Supplementary Information

Synthesis of PAMAM (G2.0)-DBM. PAMAM (G2.0)-DBM was prepared by two steps. In the first step, Michael addition was applied to generate dimethylamino half terminated G0.5 (10g, 0.0083mol) was dropwise addition of 3-dimethylamino propylamine (3.4g, 0.0332mol) in methanol at 0 ℃ under nitrogen atmosphere, and the reaction was conducted at 40 ℃ for 48 h. Then the mixture was preferentially cooling to 0 ℃ which EDA (2g, 0.0332mol) was added drop wisely into under nitrogen atmosphere, and the rection was further conducted at 25℃ for 48 h. Subsequently, the resulting material was distilled repetitively under reduced pressure to remove excess methanol and EDA, whereby G 1.0 bearing four dimethylamino terminals was obtained (labeled PAMAM (G1.0)-DMAPA).

In the second step, a tetrameric quaternary ammonium was introduced into PAMAM (G1.0)-DMAPA by dropwise addition of DBM (5g, 0.02mol) to PAMAM (G1.0)-DMAPA (8g, 0.005mol) in chloroform at 25℃ under nitrogen atmosphere. Subsequently, the reaction was conducted at 60℃ for 72h. The resulting solution was washed with methanol/hexane (1/1 v/v) to remove excess DBM, then it further distilled repetitively under reduced pressure to remove excess methanol, hexane and chloroform, whereby G1.0 bearing tetrameric quaternary ammonium terminals was yielded (labeled PAMAM (G1.0)-DBM).

Synthesis of PAMAM (G1.0)-DBM and PAMAM (G2.0)-DBM monomers. PAMAM (G1.0)-DBM 3.3g（0.0013mol）was gradually added into 20ml dimethylsulfoxide (DMSO), the mixture was dropwise addition of MAH (2g, 0.0067mol) in DMSO under nitrogen atmosphere. Then the ring-opening reaction was conducted at 70℃ for more than 6h. Consequently, the product was cooling to room temperature, filtered to obtain the precipitate. The resulting material was washed with methanol in excess dried in a vacuum 24h, whereby PAMAM (G1.0)-DBM monomer was yielded (labeled PAMAM (G1.0)-DBMF). For the synthesis of PAMAM (G2.0)-DBMF, the procedure was repeated as mentioned above, noted that PAMAM-G1.5 was starved-feed.

Synthesis of Amphoteric hyperbranched polymers (AMHPMs). A 100 ml three-necked round-bottom flask is equipped with a mechanical stirrer, nitrogen inlet, and a thermometer. 0.5g PAMAM (G1.0)-DBMF or 0.65g PAMAM (G2.0)-DBMF, 8.25g AM, and 2.25g AA dissolved in a certain volume of deionized water. The pH of the mixture solution was tuned to 7.0-7.2 utilizing 1mol/L sodium hydroxide solution. Then some volumes of deionized water was added to obtain 9.5%-10.0% mass concentration for total monomer. The procedure of synthesis and purification of polymer is consistent with the method in the literature.[23] Here, two polymers are abbreviated as AMHPM-1 and AMHPM-2, respectively, which are consistent with the comonomer PAMAM (G1.0)-DBMF and PAMAM (G2.0)-DBMF.

The density of grafted arm of poly (AM-NaAA). Polymer density of grafted arm of hydrophilic chain poly (AM-NaAA) can be calculated by the equation:[26]

$$\rho = \frac{M_{mon}}{v_{mon} N_{Av}} \tag{1}$$

Where, v_{mon} is the occupied volume of a single chemical monomer, v_{mon} ≈100Å^3; N_{Av} is the Avogadro number; $v_{mon}N_{Av}$ is monomer molar volume; $v_{mon}N_{Av}$ ≈60cm^3; M_{mon} is average monomer molar mass; ρ is the polymer density.

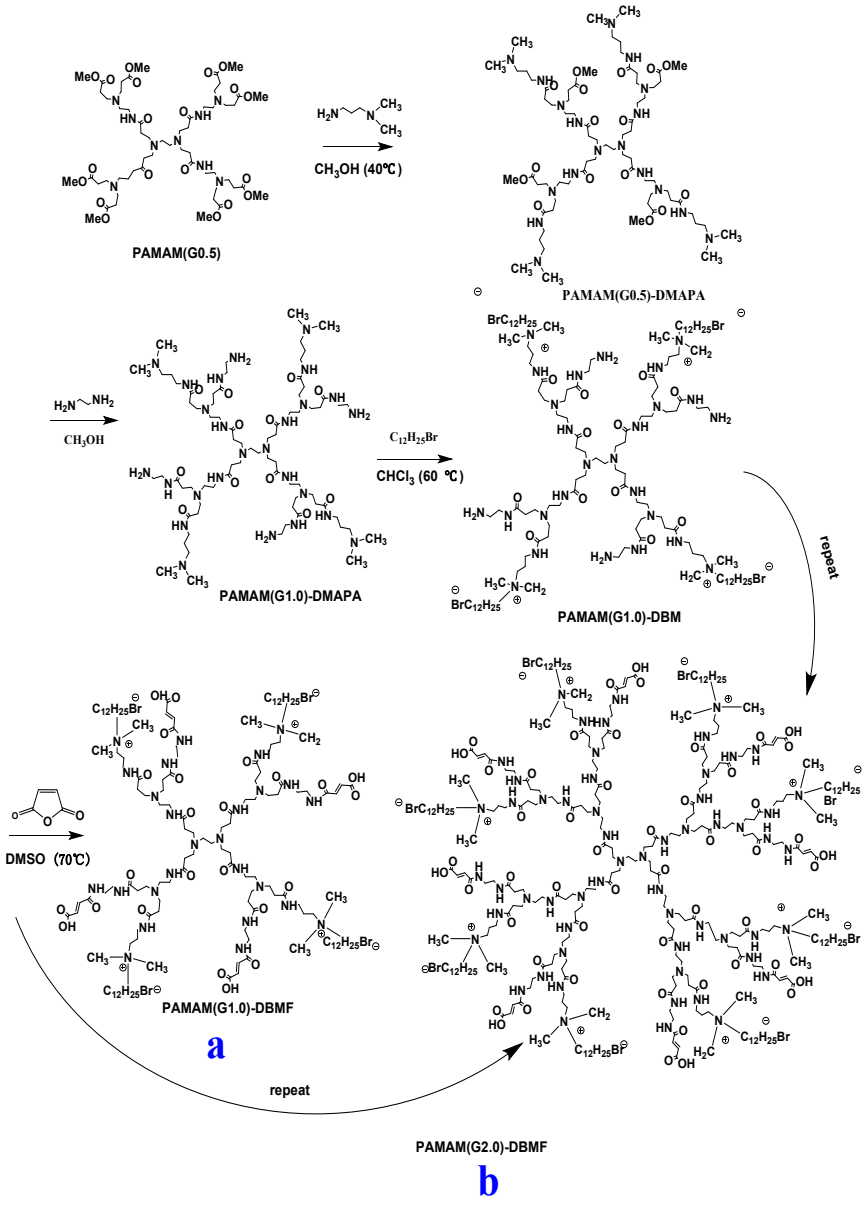


Fig. S1 Procedure of Synthesis of amphoteric hyperbranched monomers.

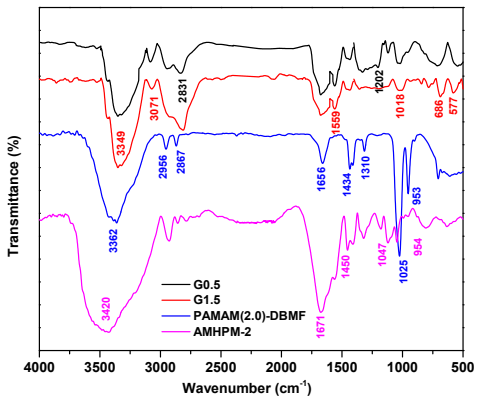


Fig. S2 IR spectrum of G0.5, G1.5, PAMAM(2.0)-DBMF and AMHPM-2.

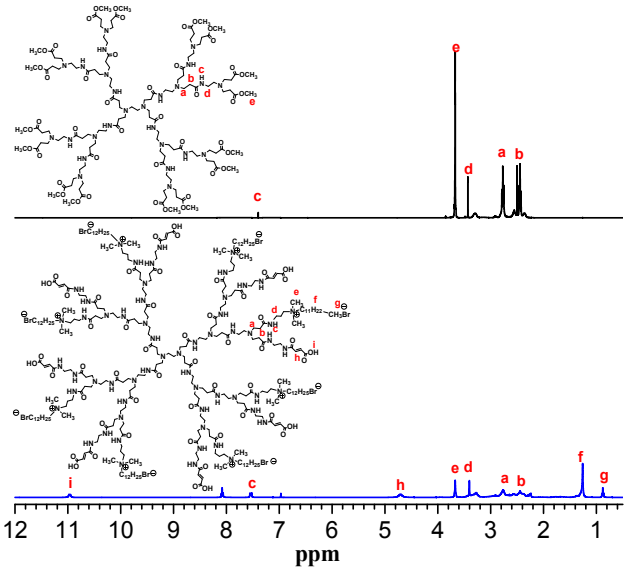
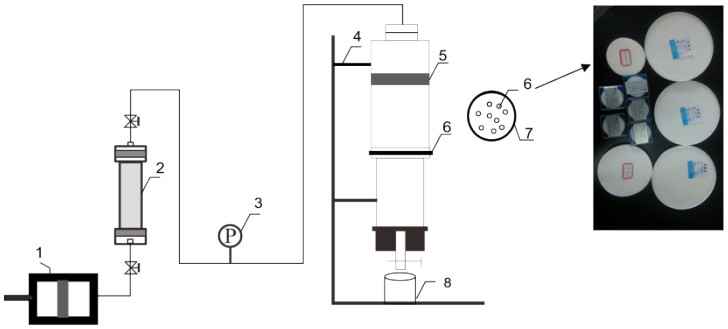


Fig. S3 ^{1}H NMR spectrum of G1.5 and PAMAM(2.0)-DBMF (the solution concentration = 50 mg/L,T= 25℃).



1-ISCO pump 2-intermediate container 3-precision pressure instrument 4-iron stand
5- container 6-millipore filter 7-packing washer 8-production collector

Fig. S4 Scheme of the experimental setup used to measure the H_c of polymer solution.

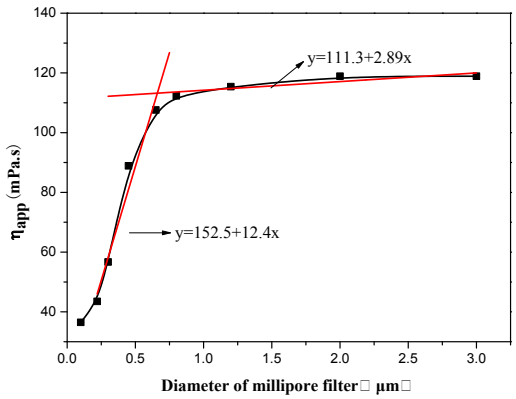


Fig. S5 Scheme of measurement of H_c for polymer samples by using millipore filter method.