

Supporting Information

Facile synthesis of helical multiblock copolypeptides: minimal side reactions with accelerated polymerization of *N*-carboxyanhydrides

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1. Materials and Methods

1.1 Materials

All chemicals were purchased from MilliporeSigma (St. Louis, MO, USA) unless otherwise specified. Amino acids were purchased from Chem-Impex International, Inc. (Wood Dale, IL, USA). Methoxy poly(ethylene glycol) amine (mPEG-NH₂, 5 kDa) was purchased from Laysan Bio, Inc. (Arab, AL, USA). Anhydrous *N,N*-dimethylformamide (DMF) was treated with polymer-bound isocyanates (MilliporeSigma, St. Louis, MO, USA) to remove any amine residues. Anhydrous chloroform (CHCl₃) were treated with 3 Å molecular sieves and stored at -30°C in a glovebox. γ -Benzyl-L-glutamate *N*-carboxyanhydride (BLG-NCA),¹ L-leucine NCA (Leu-NCA),² *N*^ε-benzyloxycarbonyl-L-lysine NCA (ZLL-NCA),³ γ -(4-propargyloxybenzyl)-L-glutamate NCA (POB-NCA),⁴ and γ -(4,5-dimethoxy-2-nitrobenzyl)-L-glutamate NCA (DMNB-NCA)⁵ were synthesized according to literature procedures. The wide-pH range buffer containing boric acid, citric acid, and sodium phosphate as active species (BCP buffer) was prepared according to the previous report.⁶

1.2 Instrumentation

Proton nuclear magnetic resonance (¹H NMR) spectra were obtained using a Varian VXR500 (500 MHz) or VNS750NB (750 MHz) spectrometer in the NMR laboratory, University of Illinois. Chemical shifts were referenced to the residual protons of deuterated solvents and reported in ppm. MestReNova (version 6.0.2, Mestrelab Research, Escondido, CA, USA) was used in the analysis of NMR data. Gel permeation chromatography (GPC) characterizations were carried out on an instrument equipped with an isocratic pump (1260 Infinity II, Agilent, Santa Clara, CA, USA), a multi-angle static light scattering (MALS) detector with the detection wavelength at 658 nm (DAWN HELEOS-II, Wyatt Technology, Santa Barbara, CA, USA), and a differential refractometer (DRI) detector (Optilab T-rEX, Wyatt Technology, Santa Barbara, CA, USA). Separations were performed using serially connected size exclusion columns (three PLgel MIXED-B columns, 10 μ m, 7.5 \times 300 mm, Agilent, Santa Clara, CA, USA) maintained at a temperature of 40 °C using DMF containing 0.1 M LiBr as the mobile phase at a flow rate of 0.7 mL/min.

The MALS detector was calibrated using pure toluene and can be used for the determination of the absolute molecular weights (MWs). All sample solutions were filtered using a 0.45 μm PTFE filter before injection. The MWs of polypeptides were determined based on the dn/dc value of each sample calculated offline by using the internal calibration system processed by the ASTRA 7 software (version 7.1.3.15, Wyatt Technology, Santa Barbara, CA, USA). The dn/dc value of PEG-PBLG macroinitiator was 0.0688. The dn/dc values for multiblock copolypeptides and the intermediates were ranging from 0.0688 to 0.1301, depending on the side-chain structures and the polypeptide lengths. Fourier transform infrared (FTIR) spectra were obtained using a Perkin Elmer 100 serial FTIR spectrophotometer (PerkinElmer, Santa Clara, CA, USA) calibrated with polystyrene film. An aliquot of the emulsion was taken out, placed on the KBr plate, and dried in air for 30 s. The resulting film of polymer/NCA mixture was then subjected to the FTIR analysis. UV-Vis spectra were recorded on an Agilent Cary 60 UV-Vis spectrophotometer (Agilent, Santa Clara, CA, USA). Circular dichroism (CD) measurements were performed on a JASCO J-815 CD spectrometer (JASCO, Easton, MD, USA). The polypeptide solutions were prepared in dichloromethane (DCM) at a concentration of 0.50 mg/mL in a quartz cell with a path length of 0.10 cm. The spectra were collected from 220 to 250 nm, as significant adsorption of DCM was observed below 220 nm. The mean residue molar ellipticity of each polypeptide was calculated on the basis of the measured apparent ellipticity by following the literature-reported formulas: Ellipticity ($[\theta]$ in $\text{deg cm}^2 \text{ dmol}^{-1}$) = (millidegrees \times mean residue weight)/(path length in millimeters \times concentration of polypeptide in mg mL^{-1}).^{7, 8}

2. Experimental Procedures

2.1 Preparation of macroinitiators

The macroinitiator, methoxy poly(ethylene glycol)-*block*-poly(γ -benzyl-L-glutamate) amine (PEG-PBLG), was prepared following a literature procedure.⁹ The purified macroinitiator was dissolved in proper solvents (chloroform or DMF, 100 mg/mL) and stored at -30°C in a glovebox. The macroinitiator was used within one week to minimize the degradation of terminal amino groups.

In order to prepare the w/o emulsion of PEG-PBLG, a chloroform solution of macroinitiators (156 μL , 100 mg/mL) was diluted with chloroform (369 μL), into which the BCP buffer (31.4 μL) was added. The two-phase mixture was emulsified using a probe sonicator (Fisherbrand, Model FB 705, Thermo Fisher Scientific, Waltham, MA, USA) with a programmed pulse setting (20 W, 20 s, with a pulse sequence of 1-s pulse on and 1-s pulse off).

2.2 Analysis of end-group fidelity

The end-group fidelity during the synthesis of triblock copolypeptides ($[\text{M}]_0/[\text{I}]_0 = 50$ for each block) was analyzed for both conventional NCA polymerization (*i.e.*, in anhydrous DMF under water-free conditions) and the polymerization in a w/o emulsion.

Polymerization in w/o emulsion: Then w/o emulsion containing PEG-PBLG (371 μL) was added into the chloroform solution of BLG-NCA (350 μL , 0.1 M, $[\text{M}]_0/[\text{I}]_0 = 50$) to start the NCA polymerization for the synthesis of the first block copolypeptides (water:chloroform = 1:50, w/w). After > 99% NCA conversion was reached for each block (confirmed by FTIR), the chloroform solution of BLG-NCA (100 μL , 0.35 M) was injected into the reaction system via a micro-syringe for chain extension. Detailed polymerization parameters were summarized in Table S1.

Conventional NCA polymerization: BLG-NCA (27.6 mg, 0.11 mmol) was dissolved in the anhydrous DMF (100 μL), into which the DMF solution of PEG-PBLG (312 μL , 100 mg/mL, $[\text{M}]_0/[\text{I}]_0 = 50$) was added. After > 99% NCA consumption for each block (confirmed by FTIR), the DMF solution of BLG-NCA (100 μL , 1.05 M) was added for further chain extension. Detailed polymerization parameters were summarized in Table S2.

Analysis of end-group fidelity: After the completion of each block, an aliquot of reaction mixture was taken out, purified by precipitation in cold hexane/ether (1:1, v/v), and dried under vacuum. The obtained copolypeptides (50 mg) were dissolved in anhydrous DMF (1.0 mL) and mixed with a DMF solution of 4-(dimethylamino)azobenzene-4'-isothiocyanate (DABITC, 2.0 mL, 7.0 mg/mL, 40 equiv. to polymer chains) and triethylamine (0.5 μL). The resulting mixture was stirred at room temperature for 24 h under

dark. After the reaction was completed, excessive DABITC was removed by repetitive precipitation in hexane/ether (1:1, v/v) until the supernatant was colorless. The labeled copolypeptides were analyzed by UV-Vis spectrophotometer ($\lambda = 429$ nm), and the end-group fidelity was calculated using a standard curve of DABITC under similar conditions (Figure S12) and the MW of the copolypeptides from GPC characterizations. The final results were represented as mean \pm s.d. from three independent tests.

2.3 Synthesis of multiblock copolypeptides

The synthesis of multiblock copolypeptides was achieved by sequential addition of NCA monomers into a w/o emulsion containing PEG-polypeptide propagating chains. Since the addition of chloroform solution of NCA monomers resulted in dilution of the reaction mixture and subsequent rate decrease, model polymerizations were first conducted to explore the relationship between polymerization time and initiator concentrations (0.97, 0.87, 0.78, 0.70, and 0.64 mM) at the designated copolypeptides chain lengths (DP = 10), and the polymerization time was estimated by FTIR until >99% NCA conversion (Figure S13). The estimated polymerization time was then used to guide the synthesis of multiblock copolypeptides.

In a typical synthesis of multiblock copolypeptides, the w/o emulsion of PEG-PBLG was mixed with the chloroform solution of NCA to start the synthesis of first block copolypeptides. At pre-determined time (typically 2 min after the NCA monomers for the previous block was fully converted), the stock solution of NCA was sequentially injected into the reaction system via a micro-syringe for chain extension. The block length was controlled through the added amount of NCA by varying the $[M]_0/[I]_0$ ratio, and the block sequence was determined by the sequence of NCA addition.

In order to check the polymerization control after each chain extension, multiple parallel batches were carried out at the same time but stopped at different numbers of chain extensions. The obtained copolypeptides were purified by precipitation in hexane/ether (1:1, v/v) and analyzed by GPC. The composition of final multiblock copolypeptides was analyzed by ^1H NMR in $\text{CDCl}_3/\text{TFA-}d_6$ (85:15, v/v).

2.4 Polymerization kinetics

The study of polymerization kinetics was monitored by ^1H NMR in CDCl_3 . After mixing the w/o emulsion

of PEG-PBLG and the CDCl₃ solution NCA in a screw-cap NMR tube (Norell, Inc., Morganton, NC, USA), the NMR spectra of the mixture was collected every minute until the disappearance of proton signals from NCA monomer.

The conversion of NCA monomers was calculated through integral of the α -H peak of NCA (δ ranges from 3.9 to 4.4 ppm, depending on side-chain structures). The NCA conversion in the first spectrum ($t = 2$ min) was calculated by comparing signals from NCAs and copolypeptides for side-chain methyl peaks (Leu-NCA, 0.6 to 1.1 ppm) or side-chain benzyl peaks (all other NCAs, 4.9 to 5.6 ppm), which was then used to determine the integral of α -H at $t = 0$ min (*i.e.*, 100% remaining NCA) for normalization. The contribution of propagating PEG-polypeptide before NCA addition was subtracted before the calculation.

3. Supporting Figures

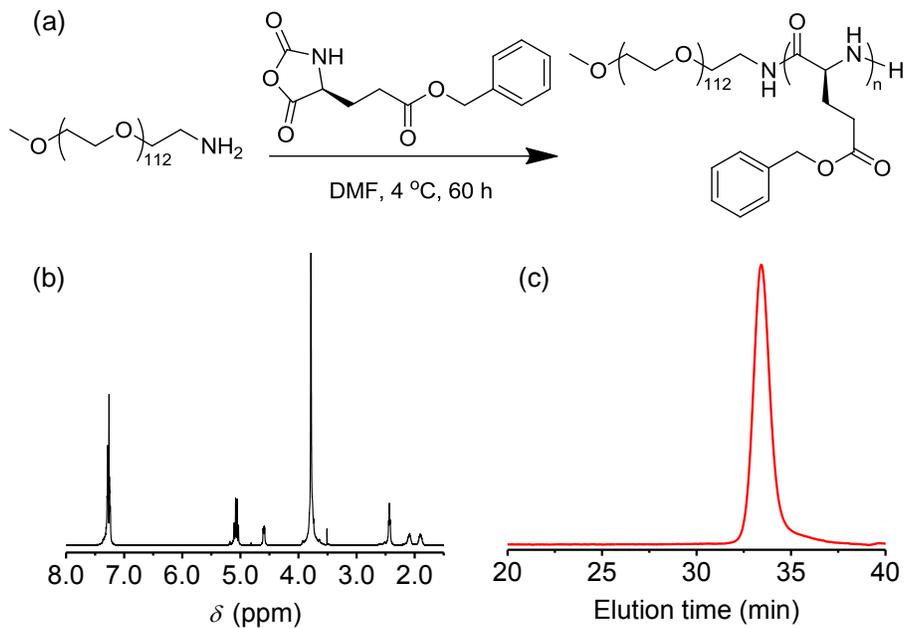


Figure S1. (a) Synthetic route to PEG-PBLG macroinitiator. (b) ^1H NMR spectrum (500 MHz) of PEG-PBLG in $\text{CDCl}_3/\text{TFA-}d_6$ (85:15, v/v). (c) Normalized GPC-LS trace of PEG-PBLG ($M_n = 14.5$ kDa, $M_w/M_n = 1.05$).

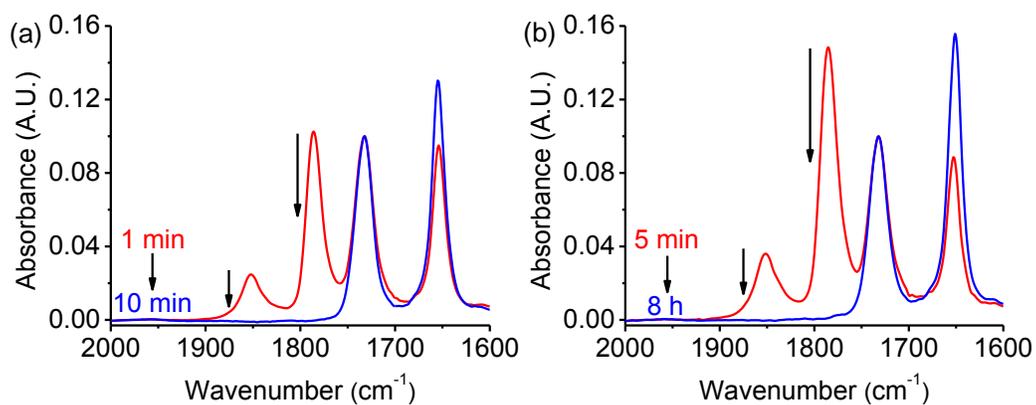


Figure S2. Representative FTIR spectra monitoring the polymerization process in a w/o emulsion (a) and a DMF solution (b). The disappearance of NCA anhydride peaks at 1852 and 1786 cm⁻¹ suggests the complete conversion of NCA monomers.

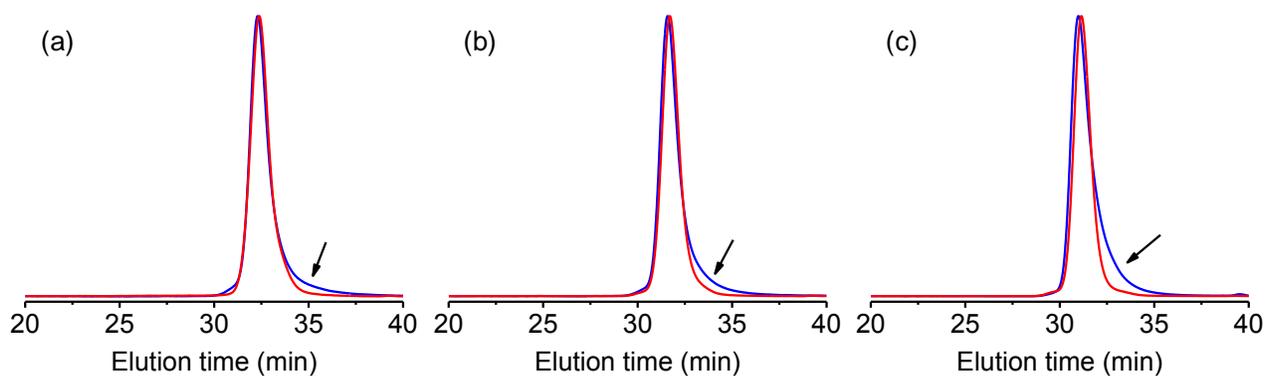


Figure S3. Normalized GPC-LS traces after the synthesis of first (a), second (b), and third (c) block using a w/o emulsion (red line) or a DMF solution (blue line). The MW tailing observed during NCA polymerization in DMF was highlighted with arrows to indicate the dead, oligomeric species.

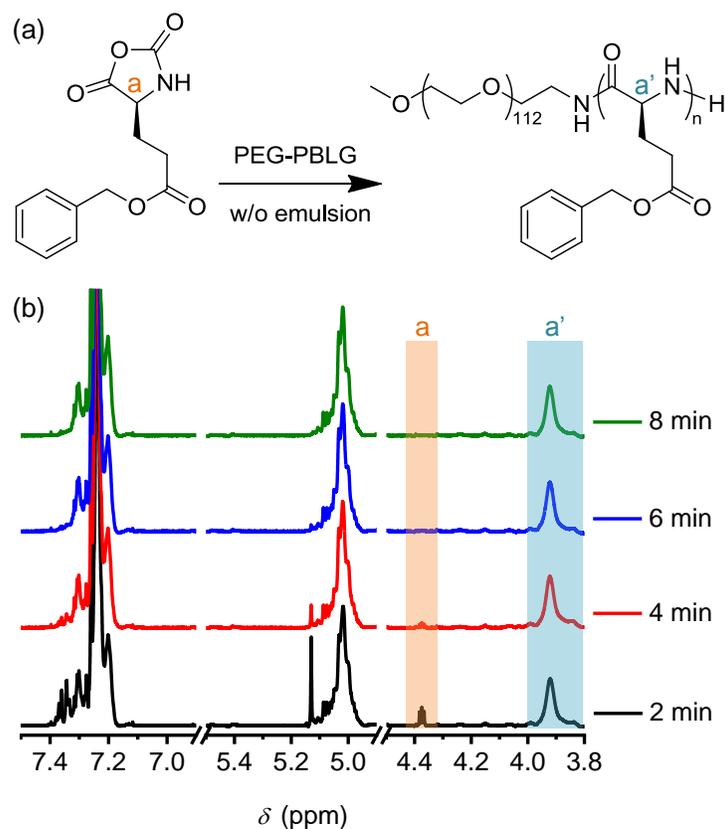


Figure S4. (a) Chemical structures of BLG-NCA and the resulting PBLG initiated by PEG-PBLG macroinitiators in a w/o emulsion. (b) Representative stacked ^1H NMR spectra (750 MHz) showing the polymerization process. The decrease in intensity of α -H peak form BLG-NCA (4.34 to 4.41 ppm) and the increase in intensity of α -H peak form PBLG (3.80 to 4.00 ppm) indicate successful NCA conversion.

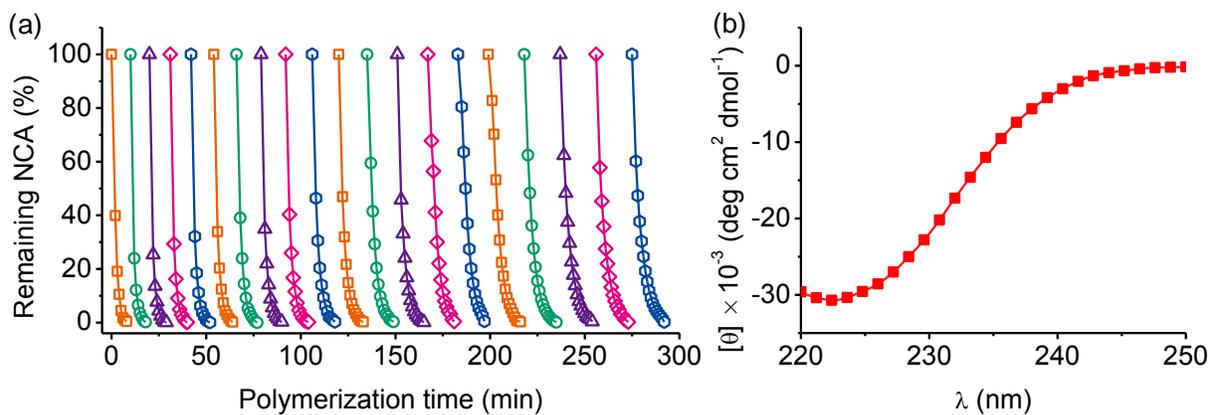


Figure S5. (a) Conversion of NCAs during the synthesis of icosablock copolypeptides. The lines are used for eye guidance only. (b) CD spectrum of the obtained icosablock copolypeptides in DCM indicating an α -helical conformation.

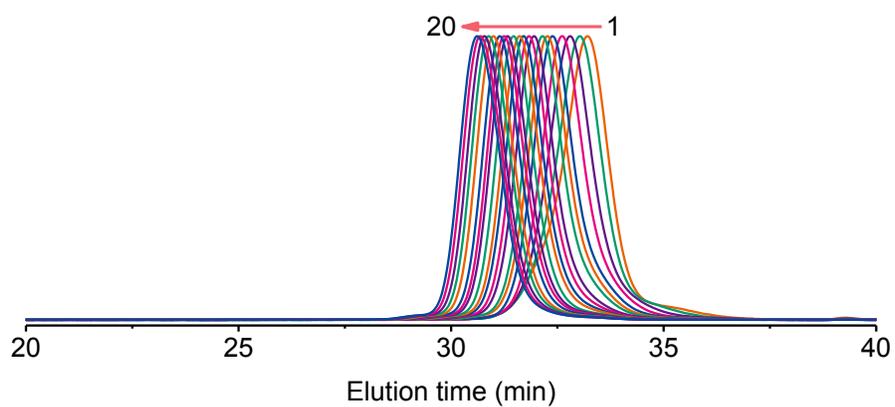


Figure S6. Normalized GPC-LS traces of intermediate polypeptides after the synthesis of each block during the synthesis of icosablock copolypeptides. No oligomeric species were observed, suggesting negligible chain terminations and remarkable control during synthesis.

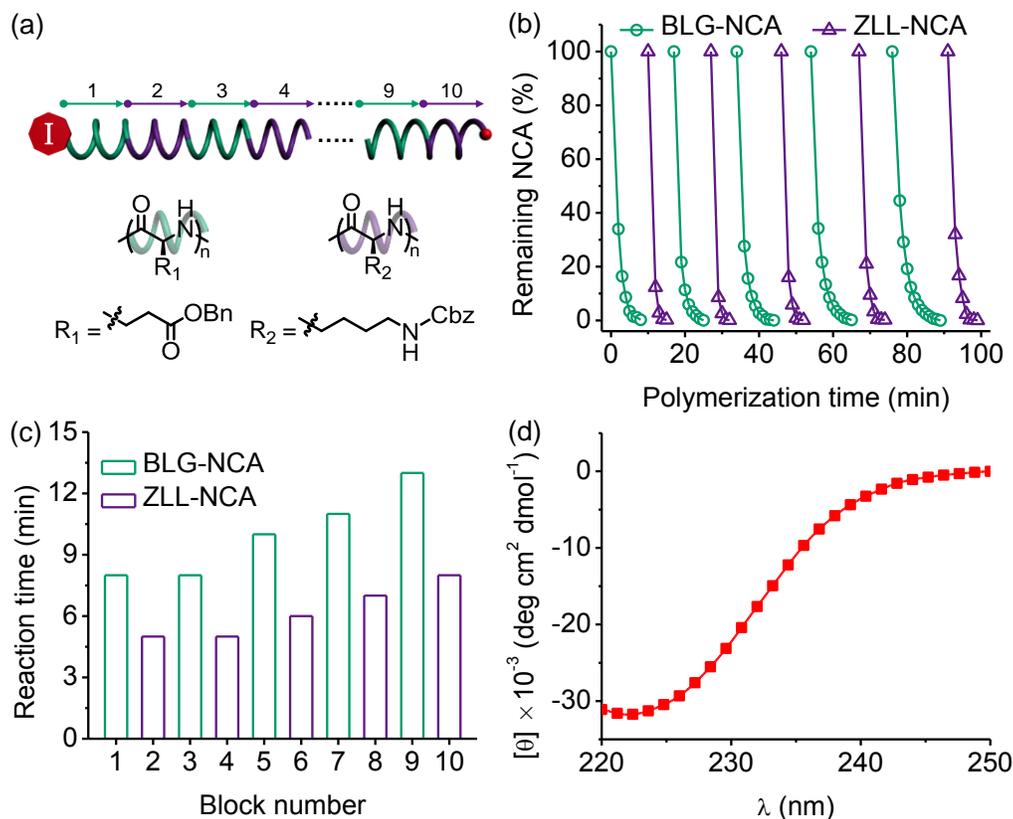


Figure S7. (a) Scheme showing the designed block sequence of the ABABABABAB decablock copolypeptides. (b) Conversion of NCAs during the synthesis of decablock copolypeptides. The lines are used for eye guidance only. (c) Reaction time for the synthesis of each block reaching > 99% NCA conversion. (d) CD spectrum of the obtained decablock copolypeptides in DCM indicating an α -helical conformation.

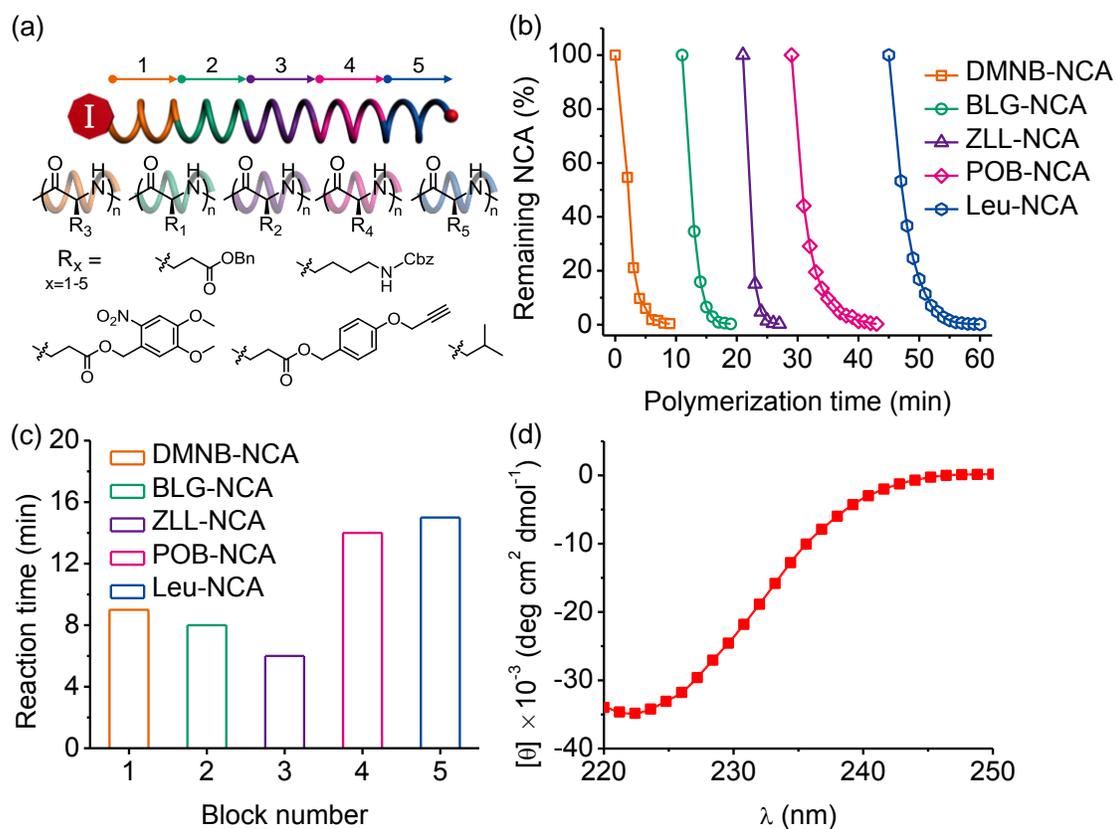


Figure S8. (a) Scheme showing the designed block sequence of the ABCDE pentablock copolypeptides. (b) Conversion of NCA during the synthesis of pentablock copolypeptides. The lines are used for eye guidance only. (c) Reaction time for the synthesis of each block reaching > 99% NCA conversion. (d) CD spectrum of the obtained pentablock copolypeptides in DCM indicating an α -helical conformation.

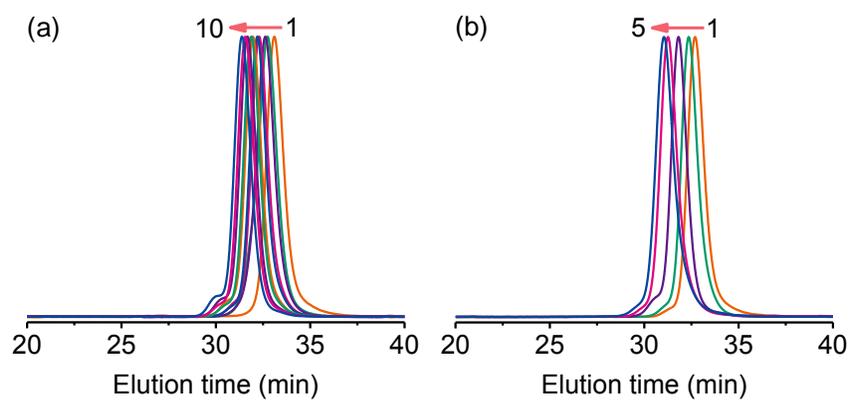


Figure S9. Normalized GPC-LS traces of intermediate polypeptides after the synthesis of each block for the decablock (a) and pentablock (b) copolypeptides.

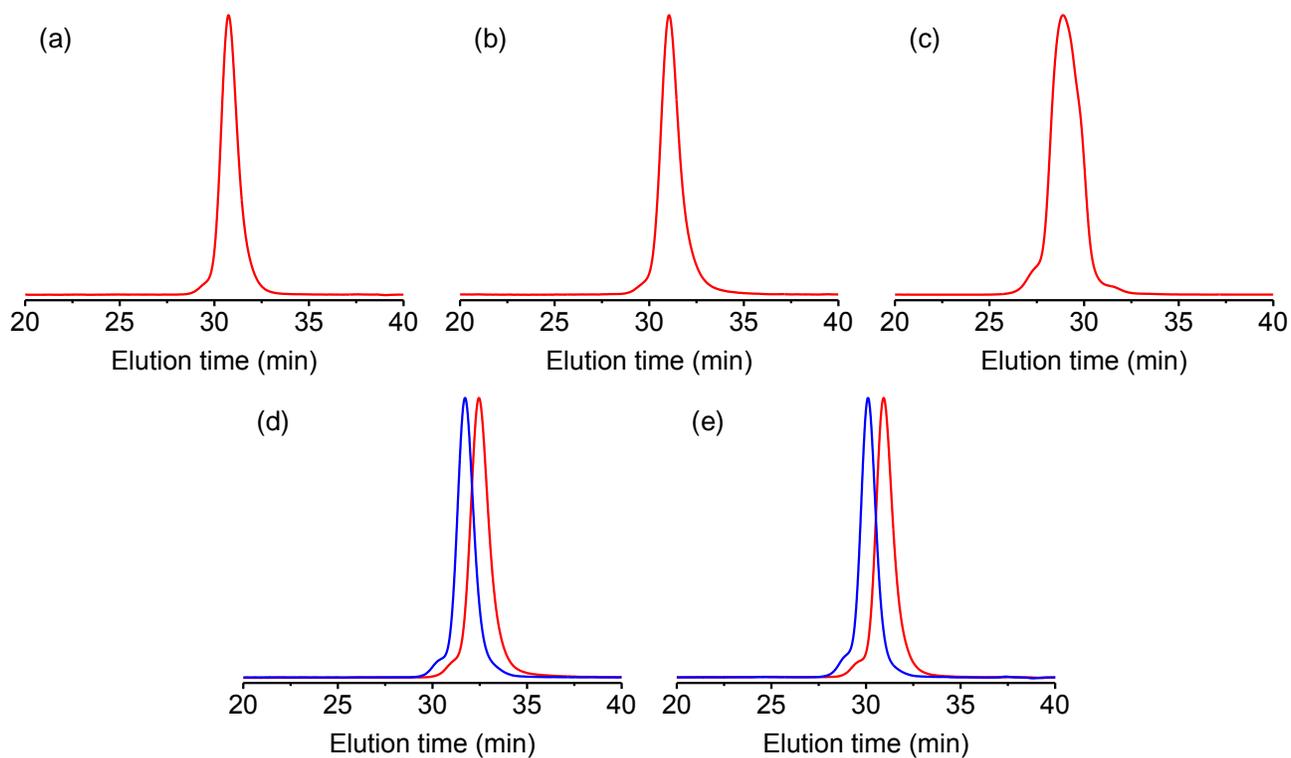


Figure S10. Normalized GPC-LS traces of triblock copolypeptide $B_{50}D_{50}C_{50}$ (a), pentablock copolypeptide $C_{25}A_{25}B_{25}D_{25}E_{25}$ (b), tetrablock copolypeptide $A_{100}C_{100}B_{100}D_{100}$ (c), pentablock copolypeptide $C_{10}A_{10}B_{10}D_{10}E_{10}$ (red line) and its chain extension product, decablock copolypeptide $C_{10}A_{10}B_{10}D_{10}E_{10}A_{10}E_{10}A_{10}D_{10}B_{10}$ (blue line) (d), and pentablock copolypeptide $C_{10}B_{20}E_{30}D_{40}A_{50}$ (red line) and its chain extension product, nonablock copolypeptide $C_{10}B_{20}E_{30}D_{40}A_{50}D_{40}E_{30}B_{20}C_{10}$ (blue line) (e). A = PBLG, B = PZLL, C = PDMNB, D = PPOB, E = PLeu.

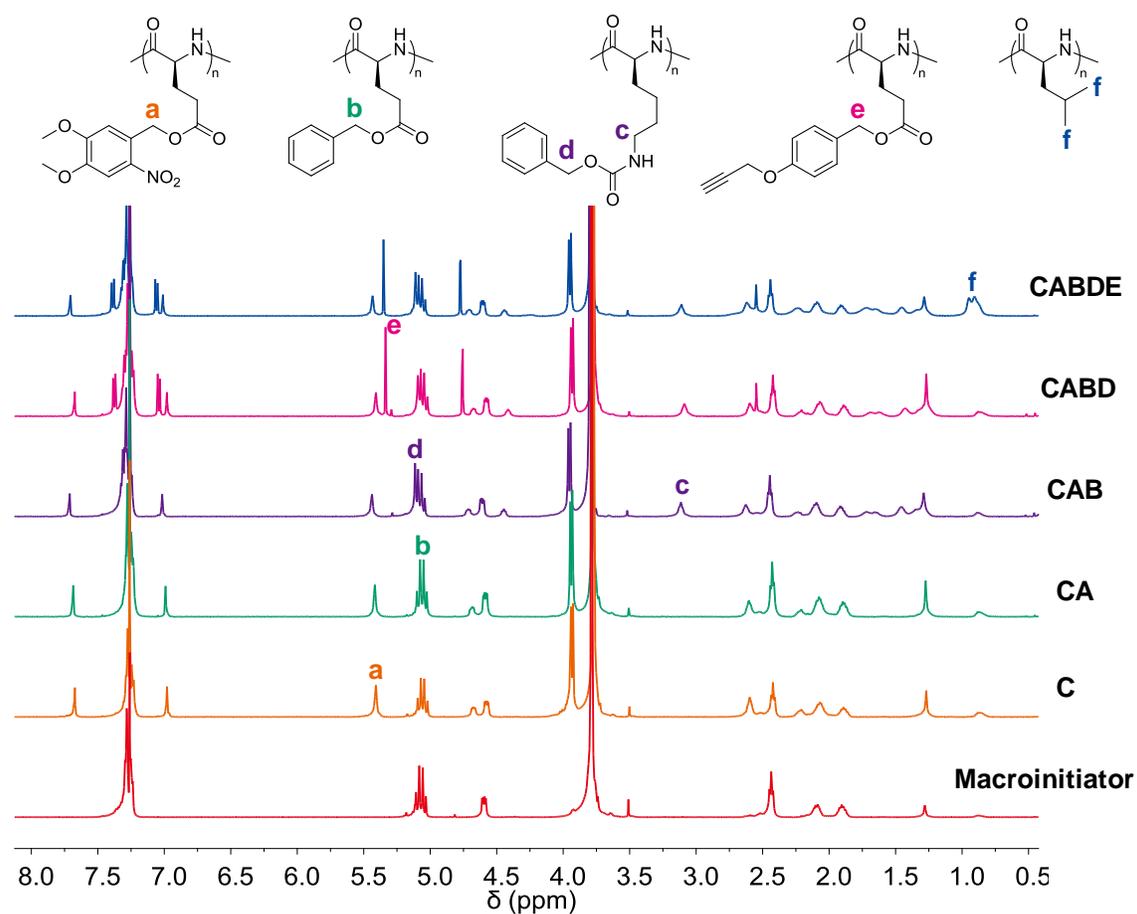


Figure S11. Stacked ^1H NMR spectra (500 MHz) of macroinitiator and all intermediate polypeptides in $\text{CDCl}_3/\text{TFA-}d_6$ (85:15, v/v) during the synthesis of pentablock copolypeptide $\text{C}_{25}\text{A}_{25}\text{B}_{25}\text{D}_{25}\text{E}_{25}$. The labelled peaks were used to calculate the composition of final multiblock copolypeptides. A = PBLG, B = PZLL, C = PDMNB, D = PPOB, E = PLeu.

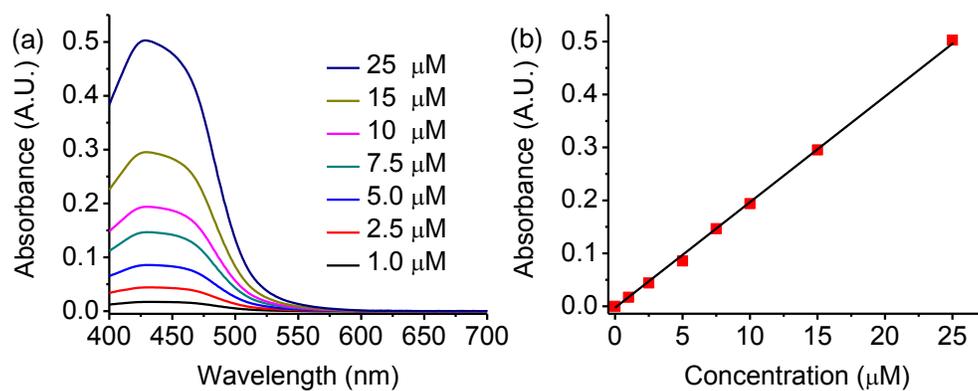


Figure S12. (a) UV-Vis spectra of DABITC in DMF at various concentrations ($\lambda_{\text{max}} = 429$ nm). (b) Standard curve of DABITC in DMF. $A_{429\text{nm}} = 0.02 \times C_{\text{DABITC}}$.

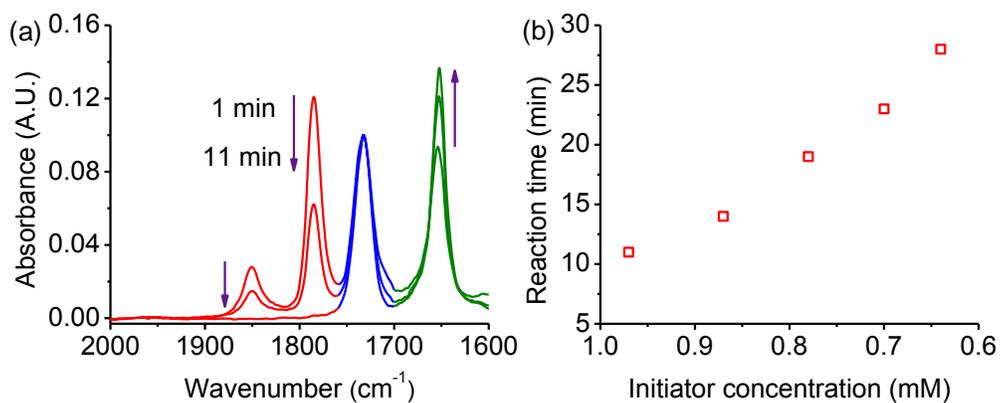


Figure S13. (a) Representative FTIR spectra showing the polymerization process in a w/o emulsion (water:CHCl₃ = 1:50, w/w; pH = 7.0). The decrease in intensity of NCA anhydride peaks at 1852 and 1786 cm⁻¹ and the increase in intensity of polypeptide amide peaks at 1652 cm⁻¹ suggests successful polymerization. (b) Polymerization time reaching > 99% NCA conversion at various initiator concentrations as determined by FTIR.

4. Supporting Tables

Table S1. Summary of the synthesis of triblock copolypeptides in a w/o emulsion.^a

Block No.	[I] ₀ (mM)	[M] ₀ (mM)	<i>t</i> ^b (min)	<i>t</i> _{total} (min)	<i>M</i> _n / <i>M</i> _n * ^{c,d} (kDa)	<i>D</i> ^d
1	0.97	48.5	10	10	25.4/25.7	1.07
2	0.85	42.5	11	23	36.5/36.7	1.08
3	0.76	38.0	14	39	47.4/47.6	1.07

^aThe synthesis of triblock copolypeptides was conducted in a w/o emulsion (water:CHCl₃ = 1:50, w/w; pH = 7.0) at room temperature through sequential addition of BLG-NCA. For the synthesis of each block, a CHCl₃ stock solution of BLG-NCA (0.35 M, 100 μL, [M]₀/[I]₀ = 50) was added. ^bPolymerization time reaching > 99% NCA conversion. ^cObtained MW/Designed MW*. ^dDetermined by GPC, *D* = *M*_w/*M*_n.

Table S2. Summary of the synthesis of triblock copolypeptides in anhydrous DMF.^a

Block No.	[I] ₀ (mM)	[M] ₀ (mM)	<i>t</i> ^b (h)	<i>t</i> _{total} (h)	<i>M</i> _n / <i>M</i> _n * ^{c,d} (kDa)	<i>D</i> ^d
1	5.10	255.0	8	8	26.4/25.7	1.09
2	4.10	205.0	18	26	38.6/36.7	1.09
3	3.43	171.5	48	74	50.7/47.6	1.16

^aThe synthesis of triblock copolypeptides was conducted in anhydrous DMF at room temperature in a glovebox through sequential addition of BLG-NCA. For the synthesis of each block, a DMF stock solution of BLG-NCA (1.05 M, 100 μL, [M]₀/[I]₀ = 50) was added. ^bPolymerization time reaching > 99% NCA conversion. ^cObtained MW/Designed MW*. ^dDetermined by GPC, *D* = *M*_w/*M*_n.

Table S3. Summary of the synthesis of icosablock copolypeptides.^a

Block No.	[I] ₀ (mM)	[M] ₀ (mM)	<i>t</i> ^b (min)	<i>t</i> _{total} (min)	<i>M</i> _n / <i>M</i> _n * ^{c,d} (kDa)	<i>D</i> ^d
1	0.97	9.70	8	8	17.2/17.4	1.07
2	0.94	9.40	8	18	19.3/19.6	1.08
3	0.92	9.20	9	29	21.4/21.8	1.08
4	0.90	9.00	9	40	23.8/24.0	1.07
5	0.87	8.70	10	52	25.9/26.2	1.07
6	0.85	8.50	10	64	27.8/28.3	1.08
7	0.83	8.30	11	77	30.1/30.5	1.08
8	0.81	8.10	11	90	32.2/32.7	1.08
9	0.79	7.90	12	104	34.5/34.9	1.08
10	0.78	7.80	12	118	36.5/37.1	1.08
11	0.76	7.60	13	133	38.6/39.3	1.08
12	0.74	7.40	14	149	41.0/41.5	1.07
13	0.73	7.30	14	165	43.3/43.7	1.07
14	0.71	7.10	14	181	45.3/45.9	1.07
15	0.70	7.00	14	197	47.4/48.1	1.07
16	0.69	6.90	17	216	49.4/50.3	1.07
17	0.67	6.70	17	235	51.7/52.5	1.07
18	0.66	6.60	17	254	53.6/54.7	1.07
19	0.65	6.50	17	273	55.9/56.8	1.08
20	0.64	6.40	17	292	57.9/59.0	1.07

^aThe synthesis of icosablock copolypeptides was conducted in a w/o emulsion (water:CHCl₃ = 1:50, w/w; pH = 7.0) at room temperature through sequential addition of BLG-NCA. For the synthesis of each block, a CHCl₃ stock solution of BLG-NCA (0.35 M, 20 μL, [M]₀/[I]₀ = 10) was added. ^bPolymerization time reaching > 99% NCA conversion. ^cObtained MW/Designed MW*. ^dDetermined by GPC, *D* = *M*_w/*M*_n.

Table S4. Summary of the synthesis of decablock copolypeptides.^a

Block No.	Monomer	[I] ₀ (mM)	[M] ₀ (mM)	<i>t</i> ^b (min)	<i>t</i> _{total} (min)	<i>M</i> _n / <i>M</i> _n * ^{c,d} (kDa)	<i>D</i> ^d
1	BLG-NCA	0.97	9.70	8	8	16.5/16.7	1.07
2	ZLL-NCA	0.93	9.30	5	15	19.0/19.3	1.08
3	BLG-NCA	0.91	9.10	8	25	21.2/21.5	1.07
4	ZLL-NCA	0.88	8.80	5	32	23.8/24.1	1.08
5	BLG-NCA	0.86	8.60	10	44	26.0/26.3	1.08
6	ZLL-NCA	0.83	8.30	6	52	28.6/28.9	1.08
7	BLG-NCA	0.81	8.10	11	65	30.8/31.1	1.08
8	ZLL-NCA	0.78	7.80	7	74	33.4/33.7	1.08
9	BLG-NCA	0.77	7.70	13	89	35.5/35.9	1.08
10	ZLL-NCA	0.74	7.40	8	99	38.0/38.5	1.09

^aThe synthesis of decablock copolypeptides was conducted in a w/o emulsion (water:CHCl₃ = 1:50, w/w; pH = 7.0) at room temperature through alternating, sequential addition of BLG-NCA and ZLL-NCA. For the synthesis of each block, a CHCl₃ stock solution of BLG-NCA (0.35 M, 20 μL, [M]₀/[I]₀ = 10) or ZLL-NCA (0.25 M, 28 μL, [M]₀/[I]₀ = 10) was added according to the designed sequence. ^bPolymerization time reaching > 99% NCA conversion. ^cObtained MW/Designed MW*. ^dDetermined by GPC, *D* = *M*_w/*M*_n.

Table S5. Summary of the synthesis of pentablock copolypeptides.^a

Block No.	Monomer	[I] ₀ (mM)	[M] ₀ (mM)	<i>t</i> ^b (min)	<i>t</i> _{total} (min)	<i>M</i> _n / <i>M</i> _n * ^{c,d} (kDa)	<i>D</i> ^d
1	DMNB-NCA	0.97	24.25	9	9	21.1/22.6	1.08
2	BLG-NCA	0.91	22.75	8	19	26.7/28.0	1.08
3	ZLL-NCA	0.83	20.75	6	27	34.2/34.6	1.09
4	POB-NCA	0.77	19.25	14	43	40.9/41.4	1.08
5	Leu-NCA	0.73	18.25	15	60	43.6/44.3	1.08

^aThe synthesis of pentablock copolypeptides was conducted in a w/o emulsion (water:CHCl₃ = 1:50, w/w; pH = 7.0) at room temperature through sequential addition of DMNB-NCA, BLG-NCA, ZLL-NCA, POB-NCA, and Leu-NCA. For the synthesis of each block, a CHCl₃ stock solution of DMNB-NCA (0.25 M, 70 μL, [M]₀/[I]₀ = 25), BLG-NCA (0.35 M, 50 μL, [M]₀/[I]₀ = 25), ZLL-NCA (0.25 M, 70 μL, [M]₀/[I]₀ = 25), POB-NCA (0.25 M, 70 μL, [M]₀/[I]₀ = 25), or Leu-NCA (0.35 M, 50 μL, [M]₀/[I]₀ = 25) were added according to the designed sequence. ^bPolymerization time reaching >99% NCA conversion. ^cObtained MW/Designed MW*. ^dDetermined by GPC, *D* = *M*_w/*M*_n.

5. NMR Spectra

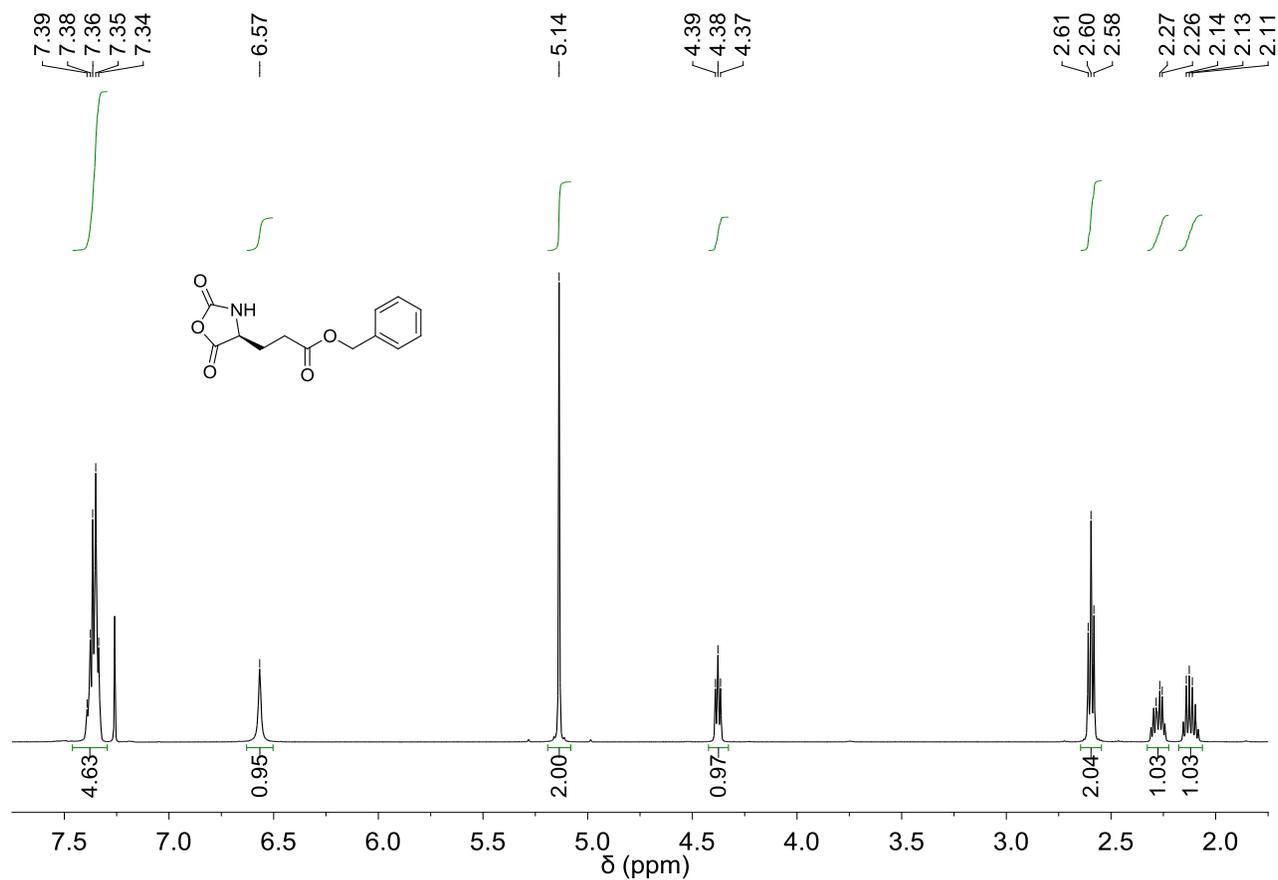


Figure S14. ^1H NMR spectrum (500 MHz) of BLG-NCA in CDCl_3 .

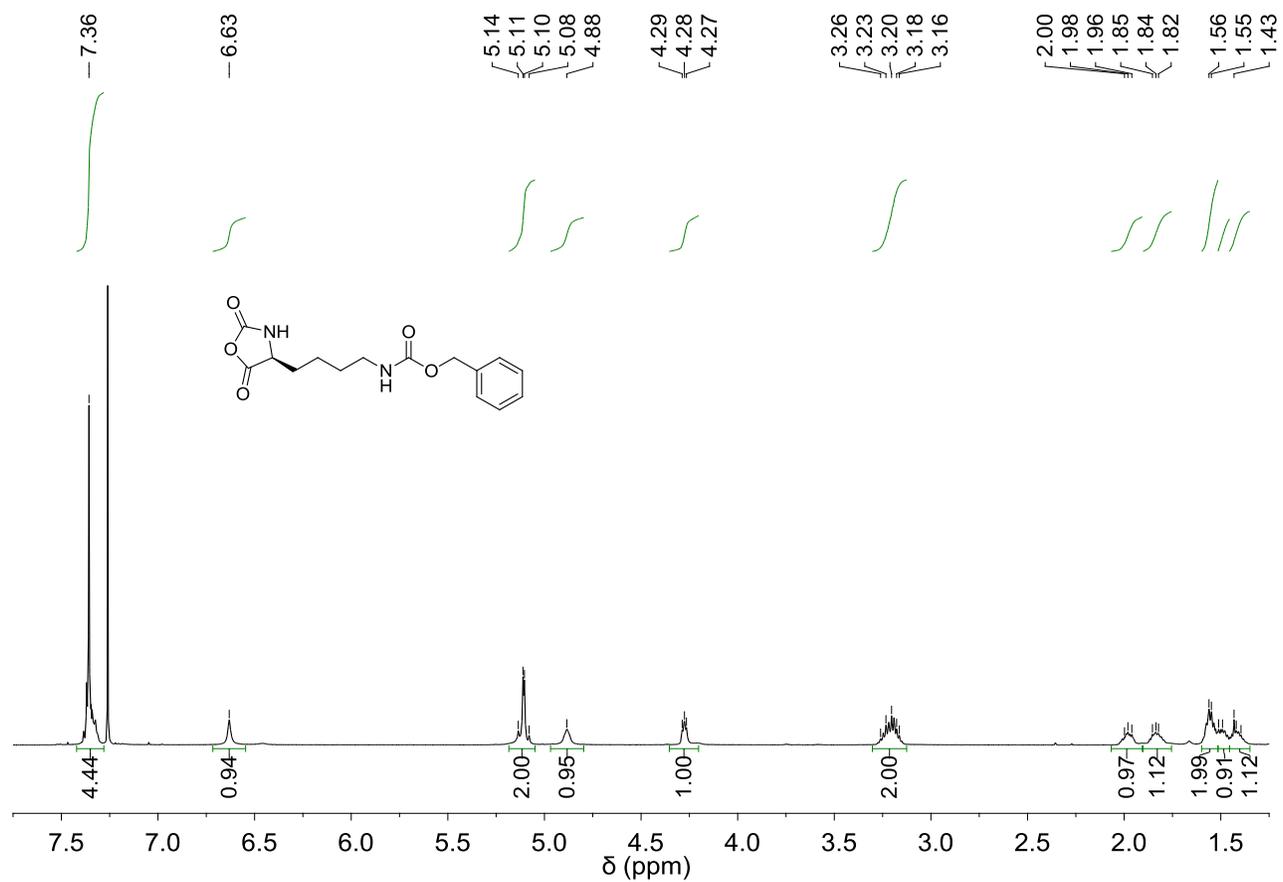


Figure S15. ¹H NMR spectrum (500 MHz) of ZLL-NCA in CDCl₃.

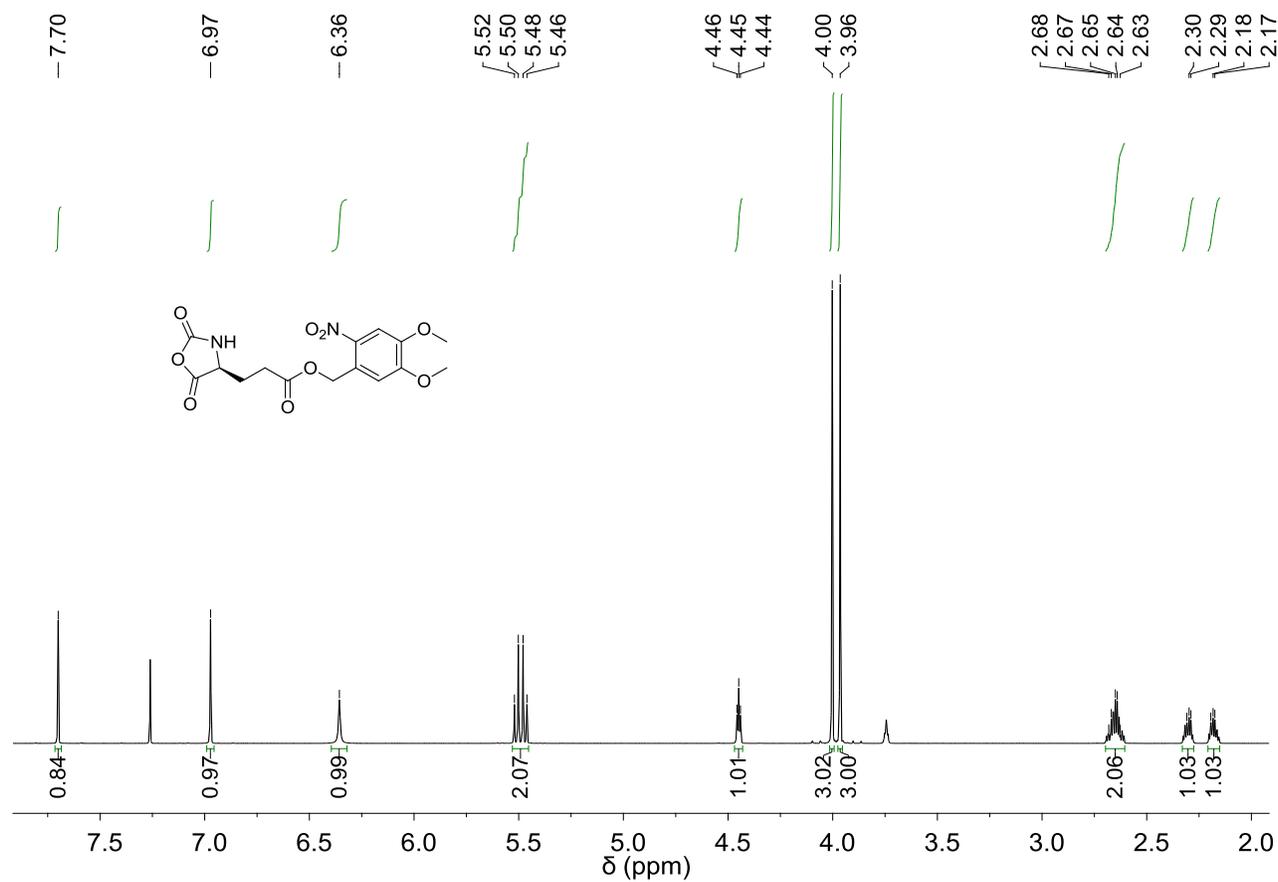


Figure S16. ^1H NMR spectrum (500 MHz) of DMNB-NCA in CDCl_3 .

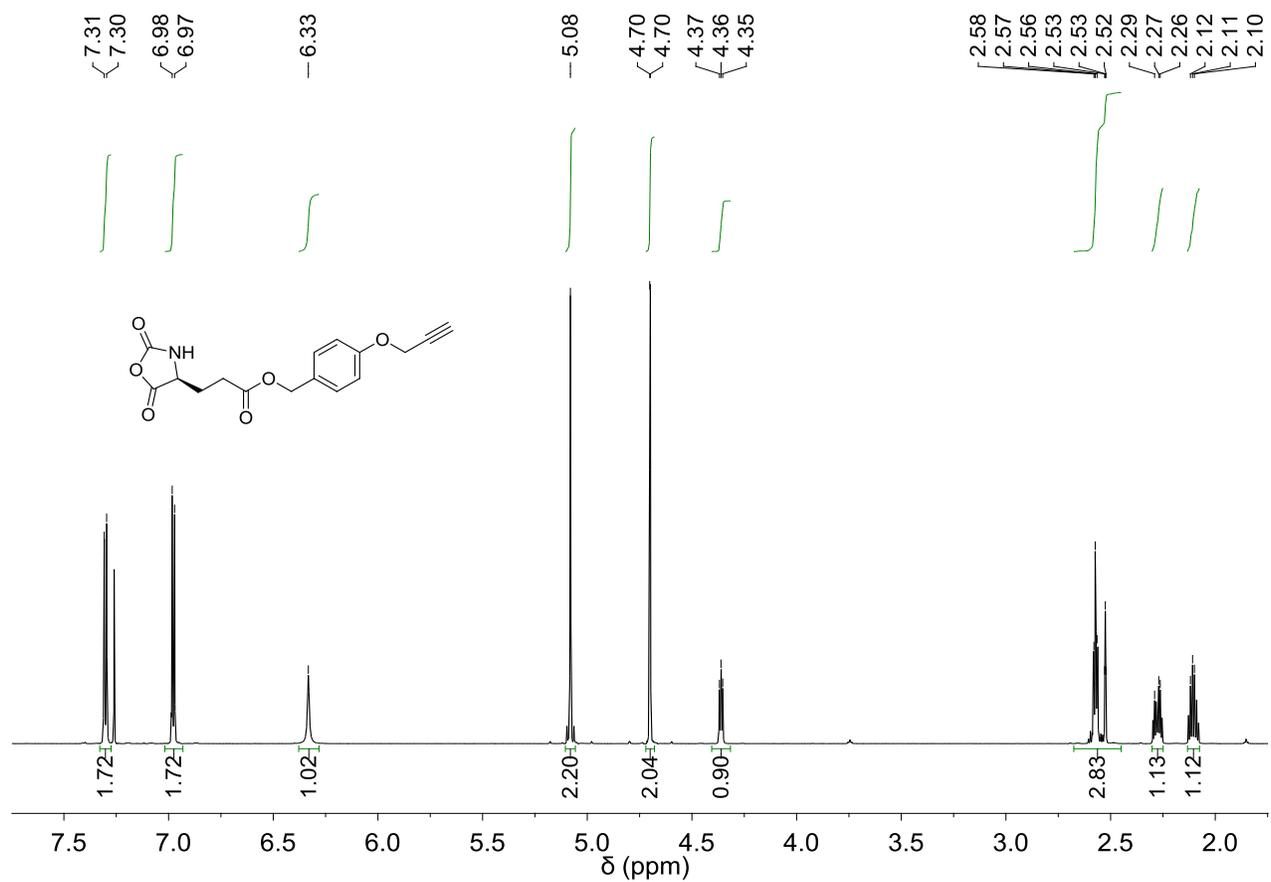


Figure S17. ^1H NMR spectrum (500 MHz) of POB-NCA in CDCl_3 .

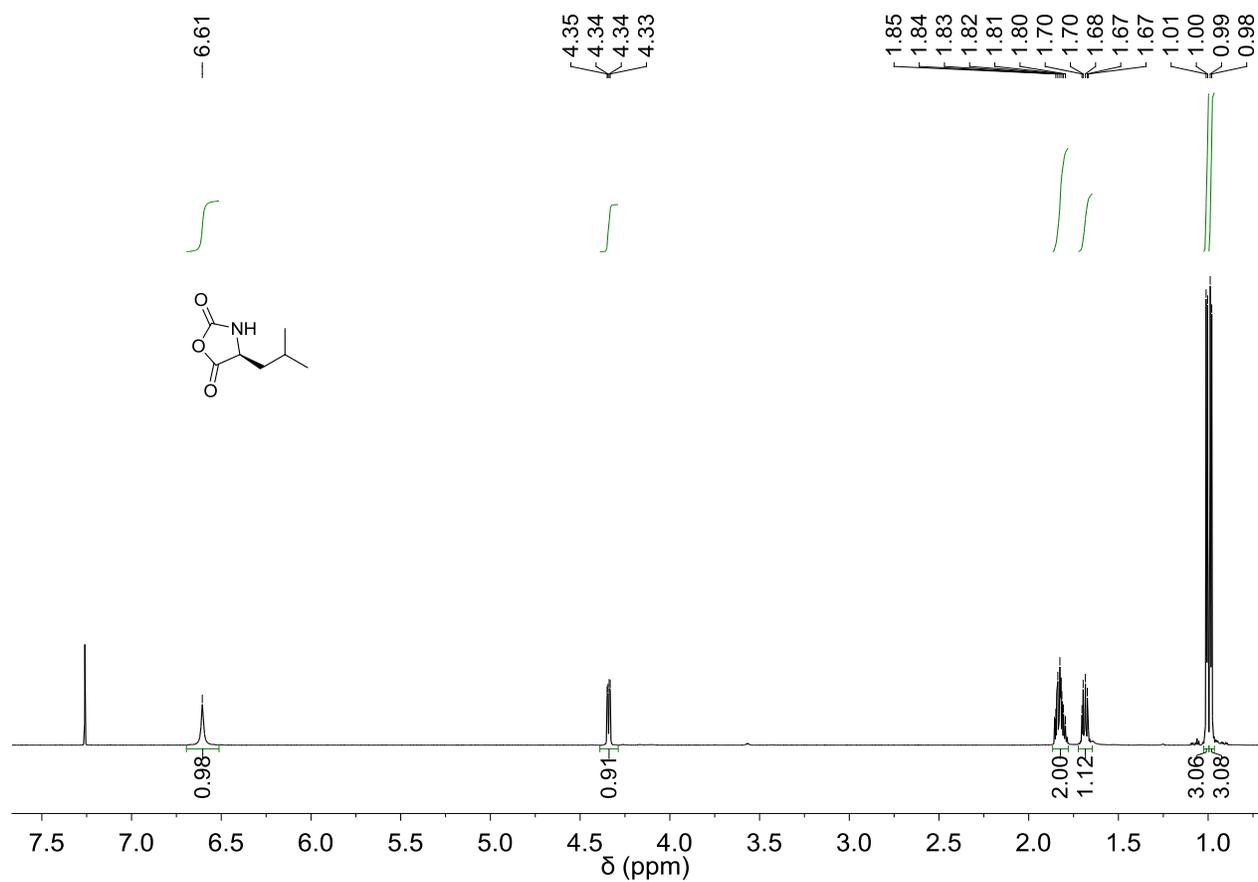


Figure S18. ¹H NMR spectrum (500 MHz) of Leu-NCA in CDCl₃.

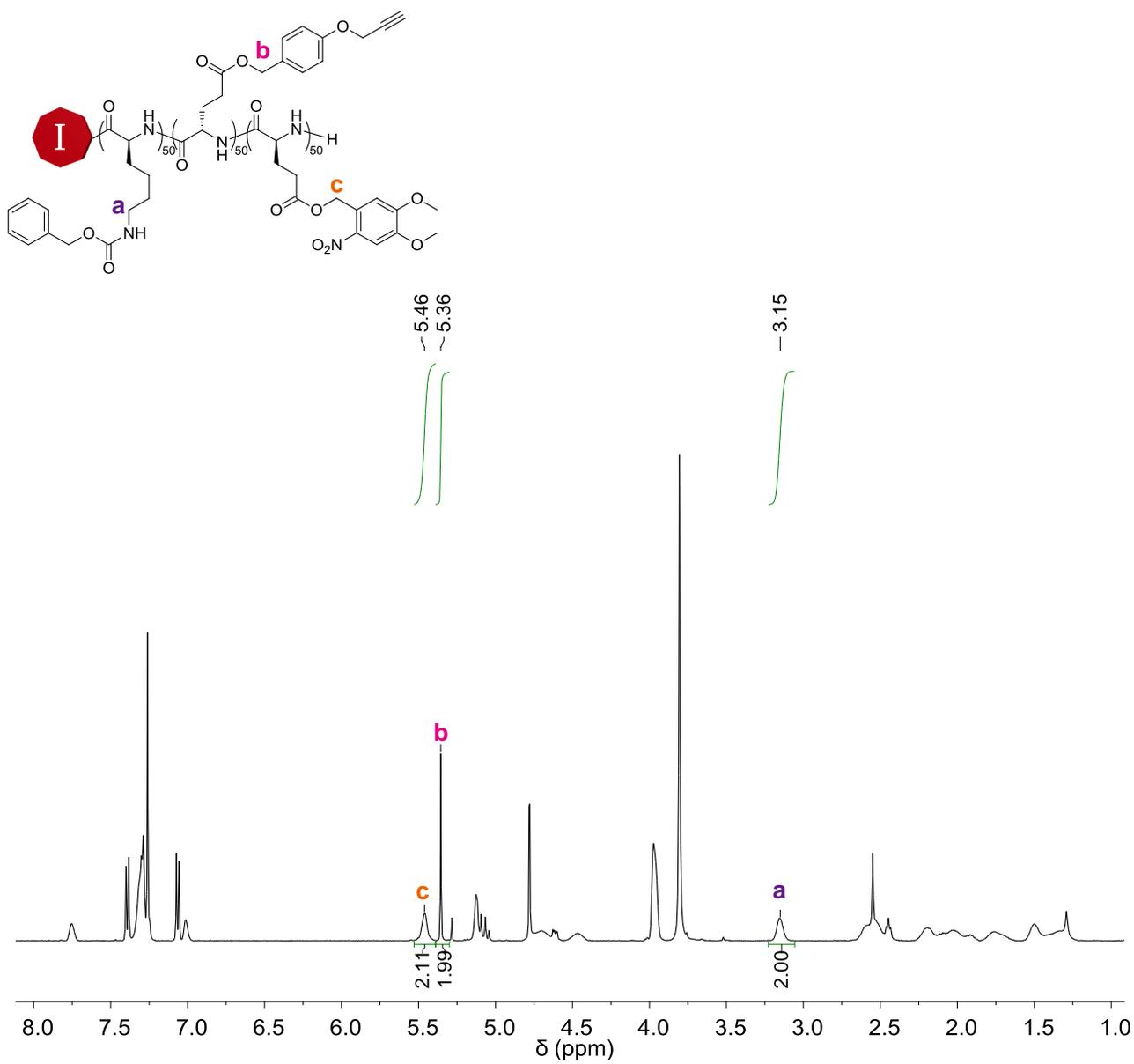


Figure S19. ¹H NMR spectrum (500 MHz) of triblock copolypeptide B₅₀D₅₀C₅₀ in CDCl₃/TFA-*d*₆ (85:15, v/v).

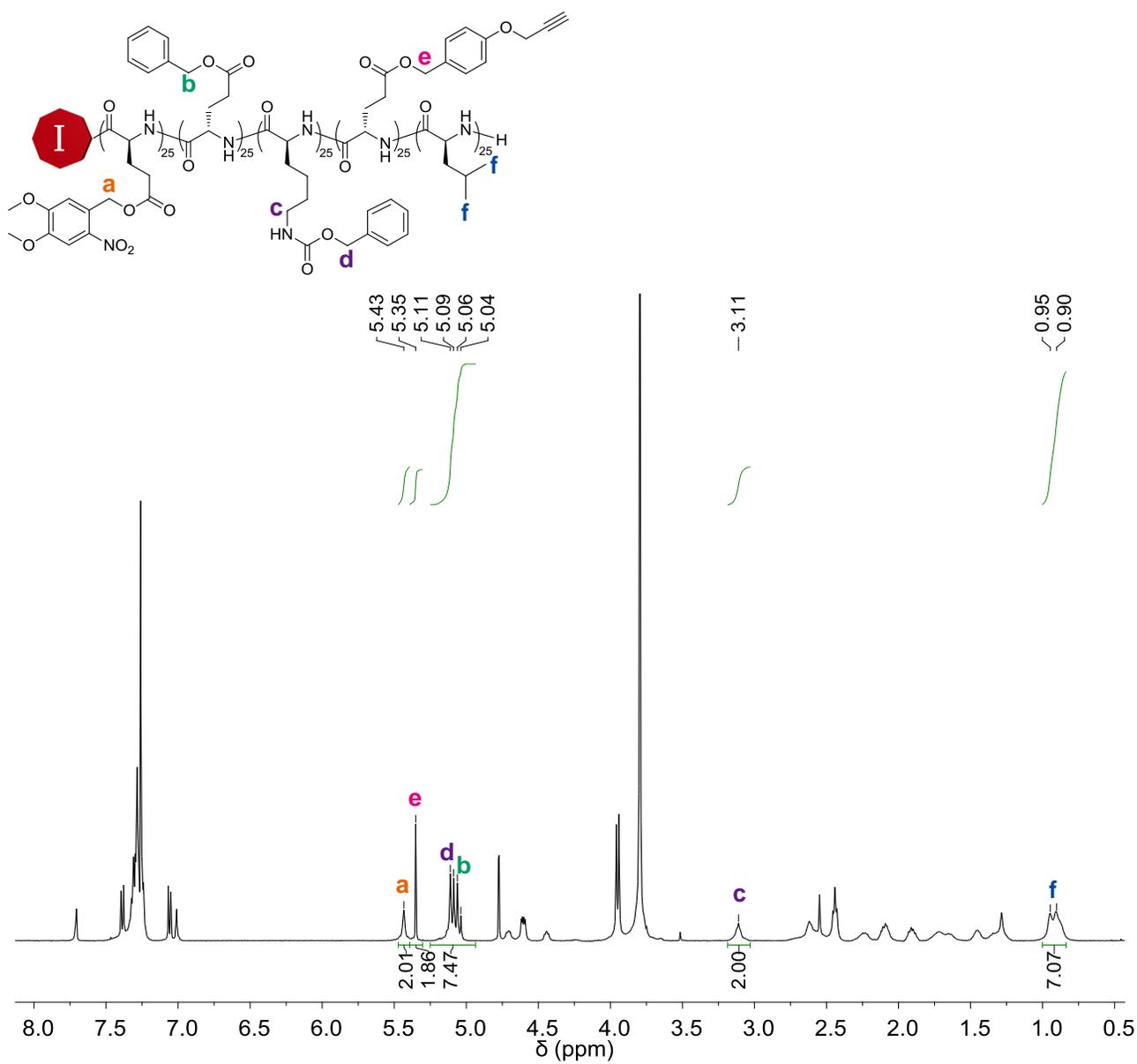


Figure S20. 1H NMR spectrum (500 MHz) of pentablock copolypeptide $C_{25}A_{25}B_{25}D_{25}E_{25}$ in $CDCl_3/TFA-d_6$ (85:15, v/v).

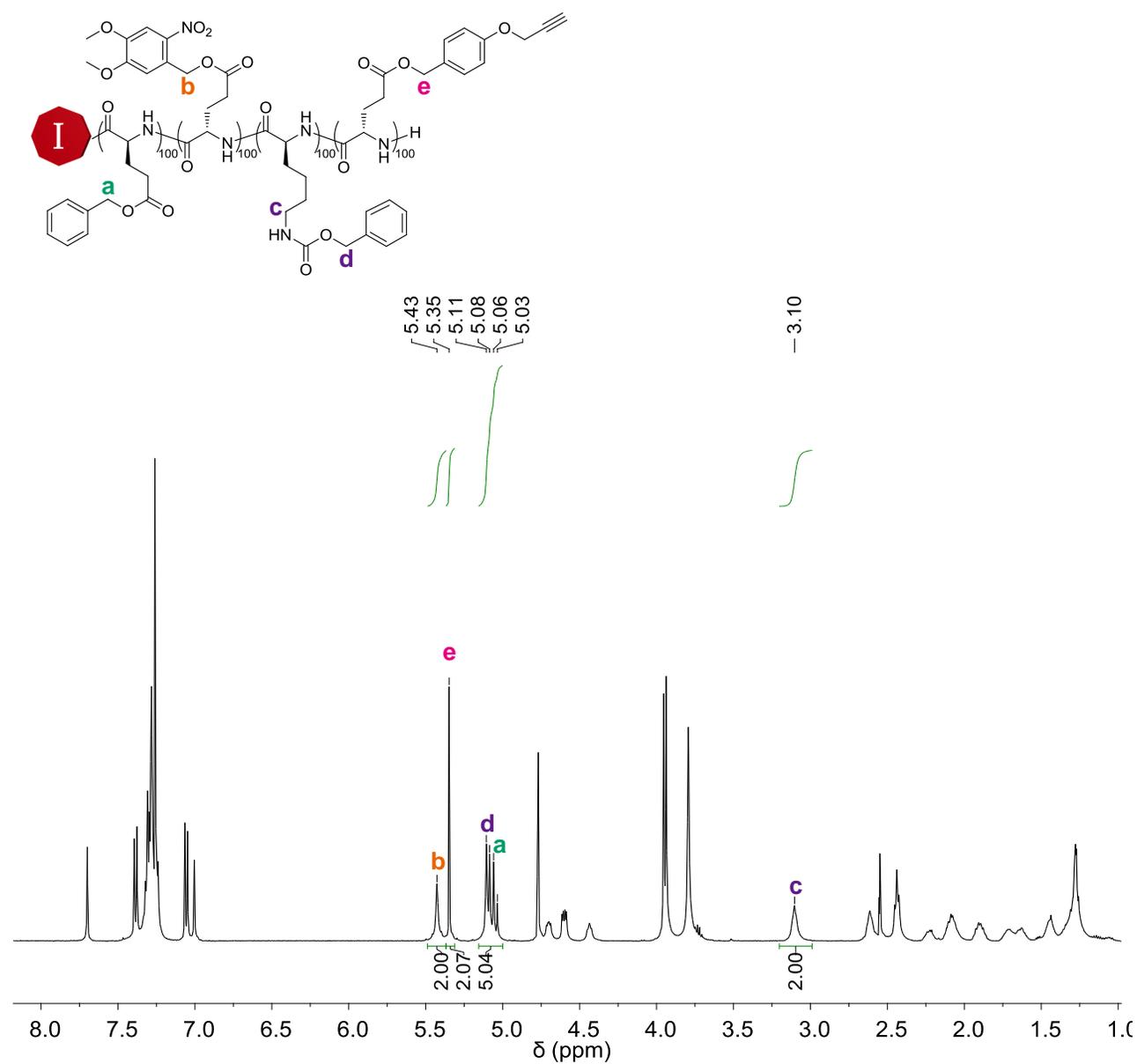


Figure S21. ¹H NMR spectrum (500 MHz) of tetrablock copolypeptide A₁₀₀C₁₀₀B₁₀₀D₁₀₀ in CDCl₃/TFA-*d*₆ (85:15, v/v).

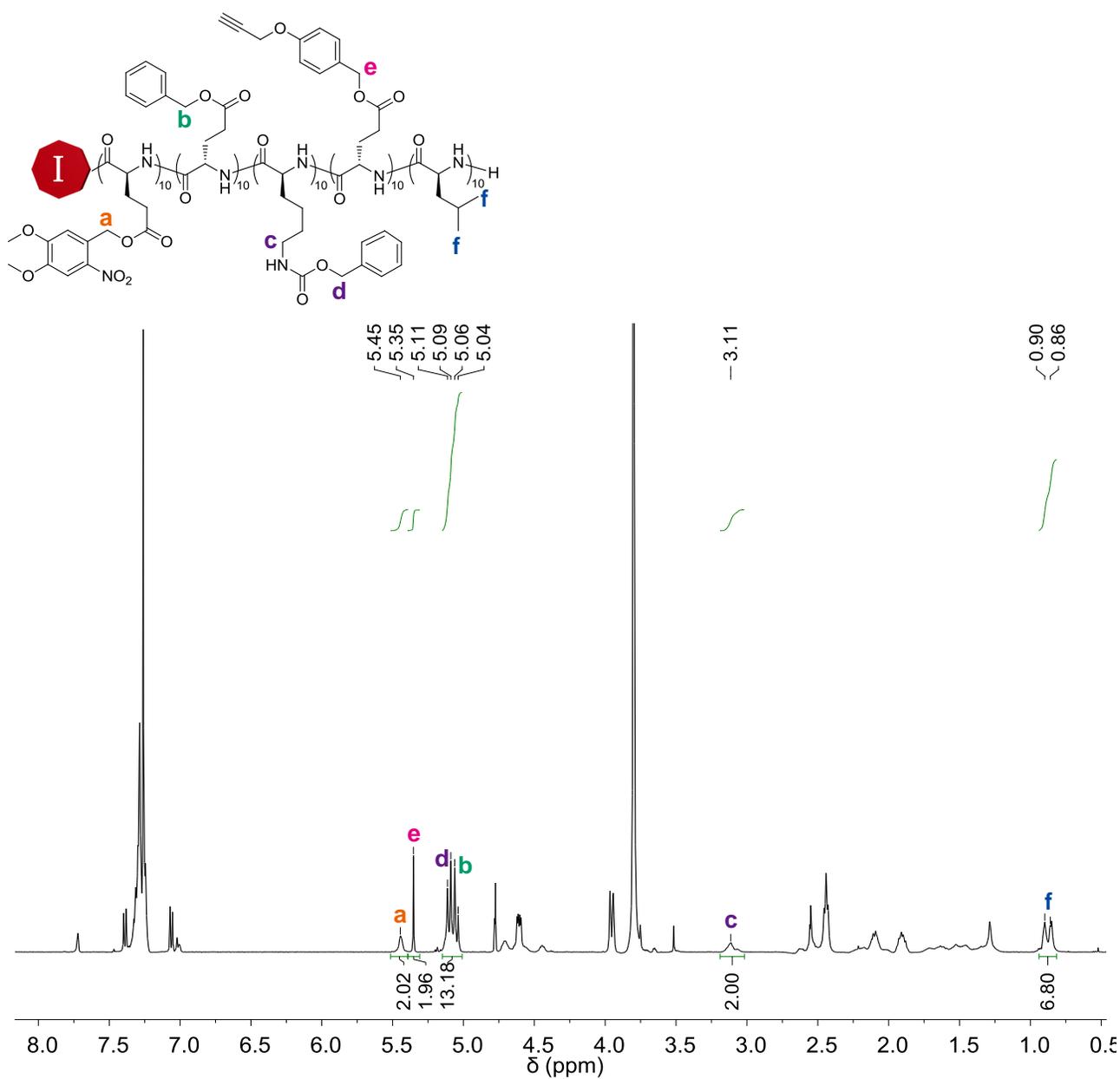


Figure S22. 1H NMR spectrum (500 MHz) of pentablock copolypeptide $C_{10}A_{10}B_{10}D_{10}E_{10}$ in $CDCl_3/TFA-d_6$ (85:15, v/v).

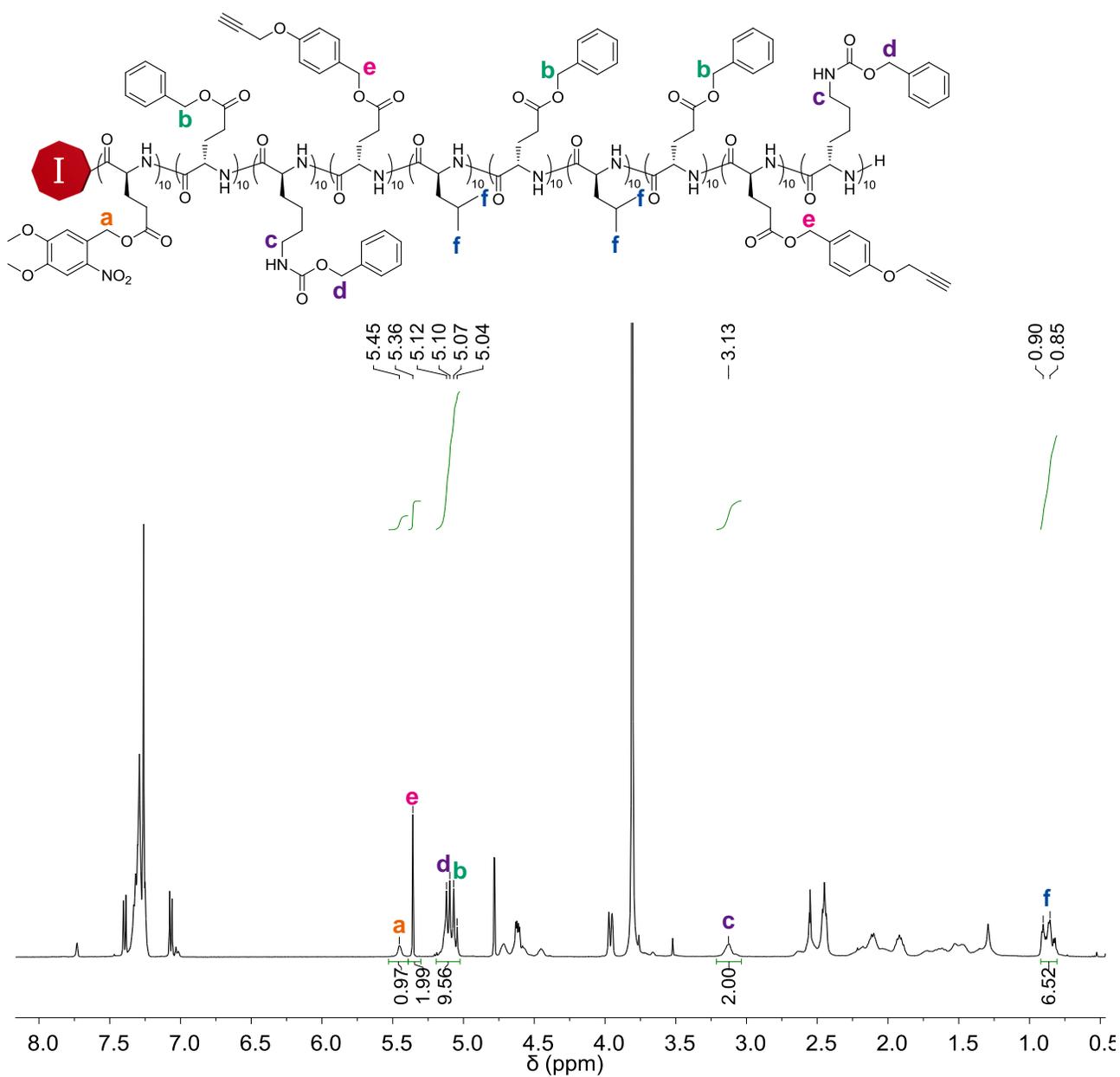


Figure S23. 1H NMR spectrum (500 MHz) of decablock copolypeptide $C_{10}A_{10}B_{10}D_{10}E_{10}A_{10}E_{10}A_{10}D_{10}B_{10}$ in $CDCl_3/TFA-d_6$ (85:15, v/v).

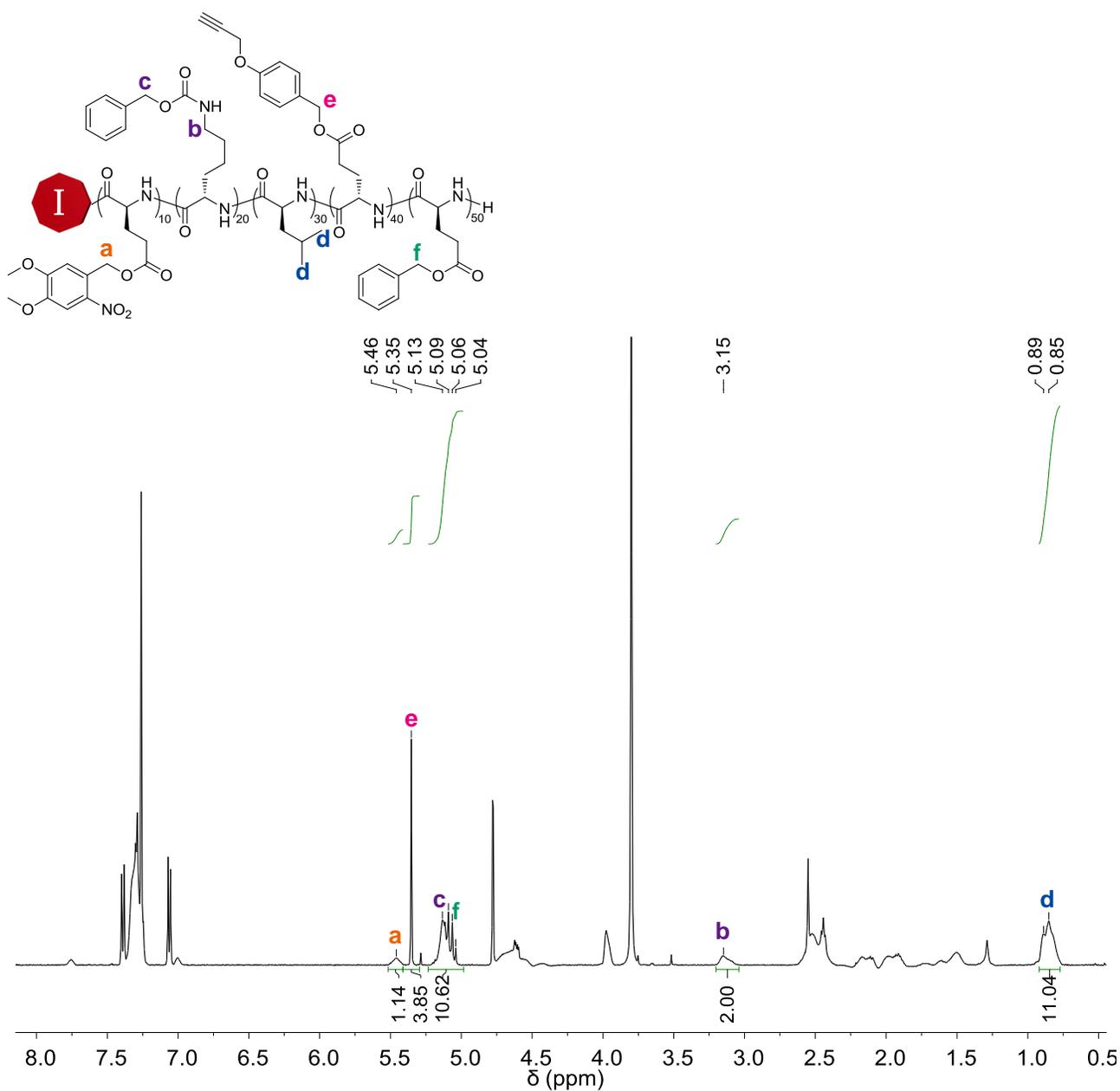


Figure S24. 1H NMR spectrum (500 MHz) of pentablock copolypeptide $C_{10}B_{20}E_{30}D_{40}A_{50}$ in $CDCl_3/TFA-d_6$ (85:15, v/v).

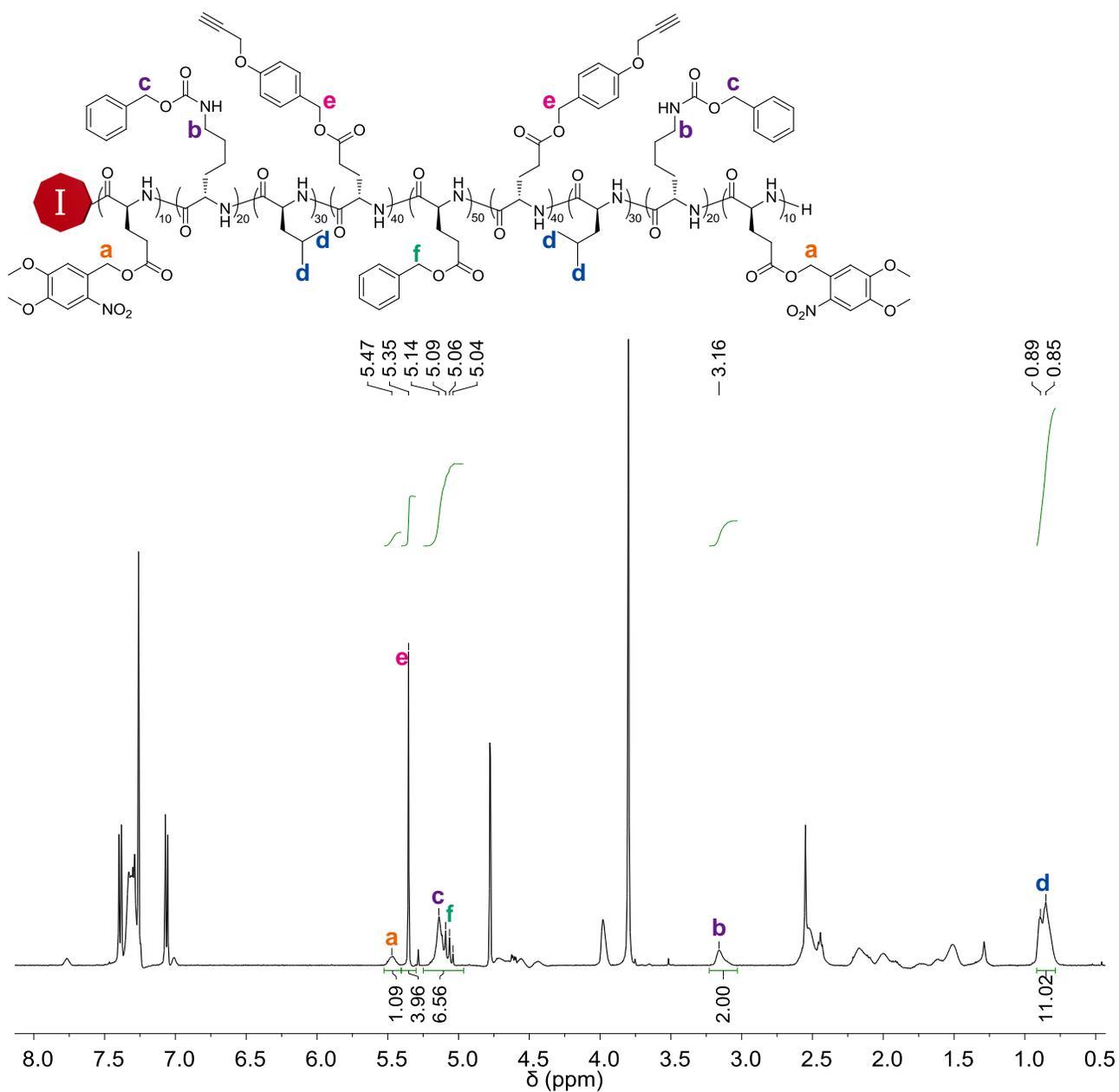


Figure S25. 1H NMR spectrum (500 MHz) of nonablock copolypeptide $C_{10}B_{20}E_{30}D_{40}A_{50}D_{40}E_{30}B_{20}C_{10}$ in $CDCl_3/TFA-d_6$ (85:15, v/v).

6. References

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