Supplementary Files 1

Single-Factor test:

DS for a series of material liquid ratios.

Reaction time (h)	DS	SD
6:1	0.171	0.015
3:1	0.212	0.021
1:1	0.384	0.017
1:3	0.495	0.023
1:6	0.433	0.019

DS for a series of reaction times.

Reaction time (h)	DS	SD
12	0.121	0.017
24	0.393	0.023
36	0.456	0.02
48	0.518	0.015
60	0.51	0.023

DS for a series of reaction temperatures.

Reaction temperature (°C)	DS	SD
23	0.193	0.023
30	0.475	0.019
37	0.52	0.015
44	0.429	0.017
51	0.244	0.018

DS for a series of amount of acetic anhydride added.

Amount of acetic anhydride added (mL)	DS	SD
1	0.132	0.03
2	0.334	0.017
3	0.416	0.02
4	0.492	0.016
5	0.431	0.015

Response Surface Optimization

Response surface test factor level and number of degree of acetyl substitution in AMPS.

Variable	Code		Levels		
	Uncoded	Coded	−1	0	1
Reaction time（h）	X_1	A	36	48	60
Reaction temperature(°C)	X_2	B	30	37	44
Amount of acetic anhydride added（mL）	X_3	C	3	4	5

Response surface experimental design of degree of acetyl substitution in AMPS.

	A	B	C	DS	
				Actual Value	Predicted Value
1	−1	−1	0	0.43 ± 0.04	0.43
2	1	−1	0	0.44 ± 0.05	0.45
3	−1	1	0	0.4 ± 0.03	0.39
4	1	1	0	0.45 ± 0.04	0.45
5	−1	0	−1	0.49 ± 0.02	0.49
6	1	0	−1	0.52 ± 0.04	0.51
7	−1	0	1	0.43 ± 0.03	0.44
8	1	0	1	0.5 ± 0.04	0.50
9	0	−1	−1	0.43 ± 0.05	0.43
10	0	1	−1	0.44 ± 0.04	0.45
11	0	−1	1	0.44 ± 0.03	0.43
12	0	1	1	0.39 ± 0.04	0.39
13	0	0	0	0.54 ± 0.05	0.54
14	0	0	0	0.53 ± 0.03	0.54
15	0	0	0	0.53 ± 0.04	0.54
16	0	0	0	0.54 ± 0.03	0.54
17	0	0	0	0.52 ± 0.04	0.54

The predicted value of DS can be calculated by the following formula:

$$DS = 0.54 + 0.02 \times A - 7.5 \times 10^{-3} \times B - 0.015 \times C + 0.01 \times A \times B + 0.01 \times A \times C - 0.015 \times B \times C - 0.025 \times A^2 - 0.085 \times B^2 - 0.03 \times C^2.$$

ANOVA analysis of degree of acetyl substitution in AMPS.

Source	Sum of Squares	df	Mean Square	F-value	P-value
Model	3.200×10^{-3}	9	5.181×10^{-3}	79.05	<0.0001
A	4.500×10^{-4}	1	3.200×10^{-3}	48.82	0.0002
B	1.800×10^{-3}	1	4.500×10^{-4}	6.87	0.0344
C	4.000×10^{-4}	1	1.800×10^{-3}	27.46	0.0012
AB	4.000×10^{-4}	1	4.000×10^{-4}	6.10	0.0428
AC	9.000×10^{-4}	1	4.000×10^{-4}	6.10	0.0428
BC	2.611×10^{-3}	1	9.000×10^{-4}	13.73	0.0076
A^2	0.030	1	2.611×10^{-3}	39.83	0.0004
B^2	3.764×10^{-3}	1	0.030	463.05	<0.0001
C^2	3.200×10^{-3}	1	3.764×10^{-3}	57.43	0.0001
Lack of Fit	4.500×10^{-4}	3	1.500×10^{-4}	68.18	0.0580