Supporting Information

4/6-herto-arm and 4/6-mikto-arm star-shaped block polymeric drug-loaded micelles and their pH-responsive controlled release properties: A dissipative particle dynamics simulation

Wensheng Wu,[1] Peng Yi,[2,3] Jing Zhang,[4] Yingchao Cheng,[1] Zhiwei Li,[1] Xiangying Hao,[1] Quan Chen*,[2,3]

1. *School of Environmental and Chemical Engineering, Zhaoqing University, Zhaoqing, 526061, Guangdong, China;*
2. *Faculty of Environmental Science & Engineering, Kunming University of Science & Technology, Kunming, 650500, Yunnan, China;*
3. *Yunnan Provincial Key Lab of Soil Carbon Sequestration and Pollution Control in Soils, Kunming, 650500, Yunnan, China;*
4. *School of Chemistry and Chemical Engineering, South China University of Technology, Guangzhou, 510640, China.*

1.1 Specific block ratios of the polymers

The five polymers of 4-mikto-arm are: $(PCL_{24})_2(PDEA_{10}$-*b*-$PPEGMA_{19})_2$, $(PCL_{24})_2(PDEA_{16}$-*b*-$PPEGMA_{19})_2$, $(PCL_{24})_2(PDEA_{22}$-*b*-$PPEGMA_{19})_2$, $(PCL_{24})_2(PDEA_{28}$-*b*-$PPEGMA_{19})_2$, and $(PCL_{24})_2(PDEA_{34}$-*b*-$PPEGMA_{19})_2$; The five polymers of 6-mikto-arm are: $(PCL_{16})_3(PDEA_8$-*b*-$PPEGMA_{10})_3$, $(PCL_{16})_3(PDEA_{14}$-*b*-$PPEGMA_{10})_3$, $(PCL_{16})_3(PDEA_{20}$-*b*-$PPEGMA_{10})_3$, $(PCL_{16})_3(PDEA_{26}$-*b*-$PPEGMA_{10})_3$ and $(PCL_{16})_3(PDEA_{32}$-*b*-$PPEGMA_{10})_3$; The five polymers of 4-unifrom-arm are: $(PCL_{22}$-$PDEA_{25}$-*b*-$PPEGMA_5)_4$, $(PCL_{22}$-$PDEA_{31}$-*b*-$PPEGMA_5)_4$, $(PCL_{22}$-$PDEA_{37}$-*b*-$PPEGMA_5)_4$, $(PCL_{22}$-$PDEA_{43}$-*b*-$PPEGMA_5)_4$, $(PCL_{22}$-$PDEA_{49}$-*b*-$PPEGMA_5)_4$; The five polymers of 6-uniform-arm are: $(PCL_{18}$-$PDEA_9$-*b*-$PPEGMA_4)_6$, $(PCL_{18}$-$PDEA_{15}$-*b*-$PPEGMA_4)_6$, $(PCL_{18}$-$PDEA_{21}$-*b*-$PPEGMA_4)_6$, $(PCL_{18}$-$PDEA_{27}$-*b*-$PPEGMA_4)_6$, $(PCL_{18}$-$PDEA_{33}$-*b*-$PPEGMA_4)_6$. For convenience of representation, the 20 polymers

after the increase and decrease of DEA block length are expressed as: 4M-6DEA, 4M, 4M+6DEA, 4M+12DEA, 4M+18DEA, 6M-6DEA, 6M, 6M+6DEA, 6M+12DEA, 6M+18DEA, 4H, 4H+6DEA, 4H+12DEA, 4H+18DEA, 4H+24DEA, 6H, 6H+6DEA, 6H+12DEA, 6H+18DEA, 6H+24DEA.

1.2 Calculation method of the interaction parameters between the beads under weakly acidic conditions

The pH-sensitive mainly depends on the protonation of the protonated group in the environment. The drug release behavior of the drug-loaded micelles in the acidic condition of cancer cells using the same pH environment simulation as the actual experiment (pH=5.0). The degree of protonation of the pH response depends on the pK_a value of the pH-sensitive group itself and the pH environment in which it is located. The degree of protonation of the group is calculated by the Henderson-Hasselbalch formula to obtain a pH-sensitive group in an environment of pH 5.0. The degree of protonation of the group is 100%. The interaction parameters between the beads calculated from the degree of protonation are shown in **Table S1**. The simulation time for the drug release process of the simulated drug-loaded micelles was set to 100000 steps, the time integration step was 0.05 ns, the elastic constant C was set to 4.0, and the dissipation force parameter γ was set to 4.5.

Table S1 Interaction parameters between the beads under weakly acid conditions (pH=5.0)

	CL	Center	D1	D2	D3	DEAH	MAA1	MAA2	PEG	Water
CL	25.00									
Center	33.32	25.00								
D1	27.46	50.19	25.00							
D2	26.24	31.58	26.54	25.00						
D3	33.42	67.16	29.48	28.54	25.00					
DEAH	92.20	27.39	111.11	112.04	79.37	25.00				
MAA1	25.01	38.96	26.91	25.84	31.50	34.60	25.00			
MAA2	25.01	38.96	26.91	25.84	31.50	34.60	25.00	25.00		

PEG	39.01	50.49	26.05	25.00	27.50	22.18	25.54	25.54	25.00	
Water	114.16	111.62	57.97	27.03	21.97	11.43	61.50	61.50	28.10	25.00

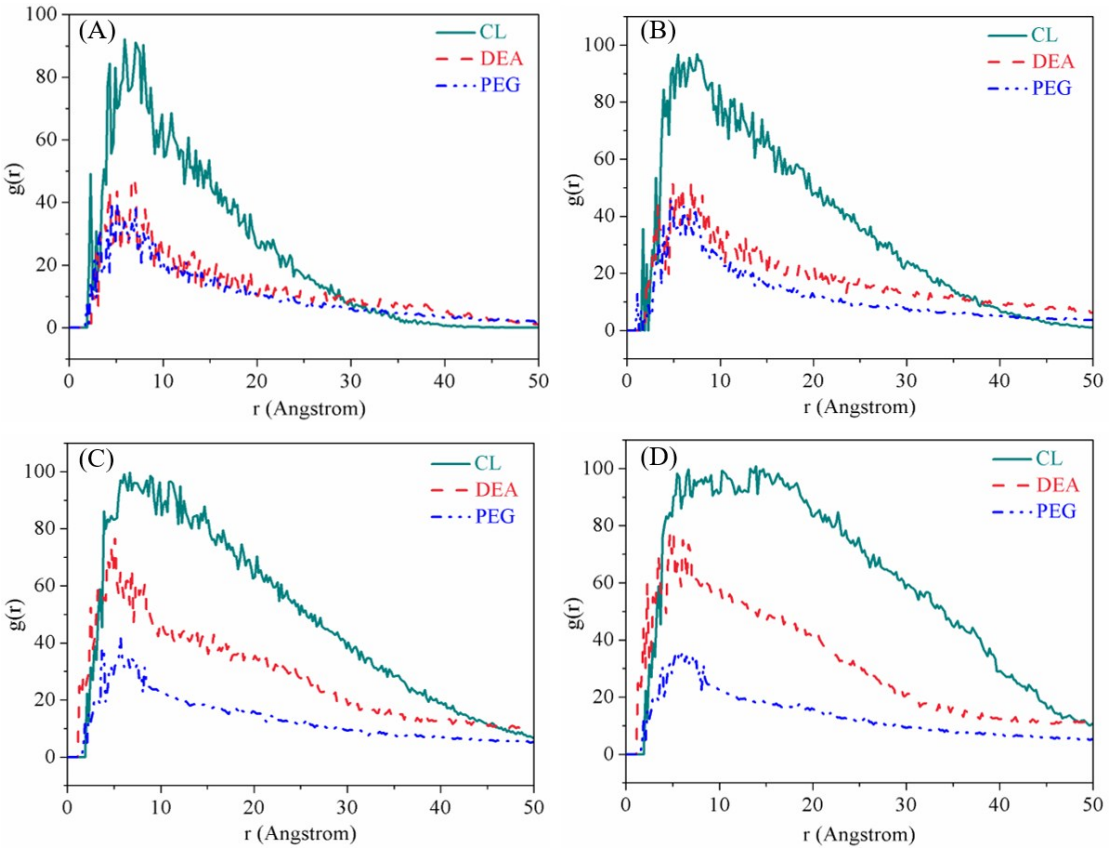

Figure S1 Radial distribution function curves of the boxes with different volume (A:150 Å^3; B:200 Å^3; C:250 Å^3; D:300 Å^3)

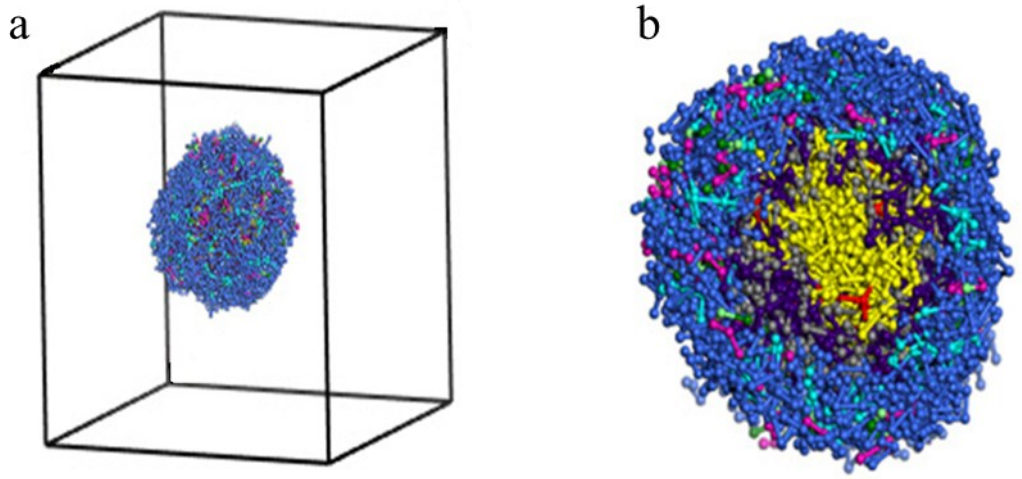

Figure S2 Micellar structure of the polymer 6M and its cross-sectional view

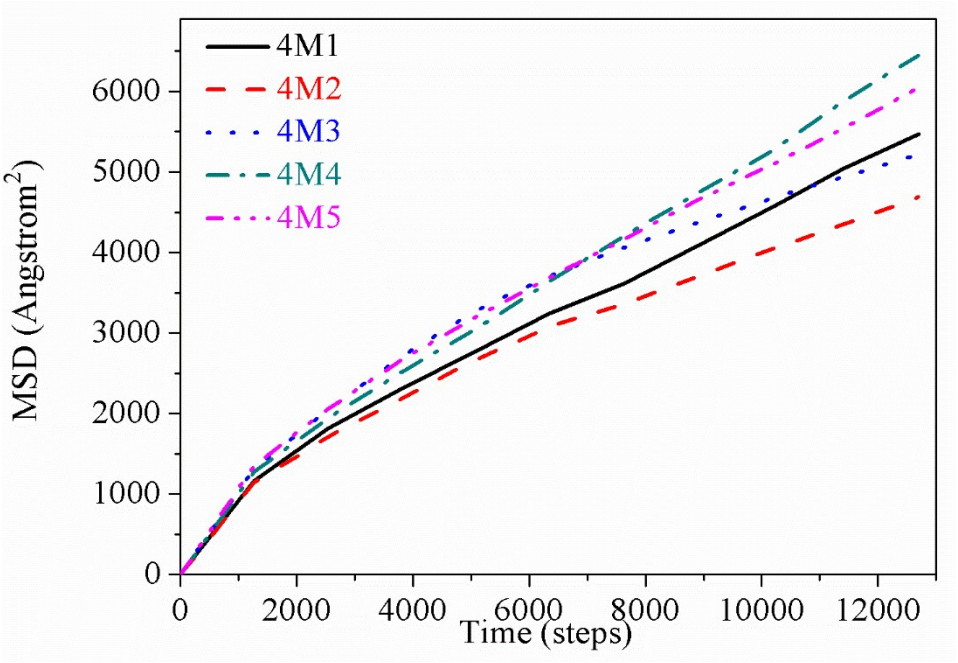

Figure S3 Mean square displacement curves of the DEAH block in 4-mikto-arm polymeric drug-loaded micelle system