Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Amphiphilic Hyperbranched Polyethyleneimine for Highly Efficient Oil-Water Separation

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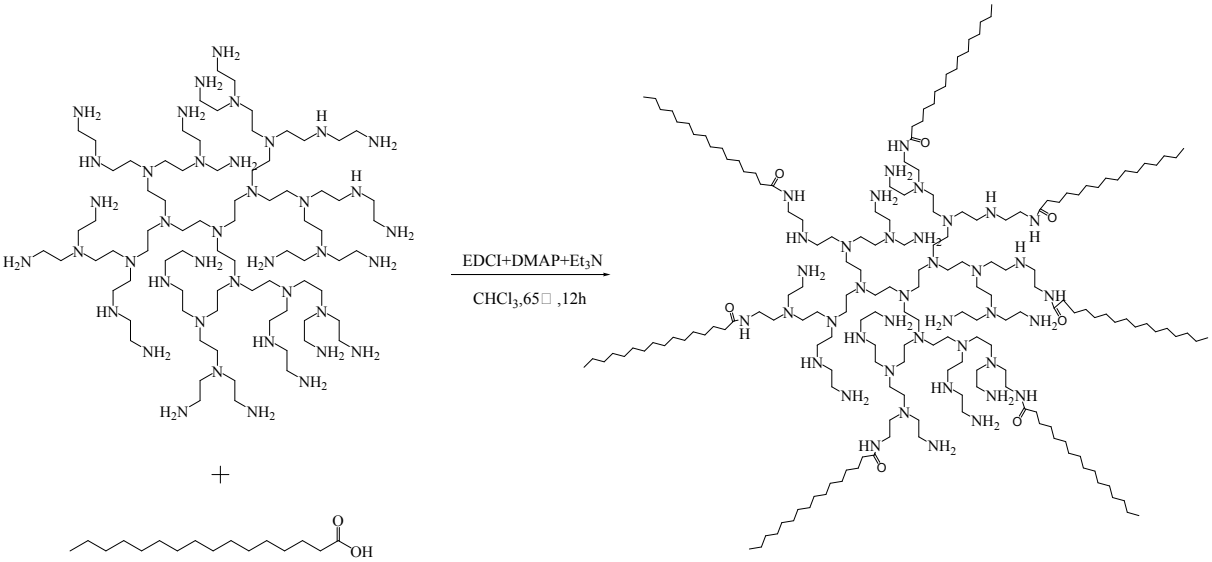

Scheme S1 Hyperbranched polyethyleneimine (HPEI) with palmitic acid to synthesize functional HPEI-g-C_{16}.

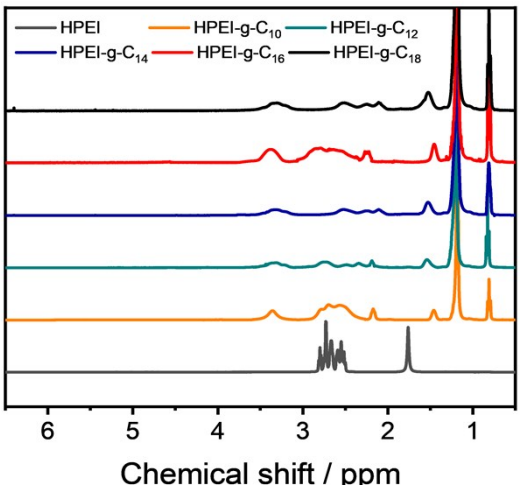

Fig. S1 ^{1}H NMR spectra of HPEI and HPEI-g-C_n.

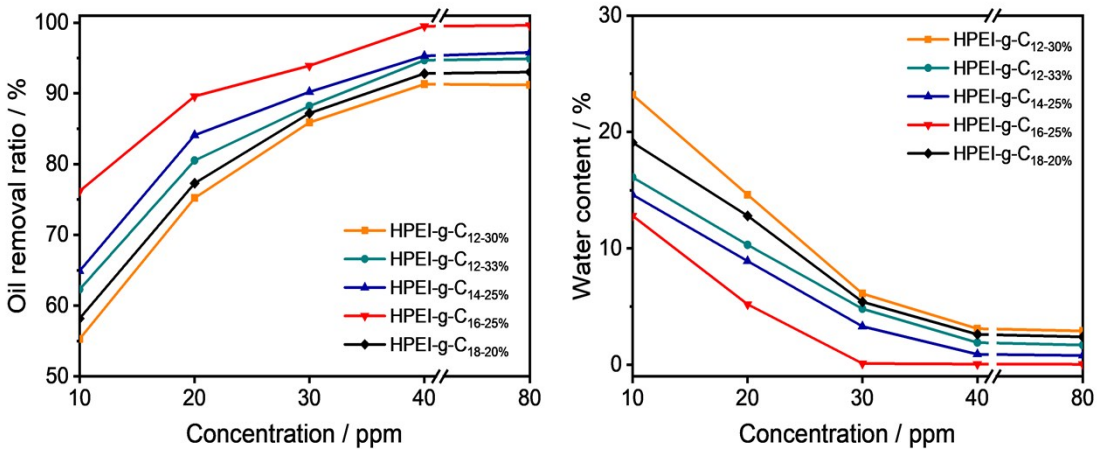

Fig. S2 Demulsification effect of HPEI-g-C_n demulsifiers on emulsion containing 10 % oil after setting for 40 min at 60 ºC.

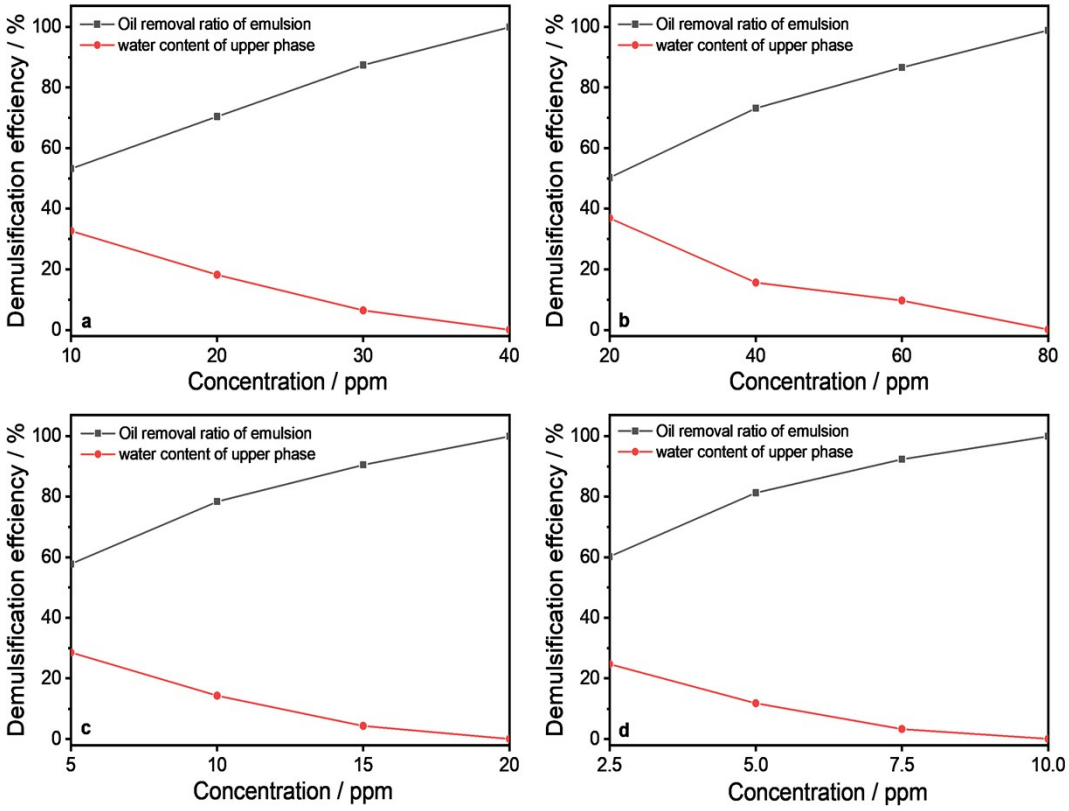

Fig. S3 Demulsification effect of HPEI-g-$C_{16\text{-}25\%}$ demulsifier on (a) crude oil emulsions with 50.2 % water after setting for 30 min, (b) WACO emulsions after setting for 40 min, (c) toluene/ water emulsions with 0.2 % asphaltene after setting for 3min and (d) simulative emulsions with 0.1 % commercial oil after setting for 5 min.

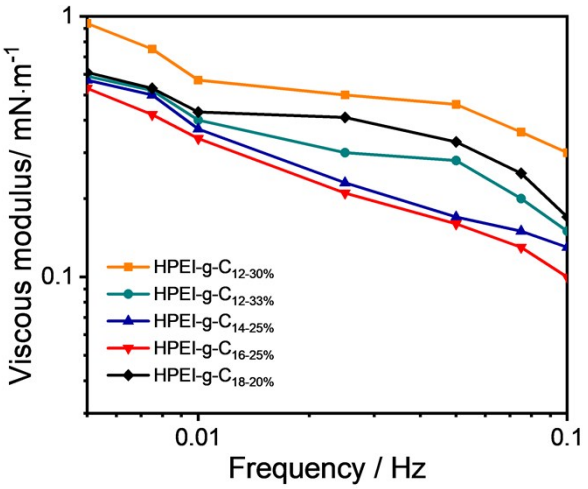

Fig. S4 Effect of the oscillating frequency on viscous modulus of oil-water interface containing Span 80 and Tween 80 with 40 ppm HPEI-g-C_n demulsifiers.

Table S1 Characterization of synthesized HPEI and HPEI-g-C_n samples.

Polymer	*DS* / % [a]	T_m / °C [b]	ΔH_m / J·g^{-1} [c]	Size / nm [d]
HPEI	—	—	—	5.92
HPEI-g-$C_{10\text{-}25\%}$	25.2	13.9	11.6	6.12
HPEI-g-$C_{12\text{-}25\%}$	25.4	19.8	15.4	6.31
HPEI-g-$C_{12\text{-}30\%}$	29.7	21.2	16.9	6.43
HPEI-g-$C_{12\text{-}33\%}$	32.6	24.9	17.2	6.57
HPEI-g-$C_{14\text{-}25\%}$	25.2	26.7	18.6	6.82
HPEI-g-$C_{16\text{-}5\%}$	5.4	31.7	13.2	6.55
HPEI-g-$C_{16\text{-}10\%}$	9.8	32.5	17.2	6.77
HPEI-g-$C_{16\text{-}15\%}$	15.3	33.5	21.7	6.93
HPEI-g-$C_{16\text{-}20\%}$	19.6	34.2	23.6	7.13
HPEI-g-$C_{16\text{-}25\%}$	24.7	36.8	25.7	7.21
HPEI-g-$C_{16\text{-}30\%}$	29.6	37.9	27.9	7.38
HPEI-g-$C_{16\text{-}33\%}$	33.4	39.7	34.8	7.59
HPEI-g-$C_{18\text{-}20\%}$	20.5	63.7	43.6	8.29
HPEI-g-$C_{18\text{-}25\%}$	25.2	64.3	46.3	8.73

[a] DS is the grafting ratio of alkyl chain determined by ^{1}H NMR; [b] T_m and [c] ΔH_m are conducted by DSC;

[d] Size is measured by DLS, Z-average size.

Table S2 Characteristics of produced emulsions from two China oilfields

Parameter	value	Parameter	value
Jiangsu Oilfield			
Oil content	9.7 %	Salinity	5435.5 mg L^{-1}
pH	9.2	Mg^{2+}	8.6 mg L^{-1}
Density at 293 K	0.8817 g cm^{-3}	Ca^{2+}	36.4 mg L^{-1}
Viscocity at 329 K	58.3 mPa s	$K^+ + Na^+$	2073.6 mg L^{-1}
Asphaltene	1.2 %	Cl^-	1822.3 mg L^{-1}
Resin	14.83 %	HCO_3^-	1725.5 mg L^{-1}
Liaohe Oilfield			
Oil content	13.4 %	Salinity	8608.2 mg L^{-1}
pH	8.7	Mg^{2+}	2.5 mg L^{-1}
Density at 293 K	0.9864 g cm^{-3}	Ca^{2+}	19.3 mg L^{-1}
Viscocity at 329 K	321 mPa s	$K^+ + Na^+$	3621.2 mg L^{-1}
Asphaltene	3.2 %	Cl^-	5520.7 mg L^{-1}
Resin	35.83 %	HCO_3^-	1061.2 mg L^{-1}