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SUPPLEMENTARY MATERIAL

Rheological properties and salt resistance of a hydrophobically associating polyacrylamide

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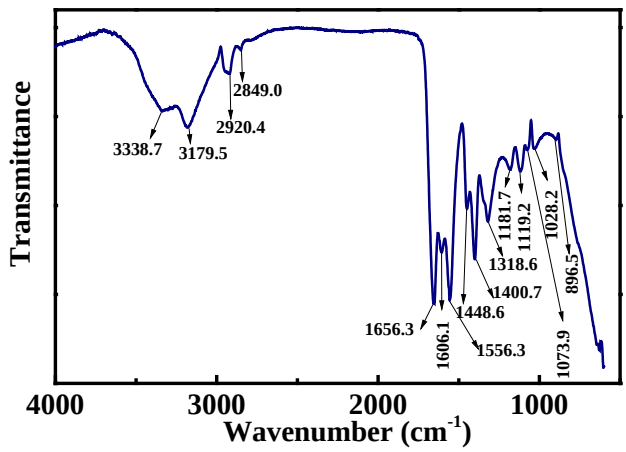

Fig. S1 FT-IR spectrum of HA-PAM.

Wavenumber (cm^{-1})	Vibration	Group
3179.5	N-H stretching	$-NH_2$, -NH-
1400.7, 1318.6, 1181.7, 1119.2, 1028.2	S=O stretching	$-SO_3^-$
1556.3, 1606.1, 1656.3	C=O stretching	$-CONH_2$, $-COO^-$
2920.4, 2849.0	C-H stretching	$-CH_3$, $-CH_2$
1448.6, 1400.7	C-H bending	$-CH_3$, $-CH_2$
1181.7, 1119.2	C-N stretching	$-CH_2-N^+$
1400.7	C-N stretching	$-CONH_2$
1448.6	C-H stretching	$-CH_3-N^+$, $-CH_2-N^+$
896.5,1073.9	C-C stretching	-C-C
3338.7, 1606.1	OH stretching and bending	H_2O

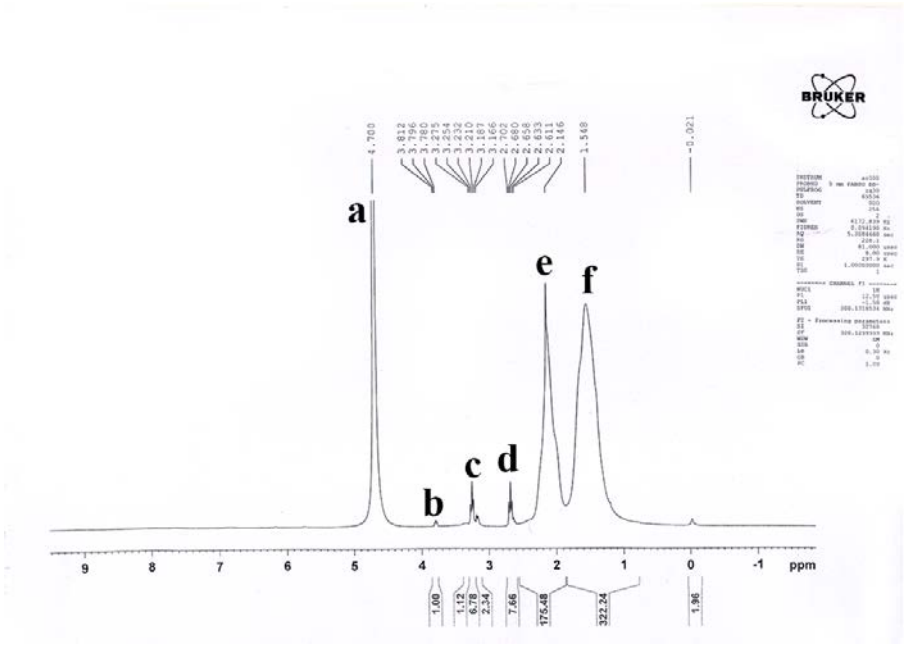

Fig. S2 ^{1}HNMR spectrum of HA-PAM.

symbol	δ (ppm)	Group
a	4.7	D_2O
b	3.812, 3.796, 3.780	2H (-CH_2 connected with N^+ and -$(CH_2)_{14}$-CH_3)
c	3.254	2H (-CH_2 of AMPS side chain)
	3.232	3H (-CH_3 connected with N^+)
	3.275, 3.21, 3.187, 3.166	2H/1H (-CH_2 or -CH on hydrophobic monomer main chain)
d	2.702–2.611	1H (-CH of AMPS and sodium acrylate chain)
e	2.146	1H (-CH of AM (acrylamide) chain)
f	1.548	2H (-CH_2 of AM chain), 3H (-CH_3 of AMPS side chain)

The active hydrogen of 2H (NH_2-CO) of AM and 1H (NH-CO) of AMPS (5.0–9.0) was exchanged by D_2O. The peak is too low to be detected.

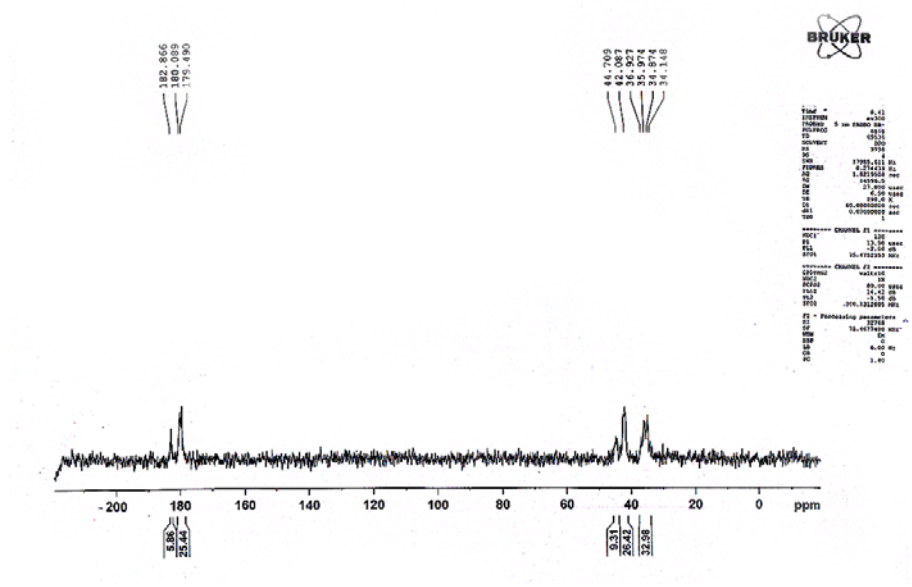

Fig. S3 Schematic molecular structure and ^{13}CNMR spectrum of HA-PAM.

δ (ppm) C=O in AM, AMPS and sodium acrylate monomers, 179.49, 180.09, 182.90; δ (ppm) CH, CH_2 and CH_3 connected with aliphatic carbon, 34.15, 34.87, 35.97, 36.93, 42.09, 44.71.

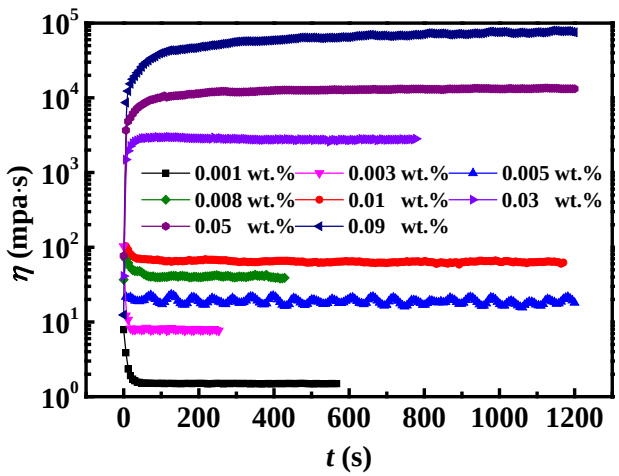

Fig. S4 Change of viscosity with creep time for HA-PAM solutions at various concentrations.

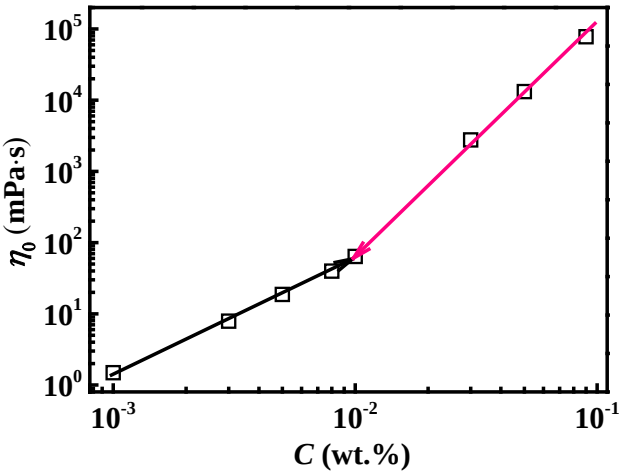

Fig. S5 Zero-shear viscosity of HA-PAM solutions at various concentrations (C).

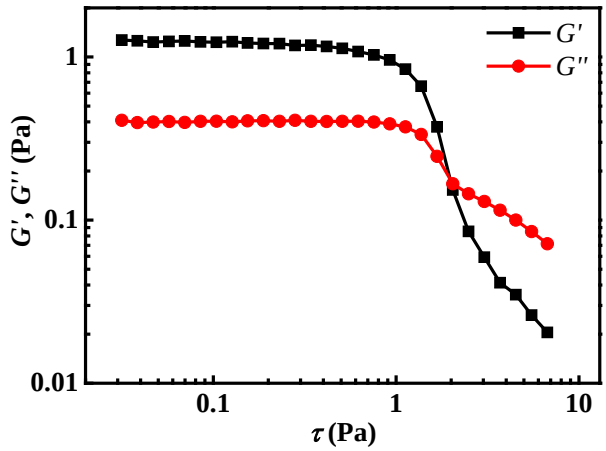

Fig. S6 Dynamic moduli (G', G'') as a function of the shear stress (τ) at frequency of 0.5 Hz for 0.1% HA-PAM solution.

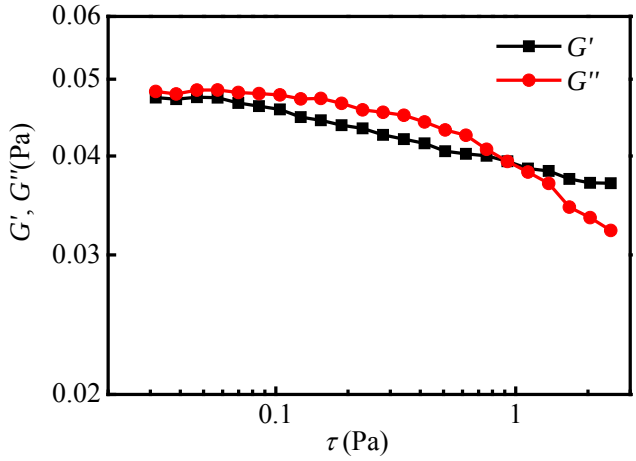

Fig. S7 Dynamic modulus (*G'*, *G''*) as a function of shear stress at frequency of 0.5 Hz for 0.1% HA-PAM solution containing 3% NaCl.

Table S1 Fitting results by a power law model for viscosity curves of 0.1% HA-PAM solutions without NaCl and with NaCl concentration of 0.1%. A, B, C are the three sections of the fitting curve of 0.1 wt.% HA-PAM and 0.1 wt.% NaCl solution.

Equation		$\eta = k\dot{\gamma}^{n-1}$		
Samples		k	n	Adj. R^2
HA-PAM		0.817	0.208	0.9999
HA-PAM	A	0.364	0.111	0.9914
+	B	0.426	0.298	0.9998
0.1 wt. % NaCl	C	0.429	0.354	0.9998

Table S2 Change of root mean square end-to-end distance (RMS) with shear rate.

Shear Rate	0	0.001	0.002	0.003	0.004	0.005
RMS	15.077	16.986	21.107	20.858	27.762	36.7111

Table S3 Comparison of rheological parameters between 0.1% HA-PAM and 0.1% partially hydrolyzed polyacrylamide (HPAM) solutions.

Samples	C_{NaCl}	C_{CaCl2}	η^a **(mPa·s)**	G'^b **(Pa)**	G''^b **(Pa)**	$\tan^b(\delta)$	η^c **retention**
0.1% HA-PAM	**0**	**/**	**132.6**	**1.17**	**0.58**	**0.49**	**/**
	3%	**/**	**63.1**	**0.077**	**0.073**	**0.94**	**47.37%**
	/	**0.08%**	**37.1**	**0.039**	**0.068**	**1.74**	**27.92%**
0.1% HPAM	**0**	**/**	**114.3**	**0.42**	**0.30**	**0.73**	**/**
	3%	**/**	**6.7**	**2.87×10^{-6}**	**1.50×10^{-3}**	**520.87**	**5.88%**
	/	**0.08%**	**10.2**	**5.42×10^{-5}**	**2.42×10^{-3}**	**44.75**	**8.88%**

[a] viscosity at 10 s^{-1};

[b] dynamic modulus at frequency of 1 Hz in the linear viscoelastic region;

[c] viscosity ratio of solution containing electrolyte to that of pure solution.

Table S4 The fitting results of viscosity *vs.* temperature curves by a Arrhenius-like equation ($\eta = A \cdot \exp(E_a/RT)$) for HA-PAM.

Line	A	E_a (kJ/mol)	Adj. R^2
1	1827.54	2.47	0.9767
2	452.01	6.06	0.9907

Table S5 The fitting results of viscosity *vs.* temperature curves by a Arrhenius-like ($\eta = A \cdot \exp(E_a/RT)$) equation for HA-PAM with 0.2 wt. %NaCl.

Line	A	E_a (kJ/mol)	Adj. R^2
3	6.29	9.31	0.8166
4	0.04	22.05	0.9987