Supplementary Information

Poly(ε-L-Lysine)-decorated particles with tunable morphology by combination of Ugi multicomponent polymerisation and RAFT-mediated PISA

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Table S1. Boc-PεLL and Boc-PεLL-TTC obtained by UGI polymerization of Boc-Lysine with formaldehyde and *tert*-butyl isocyanide.

Entry	Derivative	$[Boc\text{-}Lys]_0$:$[CEPA]_0$	Reaction time (h)	$M_{n,SEC}$ ($g.mol^{-1}$)	$M_{w,SEC}$ ($g.mol^{-1}$)	*Đ*
1	Boc-PεLL	1:0	20	2500	3700	1.53
2	Boc-PεLL	1:0	48	4000	7100	1.76
3	Boc-PεLL	1:0	90	4600	8300	1.82
4	Boc-PεLL-TTC	0.95:0.05	24	2300	4200	1.82
5	Boc-PεLL-TTC	0.95:0.05	48	4500	6000	1.35

Conditions: MeOH/H_2O v/v 1/1, room temperature.

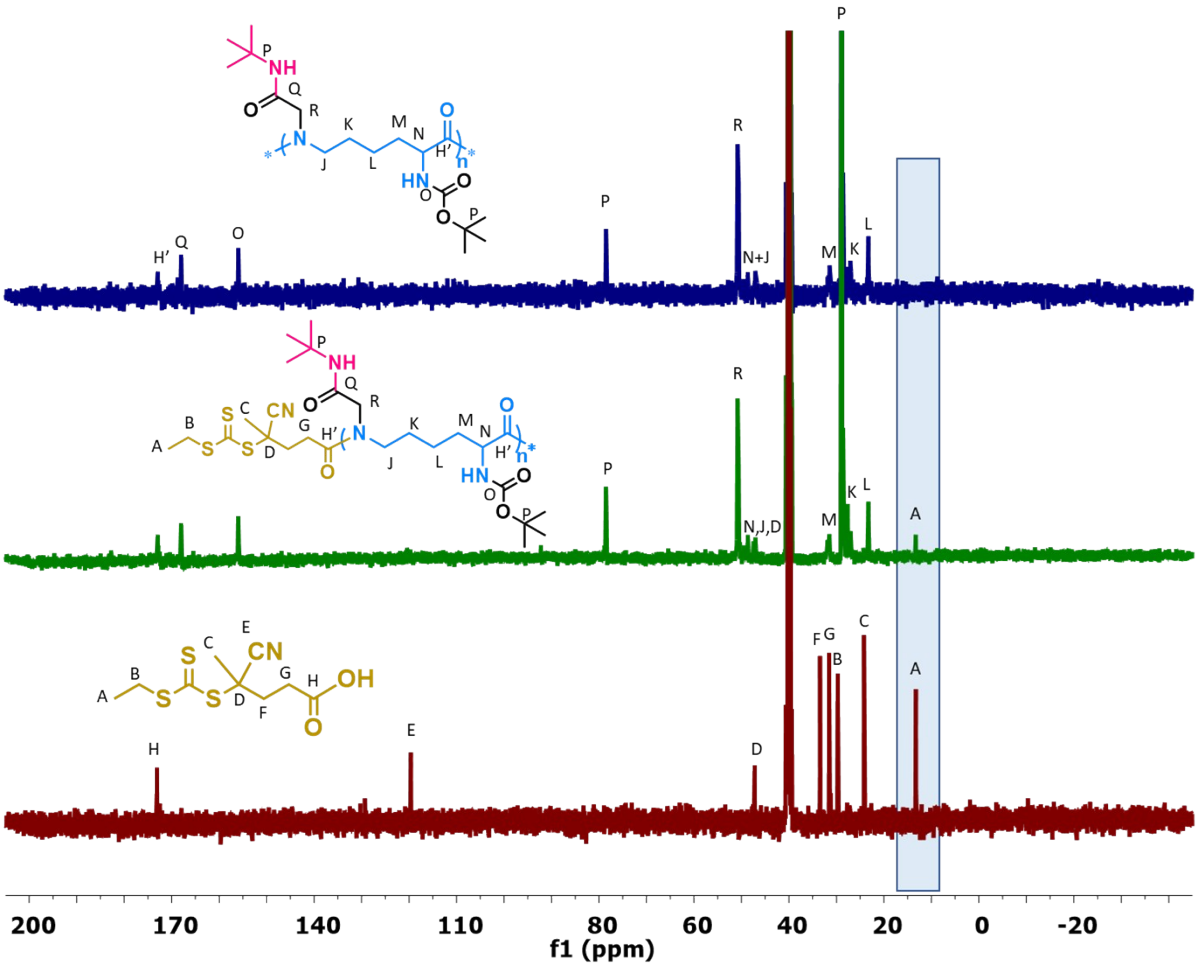

Figure S1. ^{13}C-NMR of Boc-PεLL, Boc-PεLL-TTC and CEPA in DMSO-d_6

MALDI-ToF

Polymers are dissolved in THF at a concentration of 10 mg mL^{-1}. DCTB dissolved in chloroform (10 $mg.mL^{-1}$) was used as matrix. Sodium trifluoroacetate (CF_3CO_2Na) as cationizing agent was prepared at 10$mg.mL^{-1}$ in acetonitrile. The sample was prepared by mixing the polymer solution with matrix solution and cationizing agent solution at a volume ratio of 1:9:1. Acquisitions were performed in reflector positive ion mode by an Bruker Autoflex Max spectrometer (Bruker Daltonics, Bremen). The data was processed by using Flex Analysis software provided by Bruker.

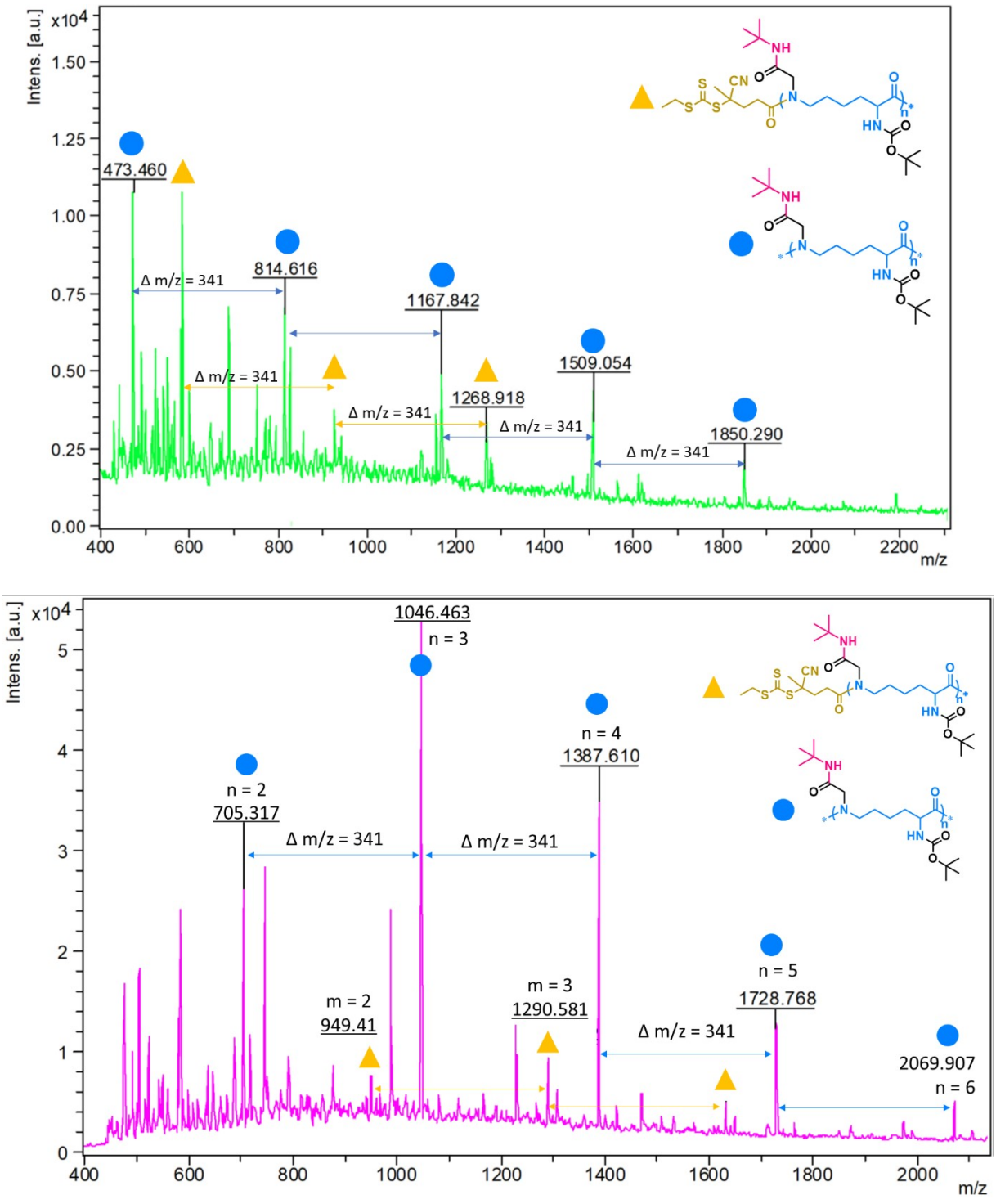

Figure S 2. MALDI-ToF of Boc-PεLL$_{1.5K}$-TTC (top) and Boc-PεLL$_{2.9K}$-TTC (bottom)

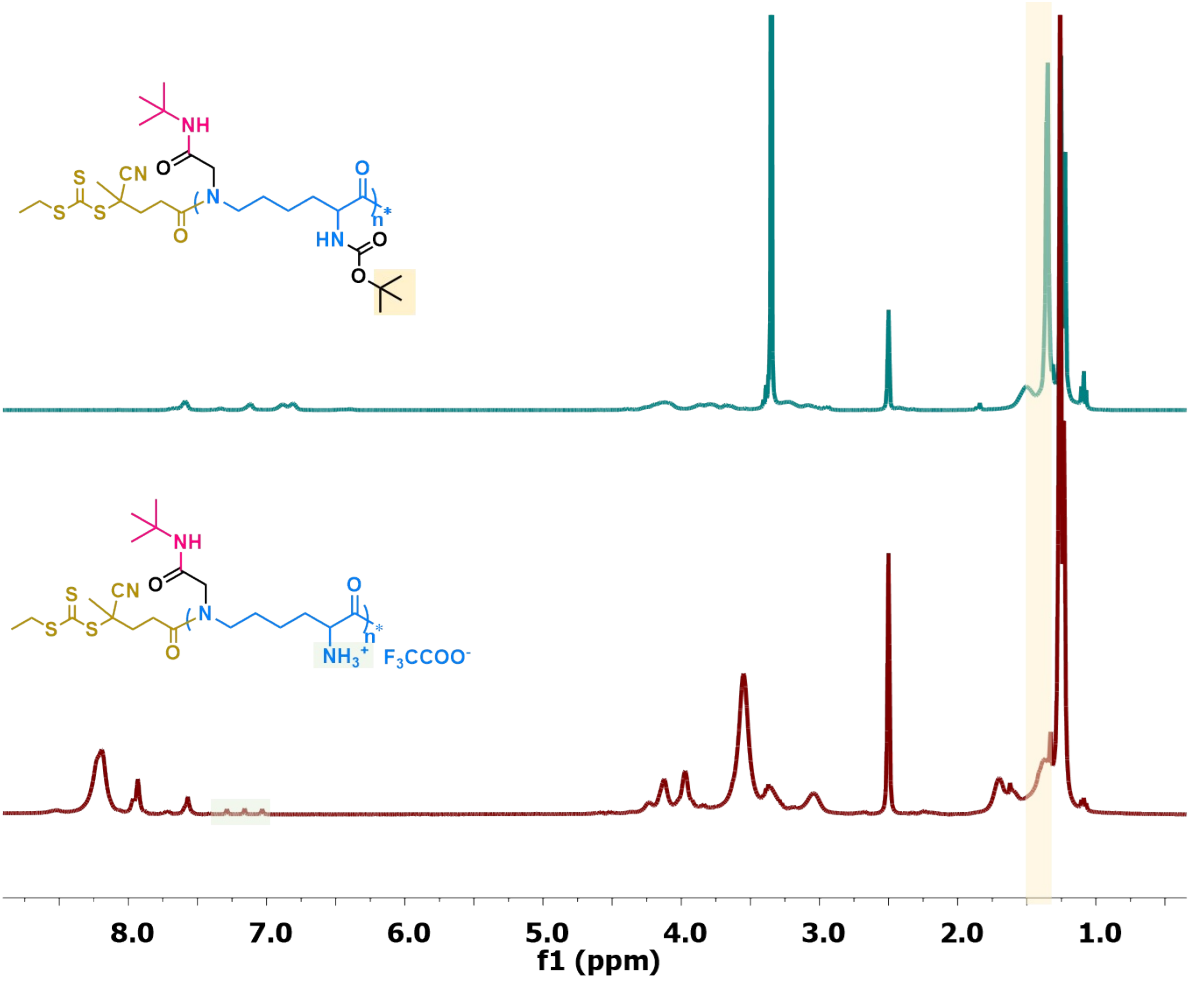

Figure S 3. ^{1}H -NMR of Boc-PεLL-TTC and PεLL-TTC in DMSO-d_6

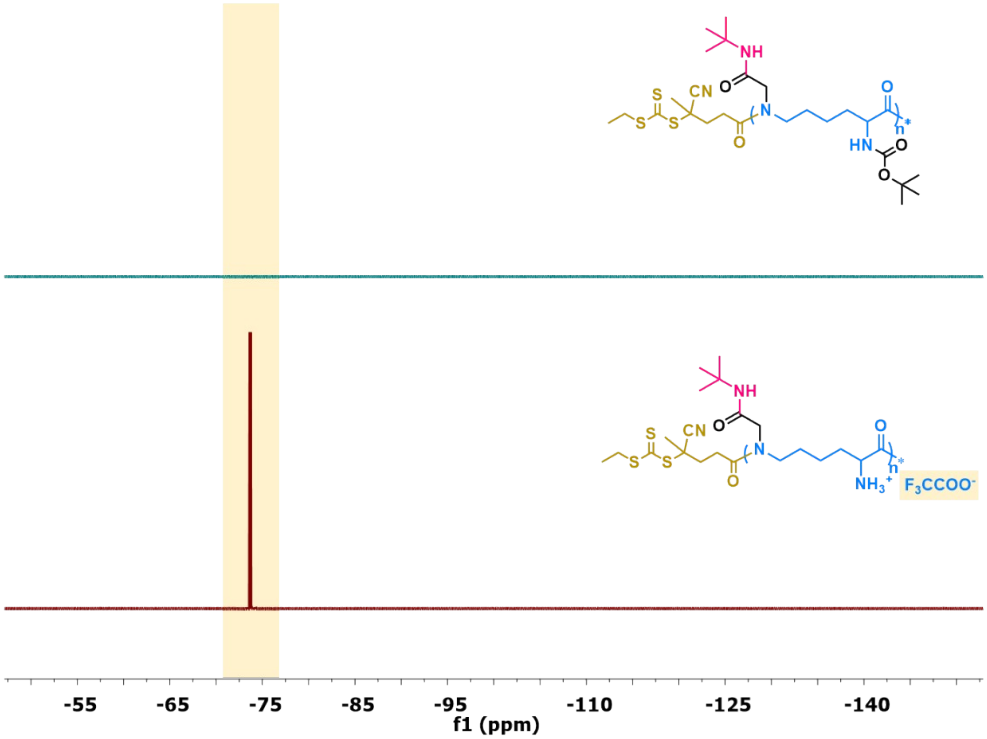

Figure S4. ^{19}F-NMR of Boc-PεLL-TTC and PεLL-TTC obtained by Boc deprotection

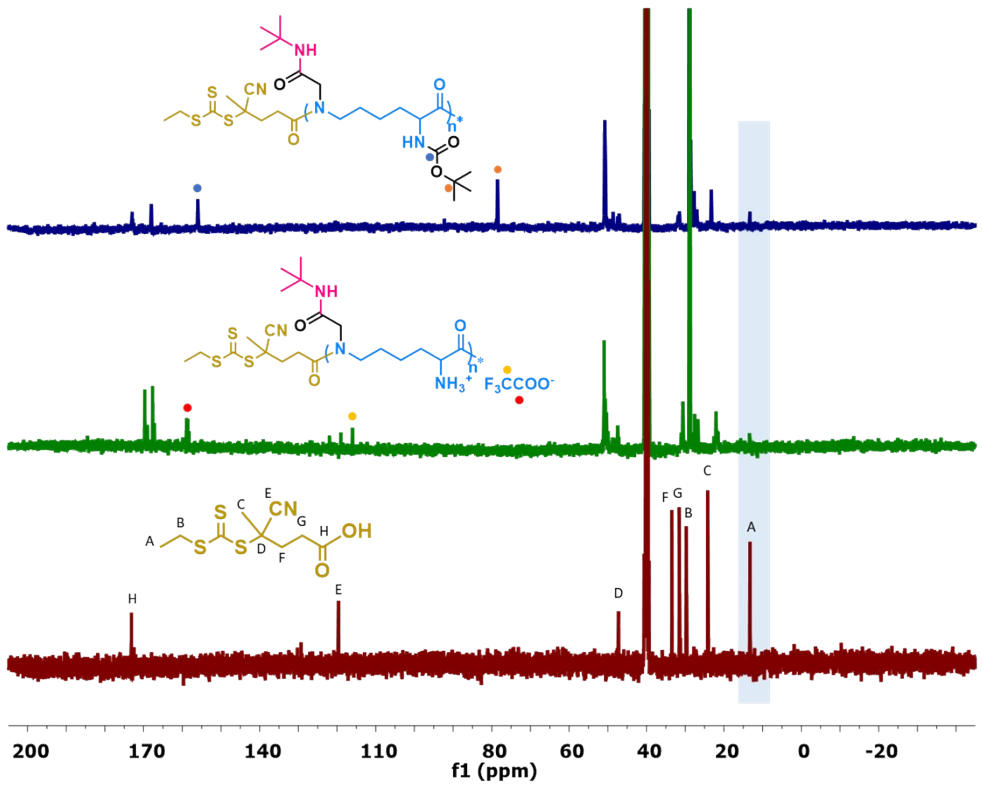

Figure S 5. ^{13}C-NMR of Boc-PεLL-TTC and PεLL-TTC and CEPA

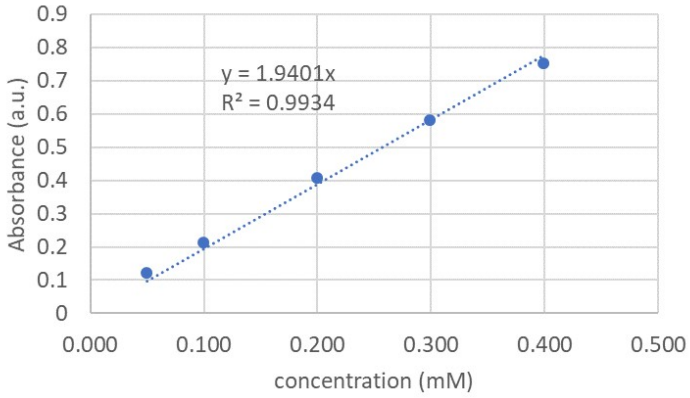

Figure S 6. Calibration curve of pure CEPA in methanol at λ = 305 nm

Concentration of trithiocarbonate ($[c]_{TTC}$) of a given solution is calculated using the extinction coefficient (ε) of 1.9401 $mM^{-1}cm^{-1}$ as following:

$$[c]_{TTC} = \frac{Abs_{305\ nm}}{1.9401}\ (mM)$$

Number average molecular weight ($M_{n,\ UV}$) is then calculated by:

$$M_{n,UV}(\frac{g}{mol}) = \frac{m\ (mg) * 1000}{Volume\ (mL) * [C]_{TTC}\ (mM)}\ \text{(}$$ **Equation 1**)

Where m (mg) is the mass of polymer contained in the studied solution (deduced from stock solution), volume (mL) is the volume of studied solution. Stock solutions of different polymers were prepared by dissolve ~5-10 mg of polymers in anhydrous methanol; different dilution of the stock solution was carried so that the studied solution showed absorbance between 0.15 to 0.70.

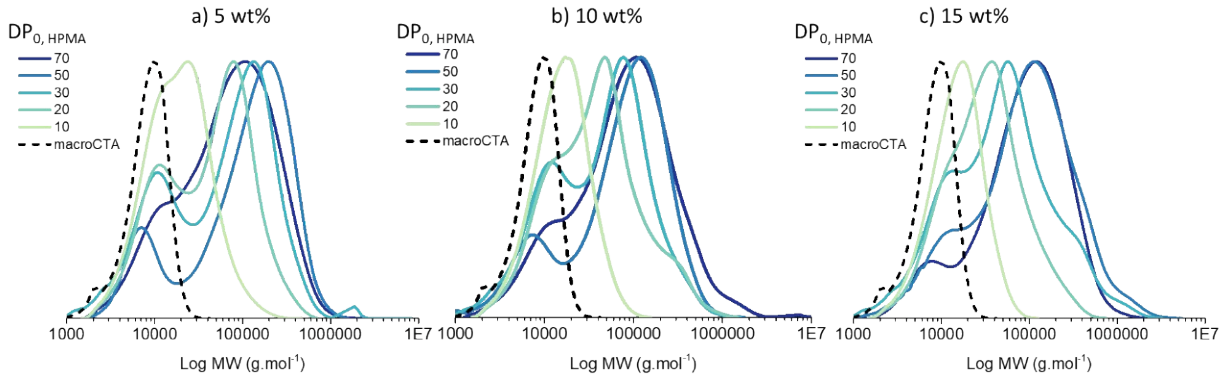

Figure S7. SEC profiles of polymers obtained by aqueous PISA-RAFT of HMPA from $P\varepsilon LL_{1.5K}$-TTC at different $D_{PHPMA,0}$ (10, 20, 30, 50, or 70) and varied monomer content of a) 5 wt%, b) 10 wt%, or c) 15 wt%.

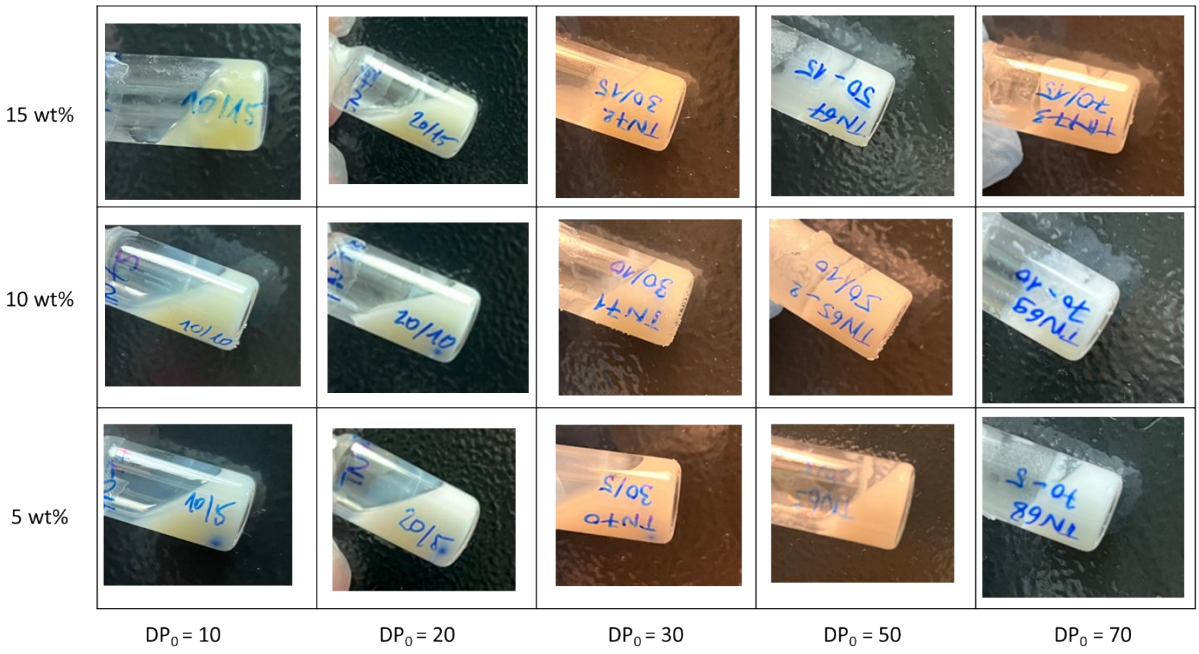

Figure S8. Photos of final solution after chain extension of PεLL$_{1.5K}$-TTC with HPMA at different formulations

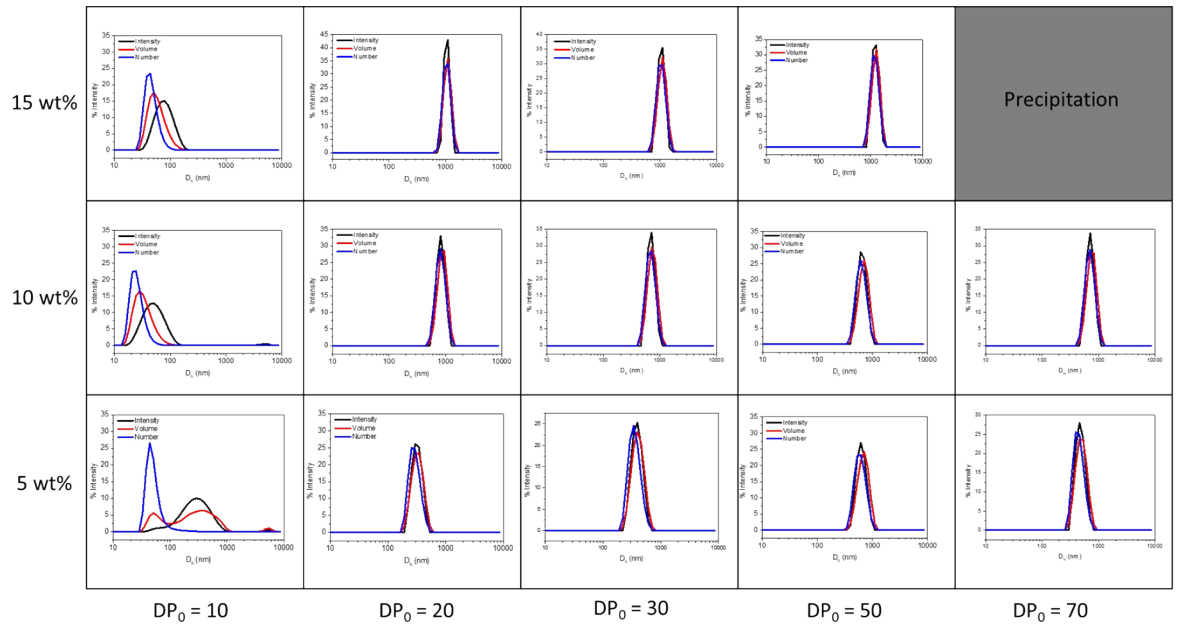

Figure S 9. DLS of diluted solution (0.03-0.05wt%) of final solution in term of intensity (black), number (blue) and volume (red) obtained by chain extension of PεLL$_{1.5K}$-TTC with HPMA at different formulations

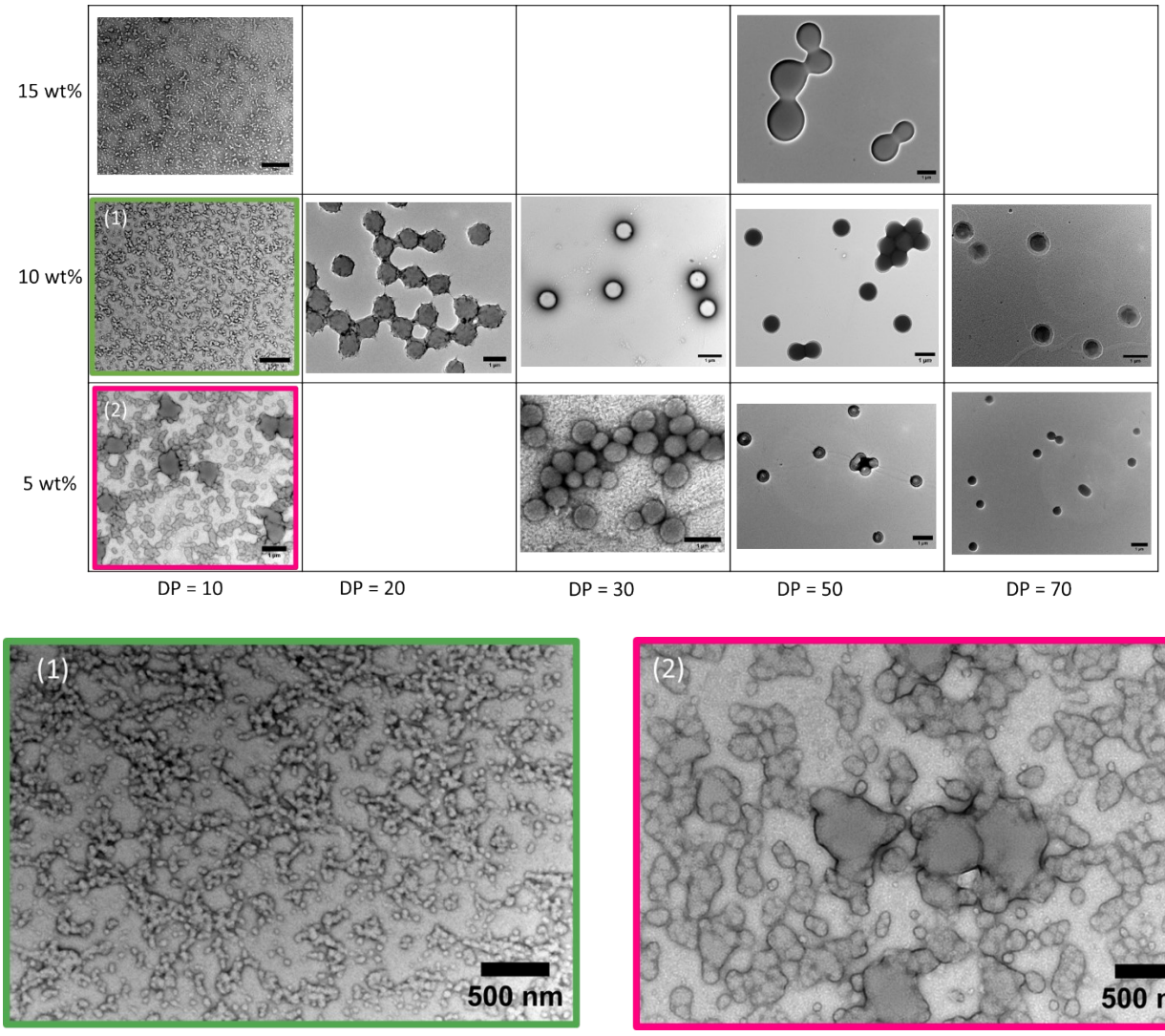

Figure S 10. (Top) TEM images of several formulations of PεLL$_{1.5K}$- PHPMA systems in function of DP$_o$ and monomer content (%wt), scale bar: 1 µm; (Bottom) Higher resolution TEM images of PεLL$_{1.5K}$-PHPMA$_{10}$ at 10 wt% (1) and 5wt% (2) representing worm-like morphology.

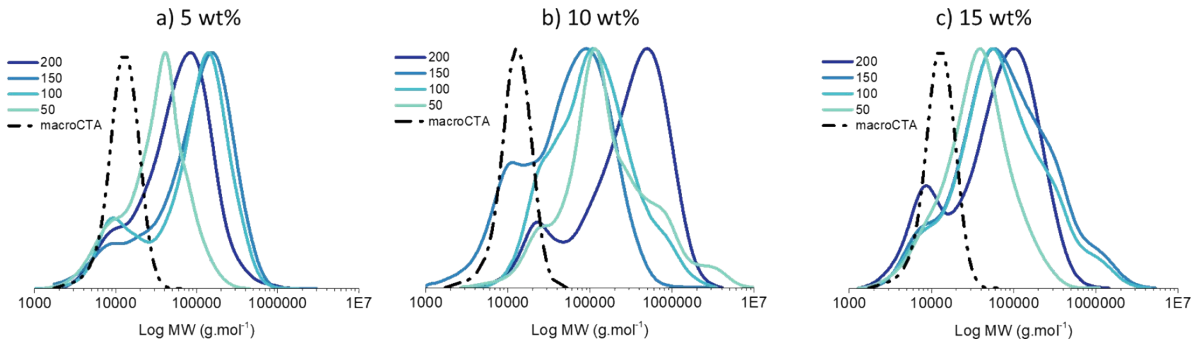

Figure S 11. SEC of PεLL$_{2.9K}$-*b*-PHPMA at different DP$_0$ and monomer contents

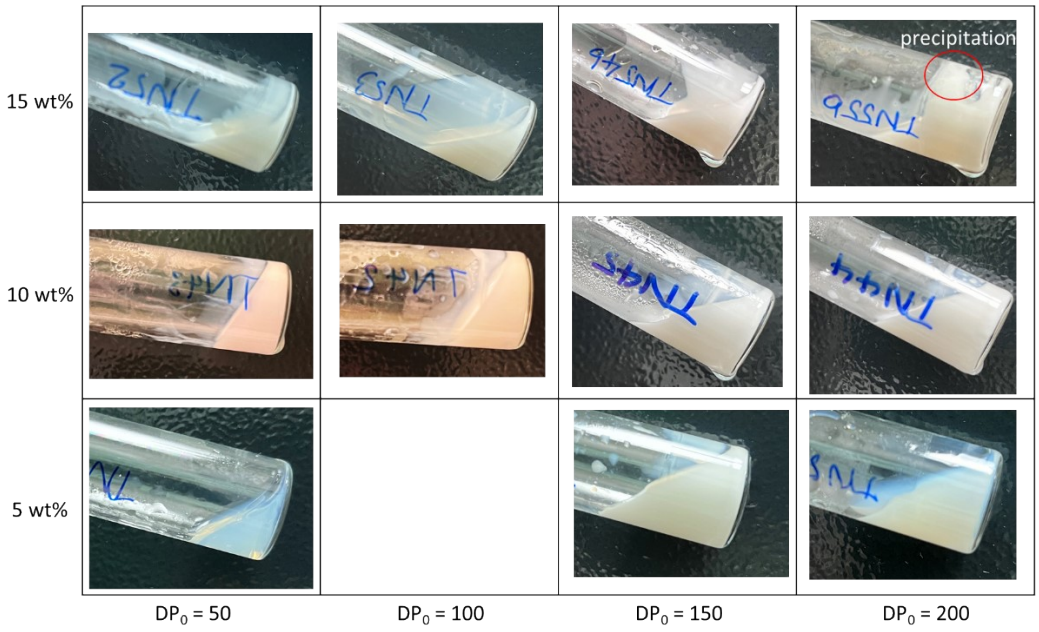

Figure S 12. Digital photos of final solution after chain extension of PεLL$_{1.5K}$-TTC with HPMA at different formulations

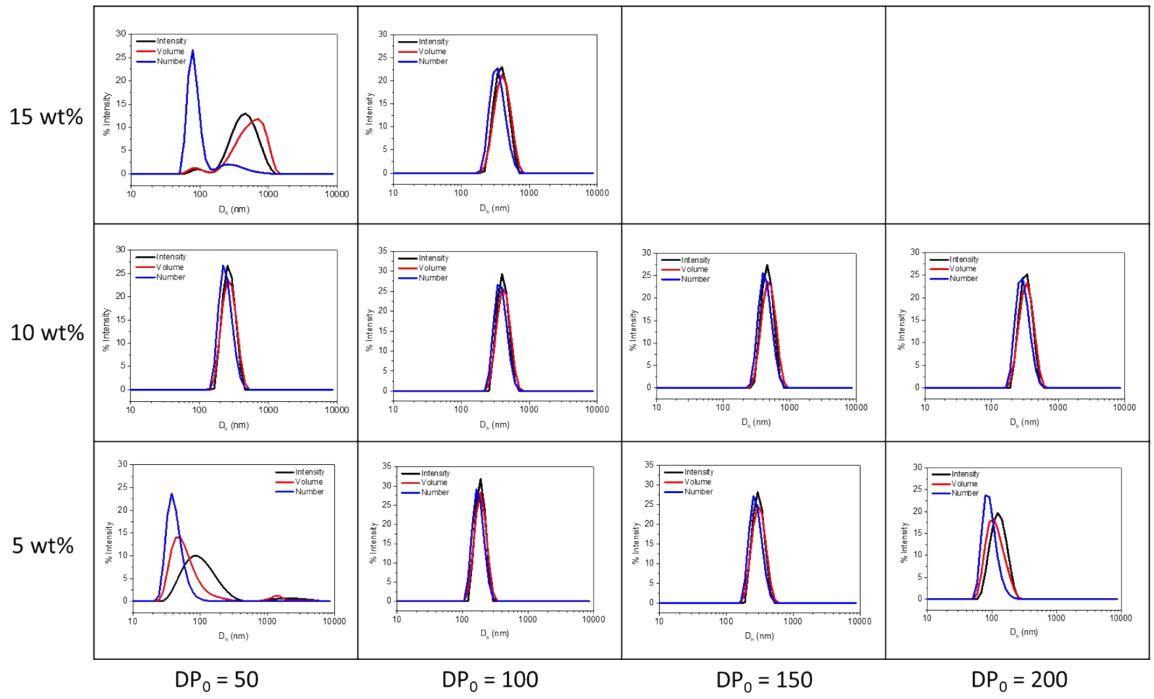

Figure S 13. DLS of diluted solution (0.03-0.05wt%) of final solution in term of intensity (black), number (blue) and volume (red) obtained by chain extension of PεLL$_{2.9K}$-TTC with HPMA at different formulations

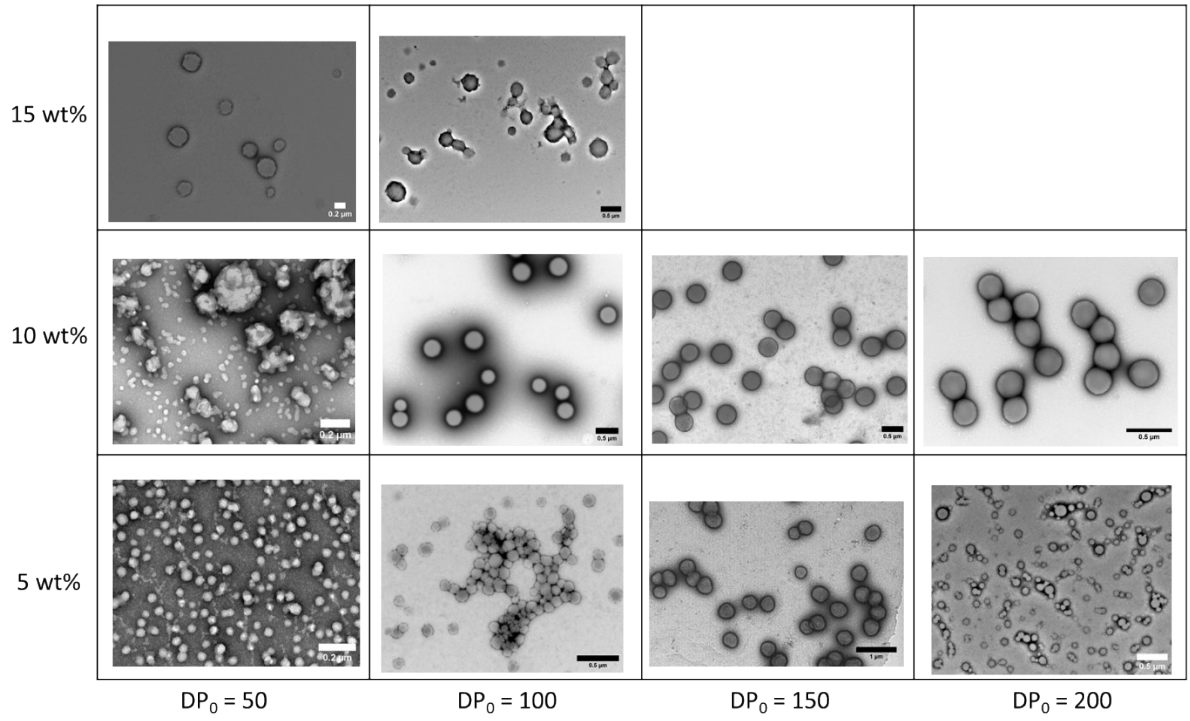

Figure S14. TEM images of several formulation of PεLL$_{2.9K}$- PHPMA systems in function of DP$_o$ and monomer content (%wt).

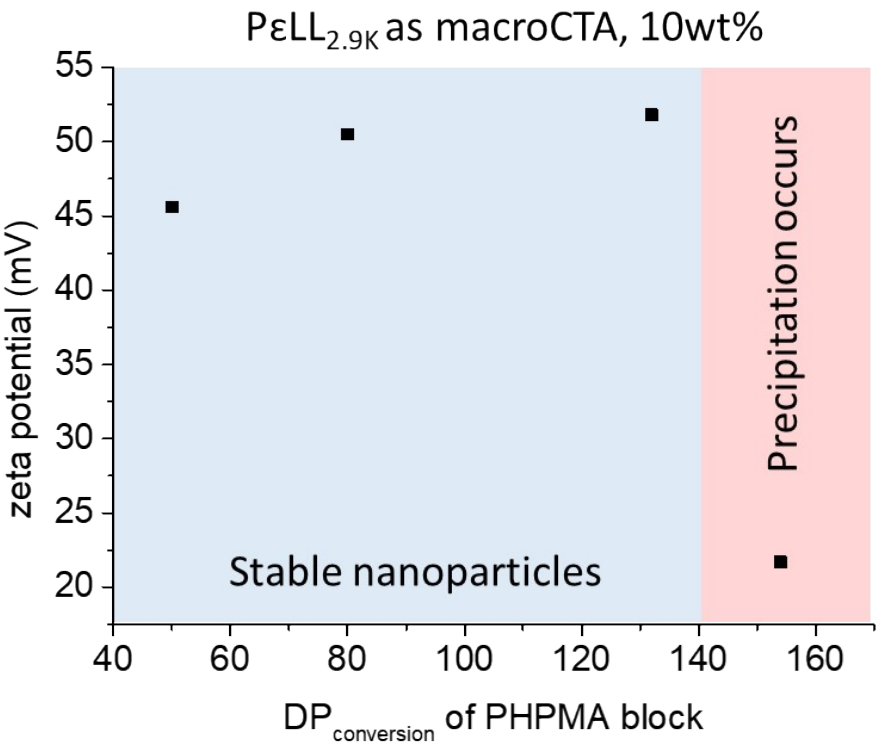

Figure S15. Zeta potential in function of DP_{HPMA} of 0.1 wt% solution of nanoparticles obtained from $PεLL_{2.9k}$-TTC at 10 wt% monomer content

Small Angle X-ray Scattering

SAXS measurements were carried out on a Xeuss 2.0 instrument from Xenocs, which uses a microfocused Cu Kα source with a wavelength of 1.54 Å and a PILATUS3 detector (Dectris, Switzerland). Experiments were performed at a sample-to-detector distance of 2480 mm with a collimated beam size of 0.8 × 0.8 mm to achieve a q-range of 0.005 $Å^{-1}$ – 0.2 $Å^{-1}$. The solutions were diluted at 1 wt% in order to avoid interaction between nanoparticles and to obtain only the form factor of each scattering object. They were then poured inside 1.5 mm glass capillaries and measured 3 hours each. Each sample has been fitted with the help of SasWiew software. In agreement with the TEM images and SAXS data, the polydisperse hard sphere model was chosen. The form factor of a spherical object is given by **Equation 2**.

$$P(q) = \frac{scale}{V} F^2(q) \quad .^{1}$$ **Equation 2**

Where:

$$F(q) = \Delta\rho \, .V \, \frac{3(\sin(qr) - q.r.cos(qr))}{(qr)^3}$$

Where r is the radius of the sphere and $\Delta\rho$ the contrast between scattering density of the scattering object and the solvent.

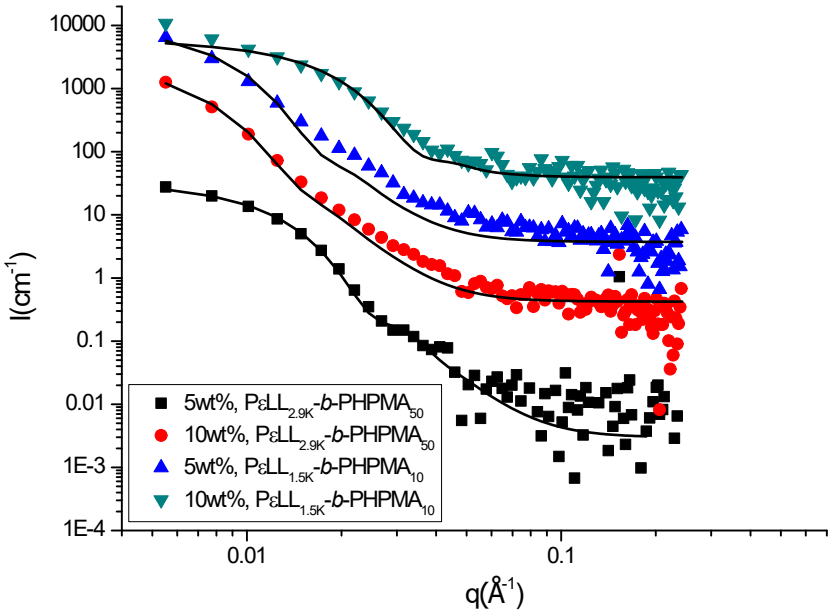

Figure S 16. SAXS results of 1 wt% solution of particles obtained from Ugi MRC and PISA-RAFT obtained by SAXS measurements; the symbols are experimental data; black lines represent fitting data based on hard-sphere model.

Table S 2. Size of the core of nanosphere obtained by SAXS

Sample	Radius (in Å)	PDI
5wt%, PeLL$_{2.9K}$-*b*-PHPMA$_{50}$	161	0.20
10wt%, PeLL$_{2.9K}$-*b*-PHPMA$_{50}$	245	0.30
5wt%, PeLL$_{1.5K}$-*b*-PHPMA$_{10}$	223	0.25
10wt%, PeLL$_{1.5K}$-*b*-PHPMA$_{10}$	110	0.25

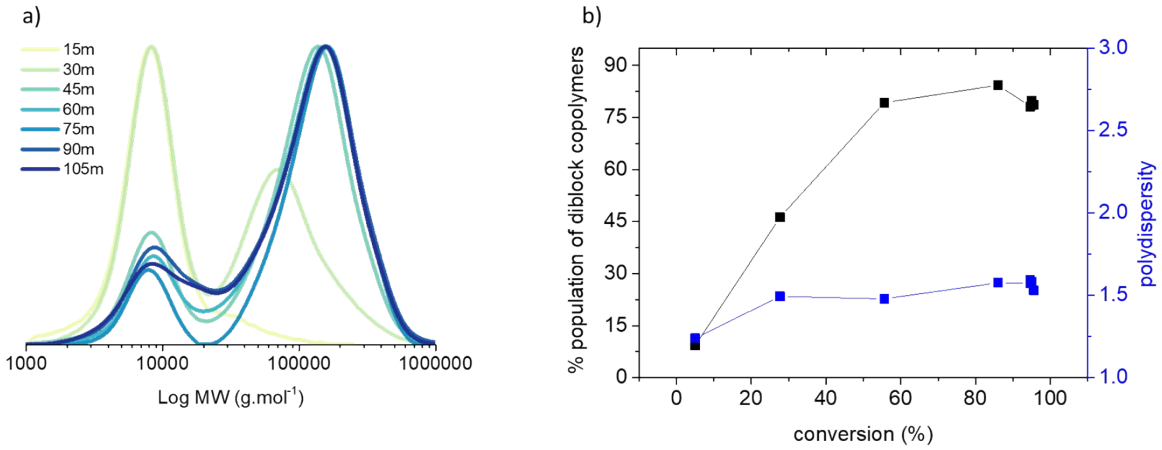

Figure S 17. Kinetic results of chain extension of PεLL$_{2.9K}$-TTC with HPMA at DP$_0$ = 100, 5 wt%: a) molar mass evolution over time, b) weight fraction of the second population (on the left at higher molar mass) over conversion and their polydispersity

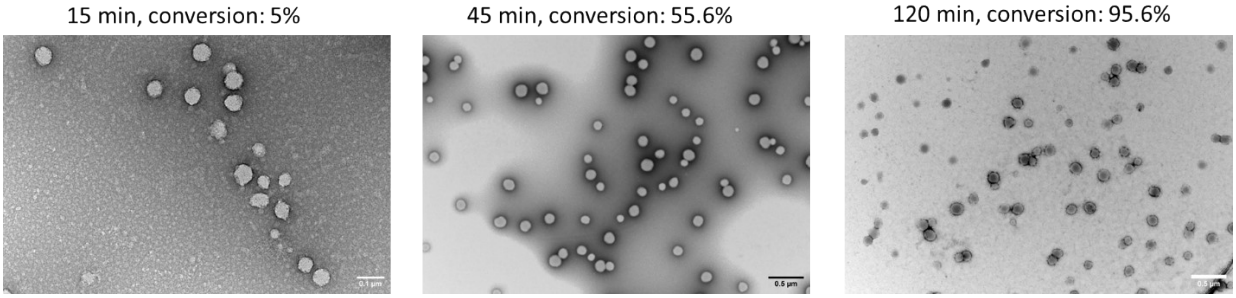

Figure S 18. TEM images of three kinetic points at 15 minutes (5% monomer conversion, left, scale bar: 0.1µm), 45 minutes (55.6 % monomer conversion, middle, scale bar: 0.5 µm) and 120 minutes (95.6% monomer conversion, right, scale bar: 0.5 µm).