

Supporting information

Mediating physicochemical properties and paclitaxel release of pH-responsive H-type poly(methacrylic acid)₂-*block*-hydroxyl-terminated polybutadiene-*block*-poly(methacrylic acid)₂ copolymer self-assembly nanomicelles through epoxidation

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1. Synthesis of H-type PtBMA₂-*b*-epoHTPB-*b*-PtBMA₂ block copolymers

Synthesis of pH-sensitive H-type PtBMA₂-*b*-epoHTPB-*b*-PtBMA₂ block copolymers was achieved via the following two-step reaction process, as shown in Figure S1, and the detailed synthesis procedure was described as follows.

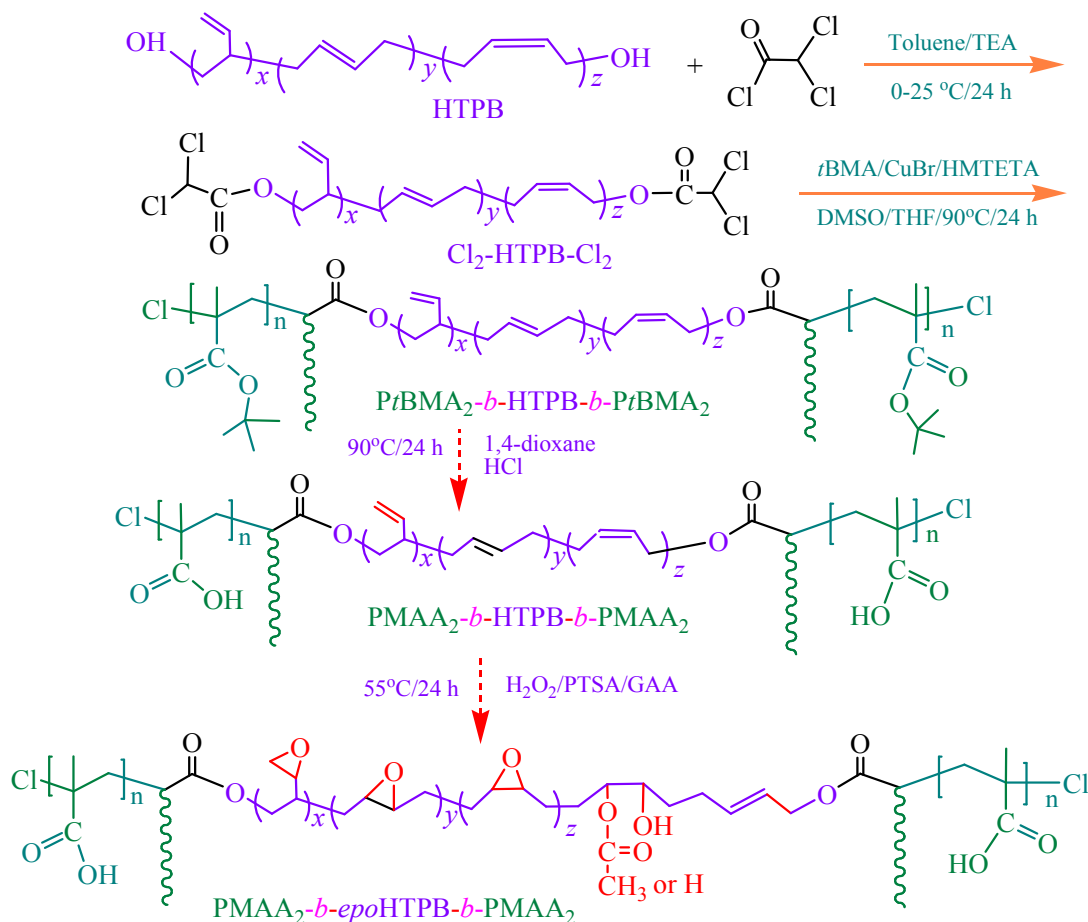


Figure S1 Schematic diagram of synthesis route of a representative H-type PMAA₂-*b*-epoHTPB-*b*-PMAA₂ block copolymer.

1.1 Preparation of Cl₂-HTPB-Cl₂

Macroinitiator Cl₂-HTPB-Cl₂ was first synthesized in a three-neck flask at molar ratios of HTPB/DCC/TEA of 1:4.3:4.3. In detail, 1.87 g (0.813 mmol) HTPB and 0.49 ml (3.496 mmol) TEA were in sequence dissolved in 30 ml dried toluene. After the solution was cooled to 0 °C in an ice-water bath, 0.28 ml (3.496 mmol) DCC dissolved in 10 ml dried toluene in advance was dropwise added into the aforementioned solution

within 1 h under the protection of dried N₂. The reaction was conducted at 0 °C for 2 h, and then at 25 °C for 24 h. The resulting mixture solution was filtrated to remove quaternary ammonium salt, followed by rotary evaporation to remove most of the solvent prior to precipitation into 10-fold methanol. The precipitate was dried at room temperature under vacuum for 24 h to offer a final product Cl₂-HTPB-Cl₂ (*Mean yield*, 80 %).

1.2 Synthesis of PtBMA₂-*b*-HTPB-*b*-PtBMA₂ copolymers

H-Type PtBMA₂-*b*-HTPB-*b*-PtBMA₂ multiblock copolymers were synthesized through ATRP of *t*BMA in a Schlenk tube at molar ratios of [Cl₂-HTPB-Cl₂]/[CuBr]/[HMTETA]/[*t*BMA] of 1/7/8/*x* (*x*=150 and 300) at 90 °C in DMSO/THF (*v/v*=1:1) mixed solvent. Typically, 0.5044 g (0.202 mmol) Cl₂-HTPB-Cl₂, 0.4396 ml (1.616 mmol) HMTETA, 4.8477 ml (30.48 mmol) *t*BMA and magnetic bar were charged into a predried Schlenk flask. 0.2028 g CuBr (1.414 mmol) was rapidly added into the flask to allow the formation of a CuBr/HMTETA complex, followed by addition of 8 ml DMSO/THF (1:1, *v/v*) solvent. The Schlenk flask was degassed and deoxygenized via a three consecutive standard ‘freeze-pump-thaw’ cycle. The polymerization tube was sealed and allowed to proceed for 24 h at 90 °C. The vial was quenched and the reaction mixture was diluted with THF. The diluted mixture was passed through a neutral Al₂O₃ column to remove copper complex. After removing most THF by rotary evaporation, the crude polymer solution was precipitated in tenfold excess methanol/cold diethyl ether. The resultant product was obtained by filtration and drying in a vacuum oven at room temperature until constant weight (*Yield*: 46 %), with number average molecular weight (*M_n*) of 19870 by *SEC*, and 15160 by ¹H NMR, named ‘Polym A’ or ‘P(*t*BMA₂₂)₂-*b*-HTPB-*b*-P(*t*BMA₂₂)₂’. Likewise, when the monomer *t*BMA of 9.6954 ml (60.96 mmol) was poured into the reaction system, the

copolymer with M_n of 28320 by SEC and 20300 by ^1H NMR was obtained, and denominated ‘Polym B’ or ‘ $\text{P}(t\text{BMA}_{31})_2$ -*b*-HTPB-*b*- $\text{P}(t\text{BMA}_{31})_2$ ’. ^1H NMR (300 MHz, CDCl_3 , δ in ppm): 5.49 (*br, m*, methyne proton signals $-\text{CH}=\text{CH}_2$ at in 1,2-*vinyl* terminated (α -olefin) structure), 5.41 (*br, m*, $-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-$ in *cis/trans*-1,4 olefinic structure), 4.97 (*br, d*, 1,2-*vinyl* $-\text{CH}=\text{CH}_2$), 2.26 (*br, m*, $-\text{CH}_2-\text{CH}-\text{CH}=\text{CH}_2-$ and $\text{OOCCH}-$ in initiator residues, and 2.03 (*br, m*, $-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-$), 1.26 (*br, m*, methylene protons in $-\text{CH}_2-\text{CH}-\text{CH}=\text{CH}_2$); 1.04-1.14 (s, $-\text{CH}_2\text{C}(\text{CH}_3)\text{OOC}(\text{CH}_3)_3-$ from PtBMA blocks), 1.41 (s, $-\text{C}(\text{CH}_3)_3$ from PtBMA blocks) and 1.56-1.83 (*br, m*, $-\text{CH}_2\text{C}(\text{CH}_3)\text{OOC}(\text{CH}_3)_3-$ from PtBMA blocks), revealing that the *t*BMA monomer has polymerized to PtBMA_2 -*b*-HTPB-*b*- PtBMA_2 block copolymers.

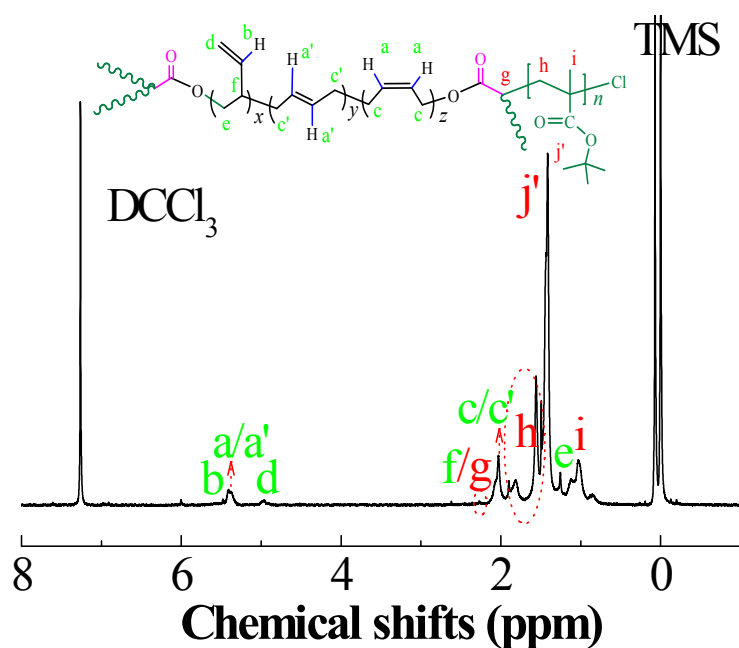


Figure S2 ^1H NMR spectra of a representative PtBMA_2 -*b*-HTPB-*b*- PtBMA_2 block copolymer.

2. Characterization of the unepoxidized PMAA₂-*b*-HTPB-*b*-PMAA₂ copolymers

Table 1 Sample codes and structural parameters of the PMAA₂-*b*-HTPB-*b*-PMAA₂ copolymers before epoxidization.

Codes	[Initiator]/ [<i>t</i> BMA] ^a	M _n by NMR	M _n by <i>SEC</i>	M _w	PDI	Percentage of acidolysis, %	Unit ratios of butadiene to MAA
AE0	1:150	9870	14930	16720	1.12	88	21/44
BE0	1:300	12960	21360	23280	1.09	87	21/62

^a Mole ratios of [Cl₂-HTPB-Cl₂] to [*t*BMA]. The copolymers with mole ratios of [Cl₂-HTPB-Cl₂]/[*t*BMA] of 1:150 and 1:300 are named P(*t*BMA₂₂)₂-*b*-HTPB-*b*-P(*t*BMA₂₂)₂, and P(*t*BMA₃₁)₂-*b*-HTPB-*b*-P(*t*BMA₃₁)₂, or “Polym A” and “Polym B”, respectively.