6	54.2 (19.7 %)
P3 + 100 eq. 1-adamantylamine·HCl	25 °C	5.4	0.7 (12.4 %)
P3 + 100 eq. 1-adamantylamine·HCl	44 °C	274.7	37.8 (13.8)
P3 + 100 eq. 1-adamantylamine·HCl	50 °C	880.9	166.7 (18.9 %)
P4	25 °C	5.0	1.1 (22.6 %)
P4	44 °C	37.7	4.7 (12.6 %)
P4	50 °C	332.7	60.7 (18.2 %)

Sample	T [°C]	D_h [nm]	Std. Dev. [nm]
P4 + 100 eq. 1-adamantylamine·HCl	25 °C	4.6	0.5 (11.2 %)
P4 + 100 eq. 1-adamantylamine·HCl	44 °C	220.4 (45.4 %)	33.5 (15.2 %)
		624.0 (54.6 %)	133.1 (21.3 %)
P4 + 100 eq. 1-adamantylamine·HCl	50 °C	207.7 (80.3 %)	26.7 (12.9 %)
		597.9 (19.7 %)	75.3 (12.6 %)

a) Intensity too high at this concentration, suggesting very large particle sizes.

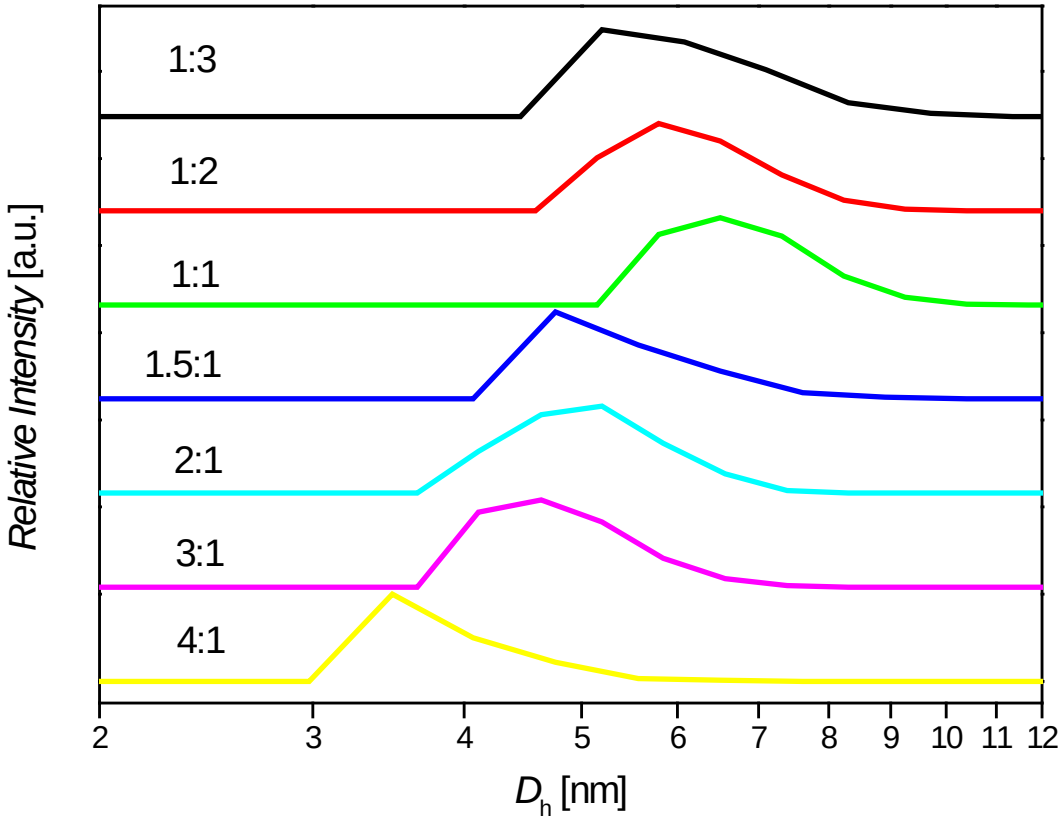

Figure S22. Comparison of the number average particle size distributions obtained from DLS measurements at 1 mg·mL^{-1} at 25 °C and different molar ratios of **P1** and **P2**.

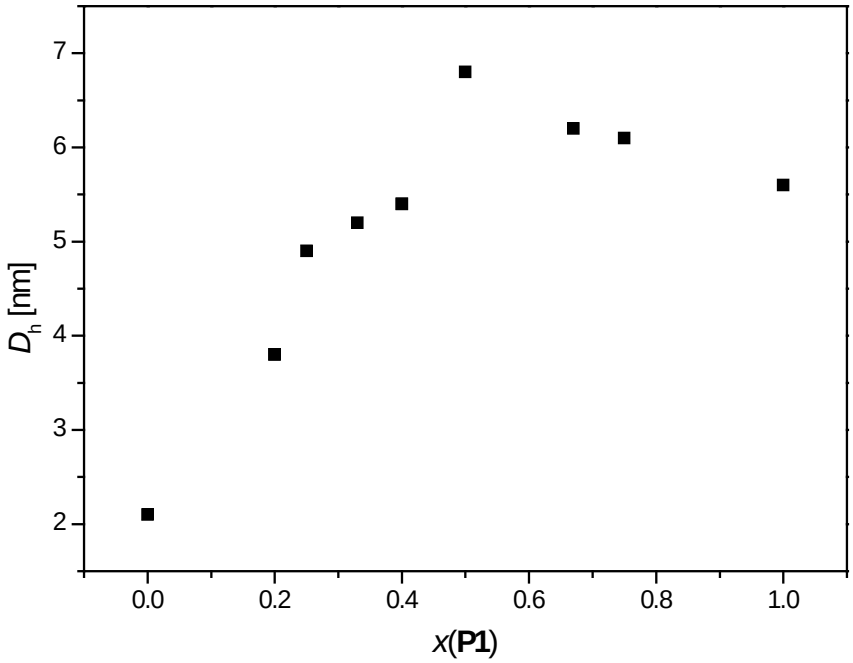

Figure S23. Comparison of the number average hydrodynamic diameter at 1 mg·mL^{-1} at 25 °C of mixtures of **P1** and **P2** in dependence of the molar fraction *x* of **P1**.

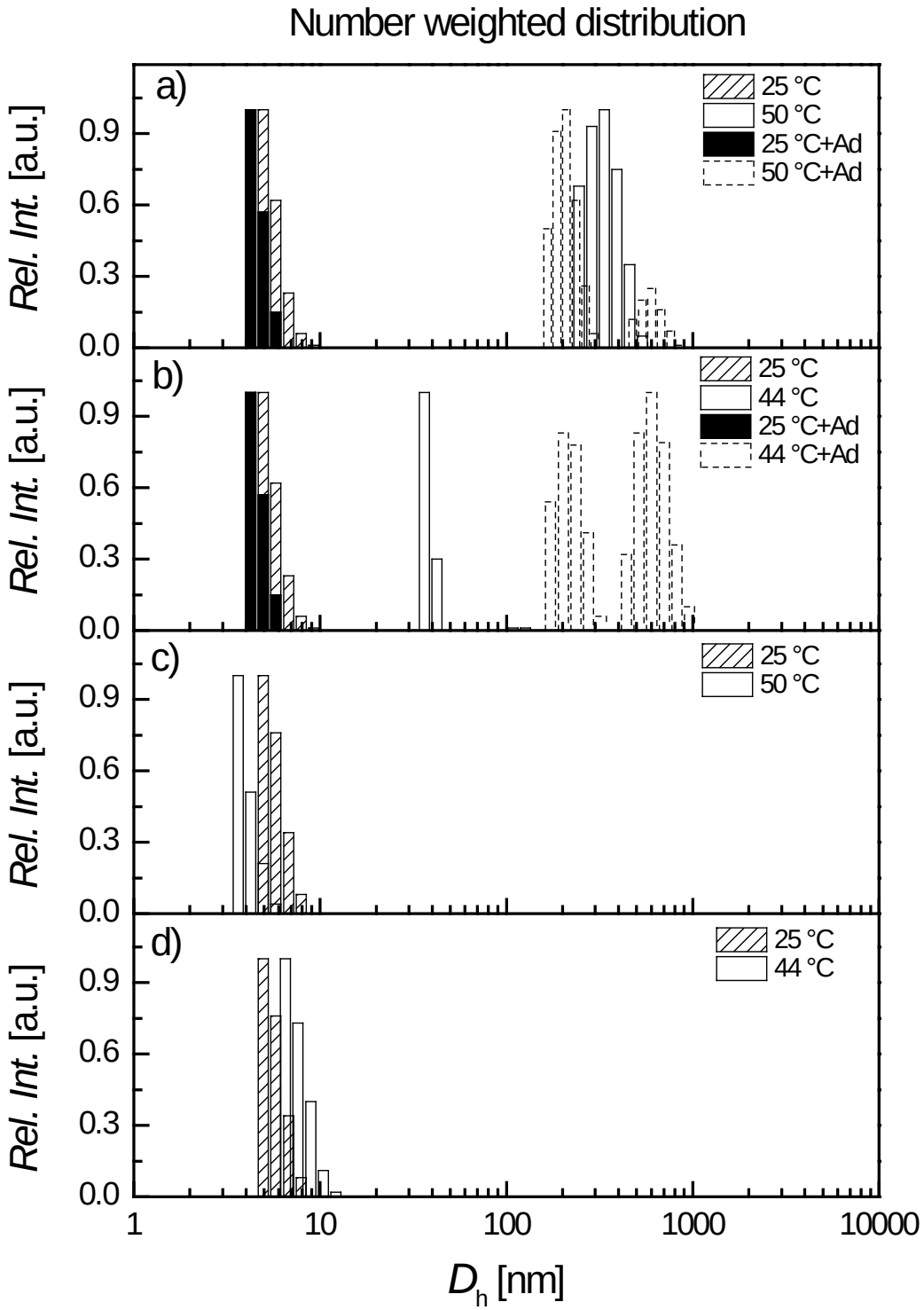

Figure S24. Comparison of the number average particle size distributions obtained from DLS measurements at 1 mg·mL^{-1}. a) The control sample **P4** at 25 °C and 50 °C, b) the control sample **P4** at 25 °C and 44 °C, c) the poly(DMAAm) block **P1** at 25 °C and 50 °C, d) the poly(DMAAm) block **P1** at 25 °C and 44 °C.

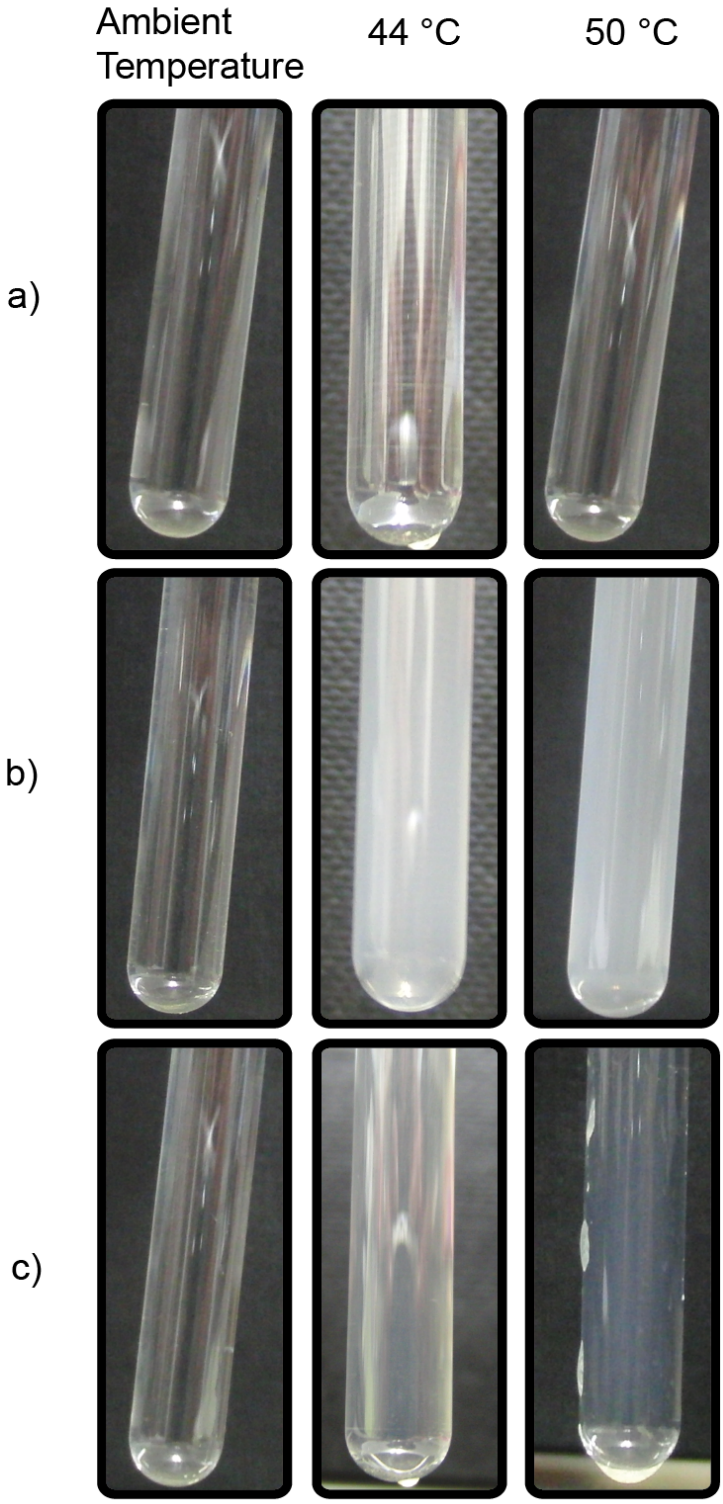

Figure S25. Pictures of the polymer solutions at different temperatures at a concentration of 1 mg·mL^{-1}. a) Mid-chain adamantyl-functionalized poly(DMAAm) **P1**, b) β-CD-functionalized poly(DEAAm) **P2** and c) the supramolecular miktoarm star polymer **P3**.

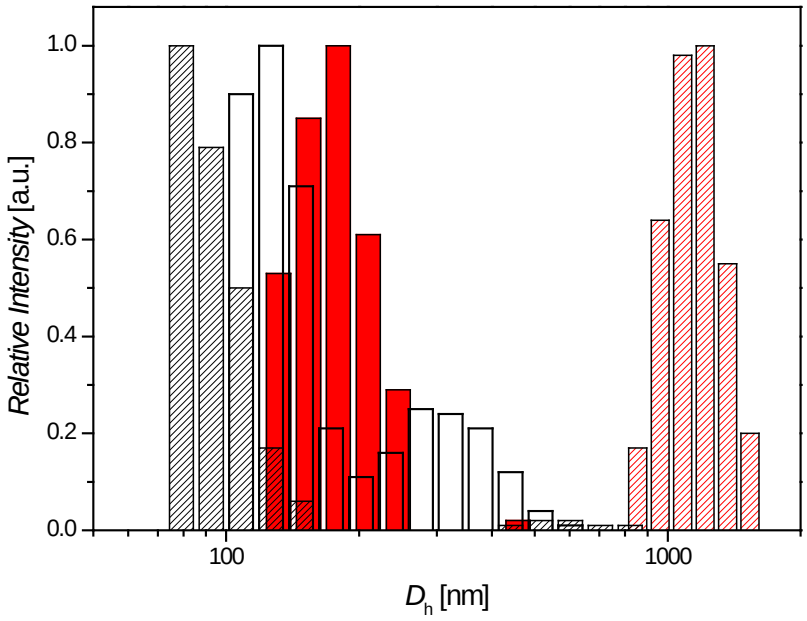

Figure S26. Comparison of the number average particle size distributions of **P3** obtained from DLS measurements with slow heating at 44 °C (white dashed) and 50 °C (red dashed) and after fast heating at 44 °C (white bars) and 50 °C (red bars).

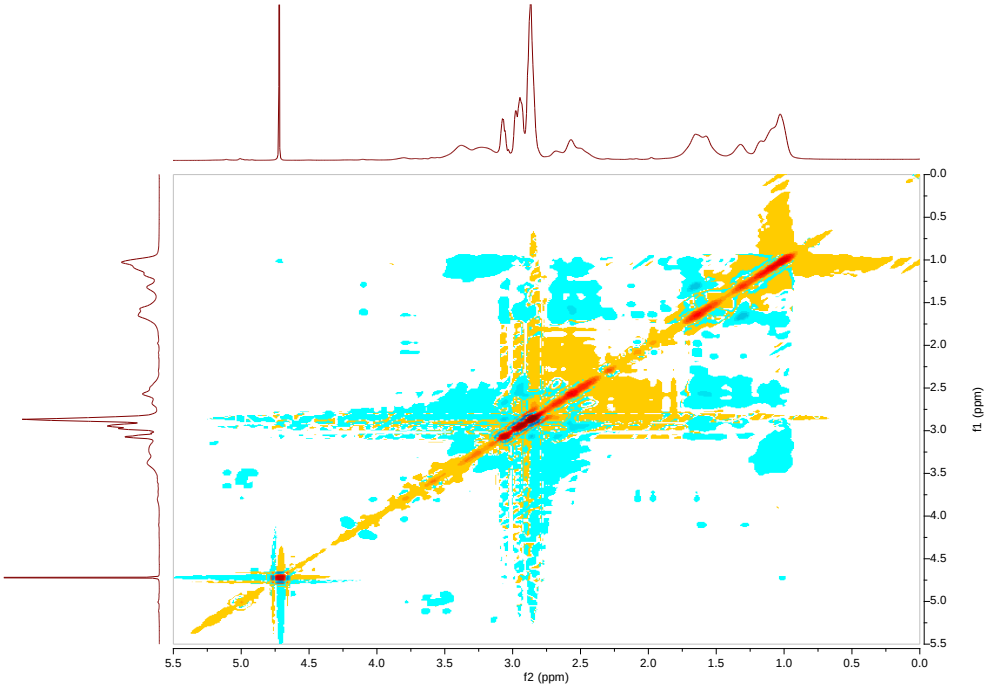

Figure S27. 2D ROESY NMR spectrum of a 1:1 molar mixture of a mid-chain adamantyl-functionalized poly(DMAAm) (M_{nGPC} = 15800 g·mol^{-1}, *PDI* = 1.41) polymerized with **CTA1** and the β-CD-functionalized poly(DEAAm) (M_{nGPC} = 10300 g·mol^{-1}, *PDI* = 1.12) in D_2O at 25 °C.

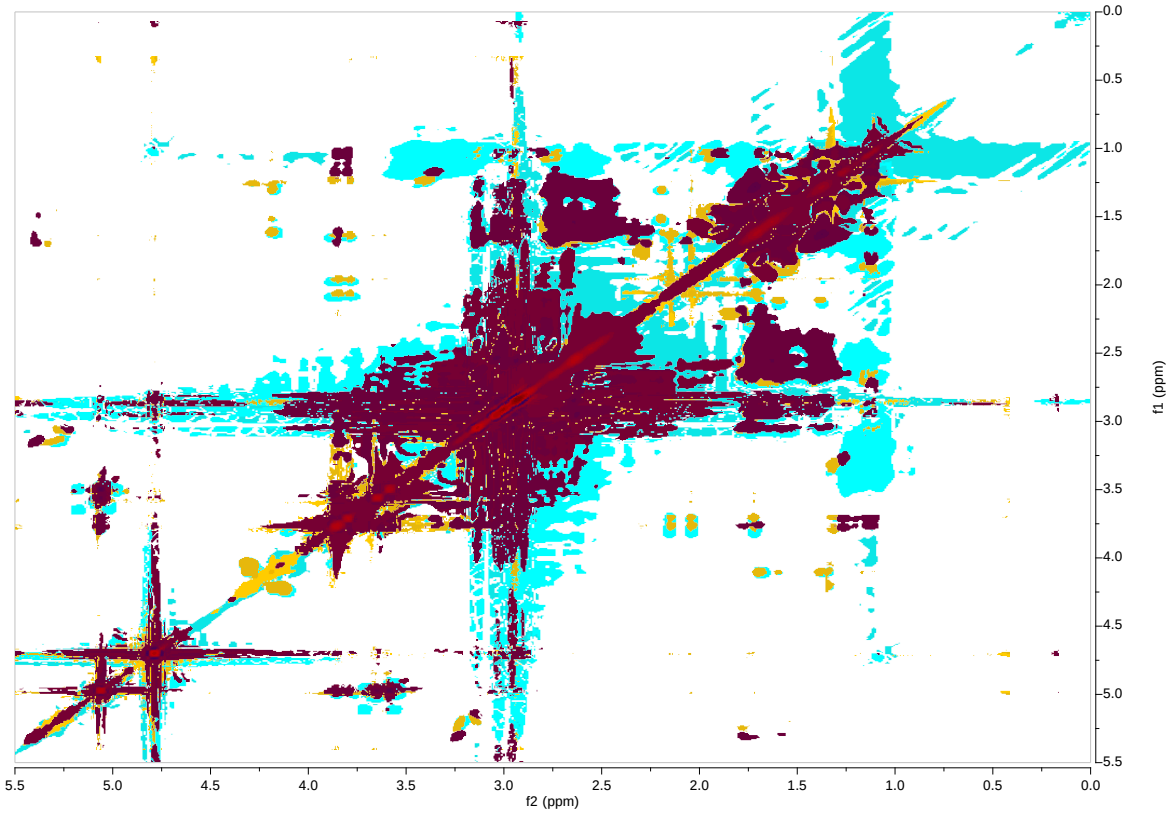

Figure S28. Overlay of the 2D ROESY NMR spectra in D_2O at 25 °C. Turquoise: 1:1 molar mixture of a mid-chain adamantyl-functionalized poly(DMAAm) (M_{nGPC} = 15800 g·mol^{-1}, *PDI* = 1.41) and the β-CD-functionalized poly(DEAAm) (M_{nGPC} = 10300 g·mol^{-1}, *PDI* = 1.12). Violet: 1:1.1 molar mixture of poly(DMAAm) (M_{nGPC} = 12800 g·mol^{-1}, *PDI* = 1.10) polymerized with EMP and β-CD. Yellow: mid-chain adamantyl-functionalized poly(DMAAm) (M_{nGPC} = 4000 g·mol^{-1}, *PDI* = 1.09) and β-CD.

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