Thiosemicarbazone-modified cellulose: synthesis, characterization and adsorption studies on Cu(II) removal

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Table S1. Error in titration method of buffer solution

	$Na_2S_2O_3$ Volume	Average V	mmol CHO	Average mmol	CV
AcOH					
Blank	0.95±0.072	0.98±0.072	0.52±0.035	0.50±0.035	2.8284
	1.00±0.072				
	1.00±0.072		0.50±0.035		
Sample	0.70±0.072	0.73±0.072			
	0.75±0.072		0.50±0.035		
	0.75±0.072				
H_2SO_4					
Blank	1.05±0.072	1.03±0.072	0.62±0.035	0.60±0.035	2.3570
	1.05±0.072				
	1.00±0.072		0.60±0.035		
Sample	0.75±0.072	0.73±0.072			
	0.75±0.072		0.60±0.035		
	0.70±0.072				
H_3PO_4					
Blank	1.00±0.072	1.02±0.072	0.60±0.043	0.59±0.043	2.9356
	1.05±0.072				
	1.05±0.072		0.60±0.043		
Sample	0.70±0.072	0.73±0.072			
	0.75±0.072		0.57±0.043		
	0.75±0.072				

Table S2. Error in UV-Vis method of buffer solution

	Optical density	Average OD	mmol CHO	Average mmol	CV
AcOH					
Blank	0.5703±0.0006	0.5702±0.0006	0.58±0.030	0.59±0.030	2.0758
	0.5700±0.0006				
	0.5705±0.0006		0.60±0.030		
Sample	0.5010±0.0072	0.5042±0.0072			
	0.5067±0.0072		0.60±0.030		
	0.5050±0.0072				
H_2SO_4					
Blank	0.5602±0.0104	0.5557±0.0104	0.58±0.025	0.58±0.025	1.7241
	0.5551±0.0104				
	0.5519±0.0104		0.59±0.025		
Sample	0.5011±0.0071	0.5041±0.0071			
	0.5045±0.0071		0.59±0.025		
	0.5068±0.0071				
H_3PO_4					
Blank	0.5600±0.0070	0.5584±0.0070	0.55±0.065	0.52±0.065	5.0879
	0.5552±0.0070				
	0.5602±0.0070		0.50±0.065		
Sample	0.5040±0.0053	0.5064±0.0053			
	0.5082±0.0053		0.53±0.065		
	0.5069±0.0053				

Table S3. Fisher statistical of buffer solution

	Titration		**S^2**	**UV-Vis**		**S^2**	**F**
	mmol	**Average x**		**mmol**	**Average x**		
AcOH							
(1)	0.52±0.035	0.50±0.035	$4x10^{-4}$	0.58±0.030	0.59±0.030	$1.5x10^{-4}$	2.667
(2)	0.50±0.035			0.60±0.030			
(3)	0.50±0.035			0.60±0.030			
H_2SO_4							
(1)	0.62±0.035	0.60±0.035	$4x10^{-4}$	0.58±0.025	0.58±0.025	$1x10^{-4}$	4
(2)	0.60±0.035			0.59±0.025			
(3)	0.60±0.035			0.59±0.025			
H_3PO_4							
(1)	0.60±0.043	0.59±0.043	$3x10^{-4}$	0.55±0.065	0.52±0.065	$7x10^{-4}$	2.333
(2)	0.60±0.043			0.50±0.065			
(3)	0.57±0.043			0.53±0.065			

Table S4. Student statistical of buffer solution

Component	**Titration**	**UV-Vis**	$\mathbf{d_i}$	$\mathbf{d_i-d_{tb}}$	$\mathbf{(d_i-d_{tb})^2}$
AcOH	0.50	0.59	-0.09	-0.09	0.0081
H_2SO_4	0.60	0.58	0.02	0.02	0.0004
H_3PO_4	0.59	0.52	0.07	0.07	0.0049
			$\mathbf{d_{tb}} = 0$		**Total** = 0.0134
$\mathbf{s_d} = 0.0578$					
$\mathbf{t} = 0$					

Table S5. ANOVA two-factor with replication of buffer solution

Anova: Two-Factor With Replication				
SUMMARY	**AcOH**	**SO4**	**PP**	**Total**
Count	3	3	3	9
Sum	1.52	1.82	1.77	5.11
Average	0.506667	0.606667	0.59	0.567778
Variance	0.000133	0.000133	0.0003	0.002294
Count	3	3	3	9
Sum	1.78	1.76	1.58	5.12
Average	0.593333	0.586667	0.526667	0.568889
Variance	0.000133	3.33E-05	0.000633	0.001211
Total				
Count	6	6	6	
Sum	3.3	3.58	3.35	
Average	0.55	0.596667	0.558333	
Variance	0.00236	0.000187	0.001577	

ANOVA						
Source	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Method (A)	5.56E-06	1	5.56E-06	0.02439	0.878493	4.747225
Component (B)	0.007433	2	0.003717	0.31707	0.000378	3.885294
Interaction	0.017878	2	0.008939	0.22439	5.44E-06	3.885294
Error	0.002733	12	0.000228			
Total	0.02805	17				

Table S6. Error in titration method of pH buffer solution

	$Na_2S_2O_3$ Volume	Average V	mmol CHO	Average mmol	CV
pH = 2.0					
Blank	1.75±0.072	1.73±0.072	0.40±0.124	0.45±0.124	11.111
	1.75±0.072				
	1.70±0.072		0.50±0.124		
Sample	1.70±0.072	1.68±0.072			
	1.70±0.072		0.45±0.124		
	1.65±0.072				
pH = 2.5					
Blank	2.05±0.072	2.03±0.072	3.00±0.124	2.83±0.017	0.249
	2.05±0.072				
	2.00±0.072		3.05±0.124		
Sample	1.75±0.072	1.73±0.072			
	1.75±0.072		2.90±0.124		
	1.70±0.072				
pH = 3					
Blank	2.05±0.072	2.02±0.072	4.05±0.072	3.33±0.017	0.2123
	2.00±0.072				
	2.00±0.072		4.00±0.072		
Sample	1.60±0.000	1.60±0.000			
	1.60±0.000		4.00±0.072		
	1.60±0.000				
pH = 3.5					
Blank	1.90±0.144	1.96±0.144	2.00±0.189	1.98±0.189	3.863
	2.00±0.144				
	2.00±0.144		1.90±0.189		
Sample	1.70±0.124	1.75±0.124			
	1.75±0.124		2.05±0.189		
	1.70±0.017				
pH = 4					
Blank	1.80±0.144	1.73±0.144	1.10±0.144	1.03±0.144	5.619
	1.70±0.144				
	1.70±0.144		1.00±0.144		
Sample	1.65±0.072	1.62±0.072			

	1.60±0.072		1.00±0.144		
	1.60±0.072				
pH = 4.5					
Blank	1.70±0.143	1.73±0.143	0.95±0.072	0.98±0.072	2.975
	1.80±0.143				
	1.70±0.143		1.00±0.072		
Sample	1.65±0.124	1.65±0.124			
	1.70±0.124		1.00±0.072		
	1.60±0.124				
pH = 5					
Blank	1.80±0.072	1.78±0.072	0.00±0.215	0.05±0.215	17.320
	1.80±0.072				
	1.75±0.072		0.00±0.215		
Sample	1.80±0.144	1.76±0.144			
	1.80±0.144		0.15±0.215		
	1.70±0.035				

Table S7. Error in UV-Vis method of pH buffer solution

	Optical density	Average OD	mmol CHO	Average mmol	CV
pH = 2.0					
Blank	0.7282±0.0018	0.7285±0.0018	0.27±0.129	0.22±0.129	23.6188
	0.7280±0.0018				
	0.7294±0.0018		0.17±0.129		
Sample	0.7171±0.0050	0.7192±0.0050			
	0.7211±0.0050		0.24±0.129		
	0.7196±0.0050				
pH = 2.5					
Blank	0.8558±0.0172	0.8637±0.0172	2.23±0.238	2.33±0.238	4.1277
	0.8687±0.0172				
	0.8668±0.0172		2.42±0.238		
Sample	0.7849±0.0080	0.7886±0.0080			
	0.7901±0.0080		2.35±0.238		
	0.7909±0.0080				
pH = 3.0					
Blank	0.8274±0.0051	0.8293±0.0051	3.51±0.089	3.50±0.089	1.0301
	0.8291±0.0051				
	0.8315±0.0051		3.54±0.089		
Sample	0.6948±0.0076	0.6968±0.0076			
	0.6954±0.0076		3.47±0.089		
	0.7004±0.0076				
pH = 3.5					
Blank	0.7078±0.0051	0.7085±0.0051	2.97±0.209	2.92±0.209	2.8856
	0.7109±0.0051				
	0.7070±0.0051		2.98±0.209		
Sample	0.5878±0.0059	0.5902±0.0059			
	0.5903±0.0059		2.83±0.209		
	0.5926±0.0059				
pH = 4.0					
Blank	0.6450±0.0284	0.6582±0.0284	1.61±0.589	1.88±0.589	12.6378
	0.6642±0.0284				
	0.6655±0.0284		2.00±0.589		
Sample	0.5805±0.0039	0.5823±0.0039			

	0.5834±0.0039		2.04±0.589		
	0.5831±0.0039				
pH = 4.5					
Blank	0.7286±0.0022	0.7286±0.0022	1.40±0.127	1.36±0.127	3.7851
	0.7296±0.0022				
	0.7278±0.0022		1.37±0.127		
Sample	0.6720±0.0043	0.6738±0.0043			
	0.6742±0.0043		1.30±0.127		
	0.6754±0.0043				
pH = 5.0					
Blank	0.6934±0.0025	0.6924±0.0025	1.39±0.250	1.28±0.250	7.8708
	0.6914±0.0025				
	0.6926±0.0025		1.27±0.250		
Sample	0.6372±0.0092	0.6406±0.0092			
	0.6401±0.0092		1.19±0.250		
	0.6446±0.0092				

Table S8. Fisher statistical of pH buffer solution

	Titration		S^2	UV-Vis		S^2	F
	mmol	**Average x**		**mmol**	**Average x**		
pH = 2							
(1)	0.40±0.035	0.45±0.124	$2.5x10^{-3}$	0.27±0.129	0.22±0.129	$2.7x10^{-3}$	1.08
(2)	0.50±0.035			0.17±0.129			
(3)	0.45±0.035			0.24±0.129			
pH = 2.5							
(1)	3.00±0.124	3.00±0.124	$2.5x10^{-3}$	2.23±0.238	2.33±0.238	$9.25x10^{-3}$	3.7
(2)	3.05±0.124			2.42±0.238			
(3)	2.90±0.124			2.35±0.238			
pH = 3.0							
(1)	4.05±0.072	4.02±0.072	$8.5x10^{-4}$	3.51±0.089	3.50±0.089	$1.3x10^{-3}$	1.53
(2)	4.00±0.072			3.54±0.089			
(3)	4.00±0.072			3.47±0.089			
pH = 3.5							
(1)	2.00±0.189	1.98±0.189	$5.85x10^{-3}$	2.97±0.209	2.92±0.209	$7.1x10^{-3}$	1.21
(2)	1.90±0.189			2.98±0.209			
(3)	2.05±0.189			2.83±0.209			
pH = 4.0							
(1)	1.10±0.144	1.03±0.144	$3.35x10^{-3}$	1.61±0.589	1.88±0.589	0.05645	16.85
(2)	1.00±0.144			2.00±0.589			
(3)	1.00±0.144			2.04±0.589			
pH = 4.5							
(1)	0.95±0.072	0.98±0.072	$8.5x10^{-4}$	1.40±0.127	1.36±0.127	$2.65x10^{-3}$	3.11
(2)	1.00±0.072			1.37±0.127			
(3)	1.00±0.072			1.30±0.127			
pH = 5.0							
(1)	0.00±0.215	0.05±0.215	$7.5x10^{-3}$	1.39±0.250	1.28±0.250	0.01015	1.35
(2)	0.00±0.215			1.27±0.250			
(3)	0.15±0.215			1.19±0.250			

Table S9. Student statistical of pH buffer solution

pH	Titration	UV-Vis	di	di-dtb	$(di-dtb)^2$
2.0	0.45	0.22	0.23	0.512857	0.263022
2.5	3.00	2.33	0.67	0.952857	0.907937
3.0	4.02	3.50	0.52	0.802857	0.64458
3.5	1.98	2.92	-0.94	-0.65714	0.431837
4.0	1.03	1.88	-0.85	-0.56714	0.321651
4.5	0.98	1.36	-0.38	-0.09714	0.009437
5.0	0.05	1.28	-1.23	-0.94714	0.89708
			dtb = -0.28		**Total= 3.475543**
s_d = 0.761					
t = 0.9734					

Table S10. ANOVA two-factor with replication of pH buffer solution

Anova: Two-Factor With Replication								
SUMMARY	2	2.5	3	3.5	4	4.5	5	Total
Count	3	3	3	3	3	3	3	21
Sum	1.35	8.95	12.05	5.95	3.1	2.95	0.15	34.5
Average	0.45	2.983333	4.016667	1.983333	1.033333	0.983333	0.05	1.642857
Variance	0.0025	0.005833	0.000833	0.005833	0.003333	0.000833	0.0075	1.849821
Count	3	3	3	3	3	3	3	21
Sum	0.68	7	10.52	8.78	5.65	4.07	3.85	40.55
Average	0.226667	2.333333	3.506667	2.926667	1.883333	1.356667	1.283333	1.930952
Variance	0.002633	0.009233	0.001233	0.007033	0.056433	0.002633	0.010133	1.102779
Total								
Count	6	6	6	6	6	6	6	
Sum	2.03	15.95	22.57	14.73	8.75	7.02	4	
Average	0.338333	2.658333	3.761667	2.455	1.458333	1.17	0.666667	
Variance	0.017017	0.132777	0.078857	0.27211	0.240657	0.0432	0.463387	

ANOVA						
Soruce	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Method (A)	0.871488	1	0.871488	1.0517	5.5E-11	4.195972
pH (B)	53.68348	6	8.947247	1079.84	8.88E-32	2.445259
Interaction AB	5.136529	6	0.856088	103.321	8.76E-18	2.445259
Error	0.232	28	0.008286			
Total	59.9235	41				

Table S11. Error in titration method of oxidized time

	$Na_2S_2O_3$ Volume	Average V	mmol CHO	Average mmol	CV
t = 4h					
Blank	1.80±0.124	1.75±0.124	0.10±0.072	0.08±0.072	13.644
	1.70±0.124				
	1.75±0.124		0.10±0.072		
Sample	1.70±0.143	1.67±0.143			
	1.60±0.143		0.05±0.072		
	1.70±0.143				
t = 5h					
Blank	1.70±0.880	1.72±0.880	0.90±0.144	0.96±0.144	6.074
	1.70±0.880				
	1.75±0.880		1.00±0.144		
Sample	1.60±0.072	1.58±0.072			
	1.60±0.072		1.00±0.144		
	1.55±0.072				
t = 6h					
Blank	2.00±0.072	1.98±0.072	3.50±0.072	3.48±0.072	0.8377
	2.00±0.072				
	1.95±0.072		3.50±0.072		
Sample	1.60±0.000	1.60±0.000			
	1.60±0.000		3.45±0.072		
	1.60±0.000				
t = 7h					
Blank	2.20±0.189	2.12±0.189	1.00±0.072	1.02±0.072	0.5316
	2.10±0.189				
	2.05±0.189		1.00±0.072		
Sample	2.10±0.181	2.03±0.181			
	2.00±0.181		1.05±0.072		
	2.00±0.181				
t = 8h					
Blank	1.75±0.017	1.75±0.000	0.50±0.144	0.46±0.144	12.676

	1.75±0.017				
	1.75±0.017		0.50±0.144		
Sample	1.70±0.017	1.70±0.000			
	1.70±0.017		0.40±0.144		
	1.70±0.017				
t = 9h					
Blank	2.00±0.124	1.95±0.124	0.50±0.143	0.43±0.143	13.460
	1.95±0.124				
	1.90±0.124		0.40±0.143		
Sample	1.95±0.124	1.90±0.124			
	1.90±0.124		0.40±0.143		
	1.85±0.124				

Table S12. Error in UV-Vis method of oxidized time

	Optical density	Average OD	mmol CHO	Average mmol	CV
t = 4h					
Blank	0.6707±0.0095	0.6751±0.0095	0.25±0.017	0.25±0.017	2.8284
	0.6777±0.0095		0.25±0.017		
	0.6770±0.0095				
Sample	0.6259±0.0051	0.6236±0.0051			
	0.6228±0.0051		0.26±0.017		
	0.6220±0.0051				
t = 5h					
Blank	0.8843±0.0169	0.8920±0.0169	0.51±0.124	0.56±0.124	8.9285
	0.8942±0.0169		0.59±0.124		
	0.8974±0.0169				
Sample	0.8065±0.0050	0.8076±0.0050			
	0.8099±0.0050		0.60±0.1244		
	0.8063±0.0050				
t = 6h					
Blank	0.8434±0.0114	0.8424±0.0114	3.79±0.188	3.70±0.188	2.049
	0.8374±0.0114		3.65±0.188		
	0.8465±0.0114				
Sample	0.6902±0.0109	0.6952±0.0109			
	0.6975±0.0109		3.67±0.188		
	0.6981±0.0109				
t = 7h					
Blank	0.7991±0.0051	0.8008±0.0051	1.92±0.030	1.93±0.030	0.6345
	0.8003±0.0051		1.94±0.030		
	0.8031±0.0051				
Sample	0.7216±0.0010	0.7219±0.0010			
	0.7218±0.0010		1.94±0.030		
	0.7224±0.0010				
t = 8h					
Blank	0.8087±0.0162	0.8080±0.0162	0.51±0.096	0.39±0.096	9.9307

	0.8011±0.0162				
	0.8141±0.0162		0.30±0.096		
Sample	0.7876±0.0034	0.7874±0.0034			
	0.7859±0.0034		0.37±0.096		
	0.7886±0.0034				
t = 9h					
Blank	0.8238±0.0016	0.8245±0.0016	0.00±0.175	0.08±0.175	8.8388
	0.8315±0.0016				
	0.8183±0.0016		0.17±0.175		
Sample	0.8238±0.0271	0.8147±0.0271			
	0.8178±0.0271		0.08±0.175		
	0.8026±0.0271				

Table S13. Fisher statistical of oxidized time

	Titration		S^2	UV-Vis		S^2	F
	mmol	**Average x**		**mmol**	**Average x**		
t = 4h							
(1)	0.10±0.072	0.08±0.072	$8.5x10^{-4}$	0.25±0.017	0.25±0.017	$5x10^{-5}$	17
(2)	0.10±0.072			0.25±0.017			
(3)	0.05±0.072			0.26±0.017			
t = 5h							
(1)	0.90±0.144	0.96±0.144	$3.4x10^{-4}$	0.51±0.265	0.56±0.265	$2.5x10^{-3}$	7.35
(2)	1.00±0.144			0.59±0.265			
(3)	1.00±0.144			0.60±0.265			
t = 6h							
(1)	3.50±0.072	3.48±0.072	$8.5x10^{-4}$	3.79±0.188	3.70±0.188	$5.75x10^{-3}$	6.76
(2)	3.50±0.072			3.65±0.188			
(3)	3.45±0.072			3.67±0.188			
t = 7h							
(1)	1.00±0.072	1.02±0.072	$8.5x10^{-4}$	1.92±0.030	1.93±0.030	$1.5x10^{-4}$	5.66
(2)	1.00±0.072			1.94±0.030			
(3)	1.05±0.072			1.94±0.030			
t = 8h							
(1)	0.50±0.035	0.46±0.144	$3.4x10^{-3}$	0.31±0.096	0.32±0.096	$1.5x10^{-3}$	2.26
(2)	0.50±0.035			0.30±0.096			
(3)	0.40±0.035			0.37±0.096			
t = 9h							
(1)	0.50±0.143	0.43±0.143	$3.35x10^{-3}$	0.00±0.175	0.08±0.175	$7.25x10^{-3}$	2.16
(2)	0.40±0.143			0.17±0.175			
(3)	0.40±0.143			0.08±0.175			

Table S14. Student statistical of oxidized time

Time(h)	Titration	UV-Vis	d_i	d_i-d_{tb}	$(d_i-d_{tb})^2$
4	0.08	0.25	-0.17	-0.10167	0.010336
5	0.96	0.56	0.4	0.468333	0.219336
6	3.48	3.7	-0.22	-0.15167	0.023003
7	1.02	1.93	-0.91	-0.84167	0.708403
8	0.46	0.32	0.14	0.208333	0.043403
9	0.43	0.08	0.35	0.418333	0.175003
			d_{tb}= -0.06833		**Total** = 1.179483
s_d = 0.4857					
t = 0.3446					

Table S15. ANOVA two-factor with replication

Anova: Two-Factor With Replication							
SUMMARY	4	5	6	7	8	9	Total
Count	3	3	3	3	3	3	18
Sum	0.25	2.9	10.45	3.05	1.4	1.3	19.35
Average	0.083333	0.966667	3.483333	1.016667	0.466667	0.433333	1.075
Variance	0.000833	0.003333	0.000833	0.000833	0.003333	0.003333	1.339191
Count	3	3	3	3	3	3	18
Sum	0.76	1.7	11.11	5.8	0.98	0.25	20.6
Average	0.253333	0.566667	3.703333	1.933333	0.326667	0.083333	1.144444
Variance	3.33E-05	0.002433	0.005733	0.000133	0.001433	0.007233	1.783097
Total							
Count	6	6	6	6	6	6	
Sum	1.01	4.6	21.56	8.85	2.38	1.55	
Average	0.168333	0.766667	3.593333	1.475	0.396667	0.258333	
Variance	0.009017	0.050307	0.017147	0.25247	0.007787	0.040977	

ANOVA						
Source	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Method (A)	0.043403	1	0.043403	1.765537	0.000316	4.259677
Time (B)	51.23378	5	10.24676	4168.172	1.94E-34	2.620654
Interaction AB	1.786114	5	0.357223	1.45311	3.96E-17	2.620654
Error	0.059	24	0.002458			
Total	53.1223	35				

Table S16. Error in titration method of oxidized temperature

	$Na_2S_2O_3$ Volume	Average V	mmol CHO	Average mmol	CV
T = 25°C					
Blank	3.00±0.144	3.06±0.144	0.40±0.144	0.46±0.144	12.6759
	3.10±0.144				
	3.10±0.144		0.50±0.144		
Sample	3.05±0.000	3.05±0.000			
	3.05±0.000		0.50±0.144		
	3.05±0.000				
T = 35°C					
Blank	3.35±0.190	3.26±0.190	0.50±0.072	0.52±0.072	5.6066
	3.25±0.190				
	3.20±0.190		0.50±0.072		
Sample	3.30±0.189	3.22±0.189			
	3.20±0.189		0.55±0.072		
	3.15±0.189				
T = 45°C					
Blank	4.10±0.072	4.12±0.072	8.50±0.144	8.53±0.144	0.6785
	4.15±0.072				
	4.10±0.072		8.60±0.144		
Sample	3.35±0.072	3.33±0.072			
	3.30±0.072		8.50±0.144		
	3.35±0.072				
T = 55°C					
Blank	3.00±0.072	2.98±0.072	1.50±0.072	1.48±0.072	18.1780
	2.95±0.072				
	3.00±0.072		1.45±0.072		
Sample	2.85±0.072	2.83±0.072			
	2.80±0.072		1.50±0.072		
	2.85±0.072				
T = 65°C					
Blank	3.40±0.124	3.35±0.124	1.00±0.144	0.93±0.144	6.2235

	3.35±0.124				
	3.30±0.124		0.90±0.144		
Sample	3.30±0.144	3.26±0.144			
	3.30±0.144		0.90±0.144		
	3.20±0.144				

Table S17. Error in UV-Vis method of oxidized temperature

	Optical density	Average OD	mmol CHO	Average mmol	CV
T = 25°C					
Blank	0.6196±0.0015	0.6194±0.0015	0.43±0.174	0.36±0.174	19.5434
	0.6188±0.0015				
	0.6200±0.0015		0.29±0.174		
Sample	0.6021±0.0062	0.6049±0.0062			
	0.6069±0.0062		0.35±0.174		
	0.6058±0.0062				
T = 35°C					
Blank	0.7392±0.0180	0.7476±0.0180	0.43±0.063	0.45±0.063	5.6655
	0.7514±0.0180				
	0.7521±0.0180		0.45±0.063		
Sample	0.7204±0.0181	0.7288±0.0181			
	0.7334±0.0181		0.48±0.063		
	0.7327±0.0181				
T = 45°C					
Blank	0.8241±0.0002	0.8242±0.0002	8.04±0.353	8.20±0.353	1.7354
	0.8242±0.0002				
	0.8242±0.0002		8.27±0.353		
Sample	0.4993±0.0141	0.4928±0.0141			
	0.4900±0.0141		8.30±0.353		
	0.4890±0.0141				
T = 55°C					
Blank	0.7081±0.0142	0.7144±0.0142	1.31±0.089	1.34±0.089	2.6907
	0.7156±0.0142				
	0.7194±0.0142		1.33±0.089		
Sample	0.6590±0.0018	0.6586±0.0018			
	0.6577±0.0018		1.38±0.089		
	0.6590±0.0018				
T = 65°C					
Blank	0.8258±0.0248	0.8373±0.0248	0.92±0.201	1.00±0.201	

	0.8435±0.0248				
	0.8427±0.0248		1.02±0.201		
Sample	0.7882±0.0181	0.7964±0.0181			
	0.8021±0.0181		1.08±0.201		
	0.7990±0.0181				

Table S18. Fisher statistical of oxidized temperature

	Titration		S^2	UV-Vis		S^2	F
	mmol	**Average x**		**mmol**	**Average x**		
t = 25°C							
(1)	0.40±0.144	0.46±0.144	$3.4x10^{-3}$	0.43±0.174	0.36±0.174	$4.95x10^{-3}$	1.45
(2)	0.50±0.144			0.29±0.174			
(3)	0.50±0.144			0.35±0.174			
T = 35°C							
(1)	0.50±0.072	0.52±0.072	$8.5x10^{-4}$	0.43±0.063	0.45±0.063	$6.5x10^{-4}$	1.30
(2)	0.50±0.072			0.45±0.063			
(3)	0.55±0.072			0.48±0.063			
T = 45°C							
(1)	8.50±0.144	8.53±0.144	$3.35x10^{-3}$	8.04±0.017	8.20±0.353	0.02025	6.04
(2)	8.60±0.144			8.27±0.017			
(3)	8.50±0.144			8.30±0.017			
T = 55°C							
(1)	1.50±0.072	1.48±0.072	$8.5x10^{-4}$	1.31±0.089	1.34±0.089	$1.3x10^{-3}$	1.53
(2)	1.45±0.072			1.33±0.089			
(3)	1.50±0.072			1.38±0.089			
T = 65°C							
(1)	1.00±0.144	0.93±0.144	$3.35x10^{-3}$	0.92±0.201	1.00±0.201	$6.6x10^{-3}$	1.97
(2)	0.90±0.144			1.02±0.201			
(3)	0.90±0.144			1.08±0.201			

Table S19. Student statistical of oxidized temperature

Temperature	Titration	UV-Vis	di	di-dtb	(di-dtb)2
25	0.46	0.36	0.1	-0.004	1.6E-05
35	0.52	0.5	0.02	-0.084	0.007056
45	8.53	8.2	0.33	0.226	0.051076
55	1.48	1.34	0.14	0.036	0.001296
65	0.93	1	-0.07	-0.174	0.030276
			$\mathbf{d_{tb}}$ = 0.104		**Total** = 0.08972
$\mathbf{s_d}$ = 0.14976					
t = 1.5528					

Table S20. ANOVA two-factor with replication of oxidized temperature

Anova: Two-Factor With Replication						
SUMMARY	25	35	45	55	65	Total
Count	3	3	3	3	3	15
Sum	1.4	1.55	25.6	4.45	2.8	35.8
Average	0.466667	0.516667	8.533333	1.483333	0.933333	2.386667
Variance	0.003333	0.000833	0.003333	0.000833	0.003333	10.26445
Count	3	3	3	3	3	15
Sum	1.07	1.36	24.61	4.02	3.02	34.08
Average	0.356667	0.453333	8.203333	1.34	1.006667	2.272
Variance	0.004933	0.000633	0.020233	0.0013	0.006533	9.567617
Total						
Count	6	6	6	6	6	
Sum	2.47	2.91	50.21	8.47	5.82	
Average	0.411667	0.485	8.368333	1.411667	0.97	
Variance	0.006937	0.00179	0.042097	0.007017	0.00556	

ANOVA						
Source	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Method (A)	0.098613	1	0.098613	2.176895	0.000149	4.351244
Temperature (B)	277.4306	4	69.35765	15310.74	1.51E-34	2.866081
Interaction AB	0.127787	4	0.031947	0.752244	0.001035	2.866081
Error	0.0906	20	0.00453			
Total	277.7476	29				

Table S21. Error in titration method of mass ratio TCR:KIO_4

	$Na_2S_2O_3$ Volume	Average V	mmol CHO	Average mmol	CV
1:1					
Blank	3.50±0.072	3.48±0.072	0.50±0.144	0.46±0.144	12.6759
	3.50±0.072				
	3.45±0.072		0.50±0.144		
Sample	3.45±0.072	3.43±0.072			
	3.45±0.072		0.40±0.144		
	3.40±0.072				
1:2					
Blank	6.10±0.072	6.12±0.072	0.50±0.072	0.52±0.072	5.6066
	6.15±0.072				
	6.10±0.072		0.50±0.072		
Sample	6.05±0.124	6.05±0.124			
	6.10±0.124		0.55±0.072		
	6.00±0.124				
1:4					
Blank	12.20±0.144	12.16±0.144	5.00±0.143	5.03±0.143	1.1506
	12.10±0.144				
	12.20±0.144		5.00±0.143		
Sample	11.70±0.124	11.65±0.124			
	11.60±0.124		5.10±0.143		
	11.65±0.124				
1:6					
Blank	12.40±0.144	12.33±0.144	15.00±0.072	15.02±0.072	0.1941
	12.30±0.144				
	12.30±0.14		15.00±0.072		
Sample	10.90±0.189	10.82±0.189			
	10.80±0.189		15.05±0.072		
	10.75±0.189				
1:8					
Blank	20.00±0.144	19.93±0.144	50.00±0.124	49.95±0.124	0.1000

	19.90±0.144				
	19.90±0.144		49.90±0.124		
Sample	15.00±0.072	15.02±0.072			
	15.00±0.072		49.95±0.124		
	15.05±0.072				
1:10					
Blank	27.05±0.124	27.05±0.124	10.90±0.144	10.96±0.144	0.5320
	27.00±0.124				
	27.10±0.124		11.00±0.144		
Sample	26.10±0.144	26.03±0.144			
	26.00±0.144		11.00±0.144		
	26.00±0.144				
1:12					
Blank	28.00±0.144	28.06±0.144	9.90±0.144	9.96±0.144	0.5854
	28.10±0.144				
	28.10±0.144		10.00±0.144		
Sample	27.20±0.144	27.13±0.144			
	27.10±0.144		10.00±0.144		
	27.10±0.144				

Table S22. Error in UV-Vis method of mass ratio TCR:KIO_4

	Optical density	Average OD	mmol CHO	Average mmol	CV
1:1					
Blank	0.5060±0.0042	0.5079±0.0042	0.33±0.112	0.38±0.112	11.9149
	0.5093±0.0042		0.42±0.112		
	0.5085±0.0042				
Sample	0.4926±0.0010	0.4927±0.0010			
	0.4924±0.0010		0.38±0.112		
	0.4932±0.0010				
1:2					
Blank	0.3891±0.0002	0.3890±0.0002	0.63±0.039	0.61±0.039	2.5920
	0.3891±0.0002		0.61±0.039		
	0.3890±0.0002				
Sample	0.3636±0.0016	0.3643±0.0016			
	0.3645±0.0016		0.60±0.039		
	0.3649±0.0016				
1:4					
Blank	0.8340±0.0119	0.8395±0.0119	4.88±0.224	4.88±0.224	1.8556
	0.8421±0.0119		4.98±0.224		
	0.8425±0.0119				
Sample	0.7680±0.0095	0.7658±0.0095			
	0.7614±0.0095		4.80±0.224		
	0.7681±0.0095				
1:6					
Blank	0.3531±0.0117	0.3585±0.0117	18.76±0.113	18.75±0.113	0.6208
	0.3611±0.0117		18.79±0.113		
	0.3615±0.0117				
Sample	0.2031±0.0199	0.2122±0.0199			
	0.2149±0.0199		18.70±0.113		
	0.2185±0.0199				
1:8					
Blank	0.6445±0.0076	0.6480±0.0076	41.54±0.065	41.56±0.065	0.0636

	0.6497±0.0076				
	0.6499±0.0076		41.59±0.065		
Sample	0.3122±0.0109	0.3154±0.0109			
	0.3137±0.0109		41.57±0.065		
	0.3205±0.0109				
1:10					
Blank	0.5004±0.0106	0.5044±0.0106	13.87±0.635	13.83±0.635	1.8498
	0.5038±0.0106				
	0.5089±0.0106		13.56±0.635		
Sample	0.3883±0.0092	0.3926±0.0092			
	0.3942±0.0092		14.07±0.635		
	0.3952±0.0092				
1:12					
Blank	0.5034±0.0086	0.5044±0.0086	6.94±0.200	6.85±0.200	0.2149
	0.5083±0.0086				
	0.5016±0.0086		6.78±0.200		
Sample	0.4473±0.0083	0.4512±0.0083			
	0.4535±0.0083		6.84±0.200		
	0.4527±0.0083				

Table S23. Fisher statistical of mass ratio TCR:KIO_4

	Titration		S^2	UV-Vis		S^2	F
	mmol	**Average x**		**mmol**	**Average x**		
1:1							
(1)	0.50±0.144	0.46±0.144	$3.4x10^{-3}$	0.33±0.112	0.38±0.112	$2.05x10^{-3}$	1.35
(2)	0.50±0.144			0.42±0.112			
(3)	0.40±0.144			0.38±0.112			
1:2							
(1)	0.50±0.072	0.52±0.072	$8.5x10^{-4}$	0.63±0.039	0.61±0.039	$2.5x10^{-4}$	3.4
(2)	0.50±0.072			0.61±0.039			
(3)	0.55±0.072			0.60±0.039			
1:4							
(1)	5.00±0.143	5.03±0.143	$3.35x10^{-3}$	4.88±0.224	4.88±0.224	$8.2x10^{-3}$	2.44
(2)	5.00±0.143			4.98±0.224			
(3)	5.10±0.143			4.80±0.224			
1:6							
(1)	15.00±0.072	15.02±0.072	$8.5x10^{-4}$	18.76±0.113	18.68±0.113	$2.1x10^{-3}$	2.47
(2)	15.00±0.072			18.79±0.113			
(3)	15.05±0.072			18.70±0.113			
1:8							
(1)	50.00±0.124	49.95±0.124	$2.5x10^{-3}$	41.54±0.065	41.56±0.065	$7x10^{-4}$	3.57
(2)	49.90±0.124			41.59±0.065			
(3)	49.95±0.124			41.57±0.065			
1:10							
(1)	10.90±0.144	10.96±0.144	$3.4x10^{-3}$	13.87±0.635	13.83±0.635	0.06	17.64
(2)	11.00±0.144			13.56±0.635			
(3)	11.00±0.144			14.07±0.635			
1:12							
(1)	9.90±0.144	9.96±0.144	$3.4x10^{-3}$	6.94±0.035	6.85±0.200	$6.55x10^{-3}$	1.92
(2)	10.00±0.144			6.78±0.035			
(3)	10.00±0.144			6.84±0.035			

Table S24. Student statistical of mass ratio TCR:KIO_4

Ratio	**Titration**	**UV-Vis**	**d_i**	**d_i-d_{tb}**	**$(d_i-d_{tb})^2$**
1:1	0.46	0.38	0.08	-0.65	0.4225
1:2	0.52	0.61	-0.09	-0.82	0.6724
1:4	5.03	4.88	0.15	-0.58	0.3364
1:6	15.02	18.68	-3.66	-4.39	19.2721
1:8	49.95	41.56	8.39	7.66	58.6756
1:10	10.96	13.83	-2.87	-3.6	12.96
1:12	9.96	6.85	3.11	2.38	5.6644
			d_{tb} = 0.73		**Total** = 98.0034
s_d = 4.0415					
t = 0.4778					

Table S25. ANOVA two-factor with replication of mass ratio TCR:KIO_4

Anova: Two-Factor With Replication								
SUMMARY	1 1	1 2	1 4	1 6	1 8	1 10	1 12	Total
Count	3	3	3	3	3	3	3	21
Sum	1.5	1.55	15.1	45.05	149.85	32.9	29.9	275.85
Average	0.5	0.516667	5.033333	15.01667	49.95	10.96667	9.966667	13.13571
Variance	0	0.000833	0.003333	0.000833	0.0025	0.003333	0.003333	263.7205
Count	3	3	3	3	3	3	3	21
Sum	1.13	1.84	14.66	56.25	124.7	41.5	20.56	260.64
Average	0.376667	0.613333	4.886667	18.75	41.56667	13.83333	6.853333	12.41143
Variance	0.002033	0.000233	0.008133	0.0021	0.000633	0.066033	0.006533	189.5744
Total								
Count	6	6	6	6	6	6	6	
Sum	2.63	3.39	29.76	101.3	274.55	74.4	50.46	
Average	0.438333	0.565	4.96	16.88333	45.75833	12.4	8.41	
Variance	0.005377	0.00323	0.01104	4.182507	21.08534	2.49308	2.9118	

ANOVA						
Source	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Method (A)	5.508193	1	5.508193	772.1766	6.27E-22	4.195972
Mass ratio (B)	8917.945	6	1486.324	208363.2	9.59E-64	2.445259
Interaction AB	147.7539	6	24.62565	3452.194	7.99E-39	2.445259
Error	0.199733	28	0.007133			
Total	9071.407	41				

Table S26. Error in titration method of ionic force

	$Na_2S_2O_3$ Volume	Average V	mmol CHO	Average mmol	CV
0.05M					
Blank	20.00±0.144	20.03±0.144	10.00±0.144	9.96±0.144	0.5854
	20.10±0.144				
	20.00±0.144		10.00±0.144		
Sample	19.00±0.189	19.08±0.189			
	19.10±0.189		9.90±0.144		
	19.15±0.189				
0.10M					
Blank	19.60±0.144	19.56±0.144	11.00±0.144	10.96±0.144	0.5320
	19.60±0.144				
	19.50±0.144		11.00±0.144		
Sample	18.50±0.072	18.52±0.072			
	18.50±0.071		10.90±0.144		
	18.55±0.071				
0.15M					
Blank	17.00±0.099	16.96±0.099	10.00±0.144	9.93±0.144	0.5828
	16.90±0.099				
	17.00±0.099		9.90±0.144		
Sample	16.00±0.144	15.96±0.144			
	15.90±0.144		9.90±0.144		
	16.00±0.144				
0.20M					
Blank	17.40±0.144	17.36±0.144	30.90±0.144	30.96±0.144	0.1888
	17.40±0.144				
	17.30±0.144		31.00±0.144		
Sample	14.35±0.189	14.28±0.189			
	14.30±0.189		31.00±0.144		
	14.20±0.189				
0.25M					
Blank	17.40±0.144	17.36±0.144	30.90±0.144	30.96±0.144	0.1888

	17.40±0.144				
	17.30±0.144		31.00±0.144		
Sample	14.35±0.189	14.28±0.189			
	14.30±0.189		30.90±0.144		
	14.20±0.189				

Table S27. Error in UV-Vis method of ionic strength

	Optical density	Average OD	mmol CHO	Average mmol	CV
0.05M					
Blank	0.2936±0.0062	0.2964±0.0062	3.38±0.578	3.54±0.578	6.5795
	0.2979±0.0062				
	0.2979±0.0062		3.81±0.578		
Sample	0.2663±0.0049	0.2678±0.0049			
	0.2671±0.0049		3.44±0.578		
	0.2701±0.0049				
0.1M					
Blank	0.3050±0.0067	0.3042±0.0067	8.29±0.578	7.92±0.578	2.8233
	0.3012±0.0067				
	0.3065±0.0067		7.75±0.578		
Sample	0.2380±0.0083	0.2402±0.0083			
	0.2386±0.0083		7.74±0.578		
	0.2441±0.0083				
0.15M					
Blank	0.3802±0.0074	0.3818±0.0074	18.72±0.351	18.76±0.351	0.7538
	0.3853±0.0074				
	0.3800±0.0074		18.63±0.351		
Sample	0.2290±0.0031	0.2276±0.0031			
	0.2267±0.0031		18.94±0.351		
	0.2270±0.0031				
0.2M					
Blank	0.5716±0.0079	0.5751±0.0079	41.94±0.682	41.77±0.370	0.3385
	0.5760±0.0079				
	0.5778±0.0079		41.71±0.682		
Sample	0.2328±0.0108	0.2363±0.0108			
	0.2350±0.0108		41.66±0.682		
	0.2412±0.0108				
0.25M					
Blank	0.5392±0.0113	0.5364±0.0113	40.46±0.172	40.42±0.172	0.1714

	0.5390±0.0113				
	0.5312±0.0113		40.34±0.172		
Sample	0.2123±0.0017	0.2124±0.0017			
	0.2132±0.0017		40.46±0.172		
	0.2118±0.0017				

Table S28. Fisher statistical of ionic strength

	Titration		S^2	UV-Vis		S^2	F
	mmol	**Average x**		**mmol**	**Average x**		
0.05M							
(1)	10.00±0.144	9.96±0.144	$3.4x10^{-3}$	3.38±0.578	3.54±0.578	0.05	14.70
(2)	10.00±0.144			3.81±0.578			
(3)	9.90±0.144			3.44±0.578			
0.10M							
(1)	11.00±0.144	10.96±0.144	$3.4x10^{-3}$	8.29±0.578	7.92±0.578	0.05	14.70
(2)	11.00±0.144			7.75±0.578			
(3)	10.90±0.144			7.74±0.578			
0.15M							
(1)	10.00±0.144	9.93±0.144	$3.4x10^{-3}$	18.72±0.351	18.76±0.351	0.02	5.88
(2)	9.90±0.144			18.63±0.351			
(3)	9.90±0.144			18.94±0.351			
0.20M							
(1)	30.90±0.035	30.96±0.144	$3.4x10^{-3}$	41.94±0.370	41.77±0.370	0.02	5.88
(2)	31.00±0.035			41.71±0.370			
(3)	31.00±0.035			41.66±0.370			
0.25M							
(1)	30.90±0.017	30.96±0.144	$3.4x10^{-3}$	40.46±0.017	40.42±0.172	$4.8x10^{-3}$	1.41
(2)	31.00±0.017			40.34±0.017			
(3)	30.90±0.017			40.46±0.017			

Table S29. Student statistical of ionic strength

Concentration (M)	**Titration**	**UV-Vis**	$\mathbf{d_i}$	$\mathbf{d_i-d_{tb}}$	$\mathbf{(d_i-d_{tb})^2}$
0.05	9.96	3.54	6.42	10.348	107.0811
0.1	10.96	7.92	3.04	6.968	48.55302
0.15	9.93	18.76	-8.83	-4.902	24.0296
0.2	30.96	41.77	-10.81	-6.882	47.36192
0.25	30.96	40.42	-9.46	-5.532	30.60302
			$\mathbf{d_{tb}}$ = -3.928		**Total** = 257.6287
$\mathbf{s_d}$ = 8.0254					
t = 1.094					

Table S30. ANOVA two-factor with replication of ionic strength

Anova: Two-Factor With Replication						
SUMMARY	0.05	0.1	0.15	0.2	0.25	Total
Count	3	3	3	3	3	15
Sum	29.9	32.9	29.8	92.9	92.8	278.3
Average	9.966667	10.96667	9.933333	30.96667	30.93333	18.55333
Variance	0.003333	0.003333	0.003333	0.003333	0.003333	109.9198
Count	3	3	3	3	3	15
Sum	10.63	23.78	56.29	125.31	121.26	337.27
Average	3.543333	7.926667	18.76333	41.77	40.42	22.48467
Variance	0.054233	0.099033	0.025433	0.0223	0.0048	273.9204
Total						
Count	6	6	6	6	6	
Sum	40.53	56.68	86.09	218.21	214.06	
Average	6.755	9.446667	14.34833	36.36833	35.67667	
Variance	12.40079	2.813427	23.40218	35.02386	27.00231	

ANOVA						
Source	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Method (A)	115.9154	1	115.9154	5210.46	1.18E-25	4.351244
NaCl concentration (B)	4986.466	4	1246.616	56036.1	3.52E-40	2.866081
Interaction AB	386.8525	4	96.71312	4347.308	4.4E-29	2.866081
Error	0.444933	20	0.022247			
Total	5489.678	29				

Table S31. Error of condensed temperature (T = 40^{o}C)

Optical density	Average OD	CV
26 mL		
0.6099±0.0016	0.6092±0.0016	0.1057
0.6089±0.0016		
0.6087±0.0016		
28 mL		
0.6389±0.0030	0.6378±0.0030	0.1917
0.6381±0.0030		
0.6365±0.0030		
30 mL		
0.6800±0.0014	0.6806±0.0014	0.0811
0.6810±0.0014		
0.6809±0.0014		
32 mL		
0.7451±0.0009	0.7449±0.0009	0.0511
0.7445±0.0009		
0.7452±0.0009		
34 mL		
0.7899±0.0016	0.7896±0.0016	0.0815
0.7889±0.0016		
0.7901±0.0016		
36 mL		
0.8479±0.0010	0.8475±0.0010	0.0479
0.8471±0.0010		
0.8476±0.0010		
38 mL		
0.9078±0.0016	0.9071±0.0016	0.0718
0.9071±0.0016		
0.9065±0.0016		
40 mL		
0.9666±0.0018	0.9663±0.0018	0.0763

0.9669±0.0018		
0.9655±0.0018		
42 mL		
1.0159±0.0088	1.0156±0.0088	0.35222
1.0155±0.0088		
1.0156±0.0088		
44 mL		
1.0588±0.0009	1.0585±0.0009	0.0359
1.0581±0.0009		
1.0587±0.0009		

Trendline of T = 40^{o}C: y = 0.0262x – 0.0929 with R^2 = 0.9962.

Table S32. Error of condensed temperature (T = 60°C)

Optical density	Average OD	CV
26 mL		
0.5377±0.0007	0.5376±0.0007	0.0468
0.5379±0.0007		
0.5373±0.0007		
28 mL		
0.5699±0.0005	0.5696±0.0005	0.0360
0.5694±0.0005		
0.5696±0.0005		
30 mL		
0.6305±0.0014	0.6300±0.0014	0.0904
0.6302±0.0014		
0.6294±0.0014		
32 mL		
0.6690±0.0012	0.6684±0.0012	0.0717
0.6683±0.0012		
0.6681±0.0012		
34 mL		
0.7268±0.0011	0.7268±0.0011	0.0622
0.7264±0.0011		
0.7273±0.0011		
36 mL		
0.7548±0.0015	0.7547±0.0015	0.0800
0.7541±0.0015		
0.7553±0.0015		
38 mL		
0.8299±0.0012	0.8293±0.0012	0.0596
0.8291±0.0012		
0.8290±0.0012		
40 mL		
0.8729±0.0016	0.8728±0.0016	0.0751

0.8722±0.0016		
0.8735±0.0016		
42 mL		
0.9011±0.0021	0.9019±0.0021	0.0944
0.9019±0.0021		
0.9028±0.0021		
44 mL		
0.9216±0.0011	0.9211±0.0011	0.0491
0.9211±0.0011		
0.9207±0.0011		

Trendline of T = 60^{o}C: y = 0.0227x – 0.0545 with R^2 = 0.9903.

Table S33. Error of condensed temperature (T = 80^{o}C)

Optical density	Average OD	CV
26 mL		
0.6101±0.0021	0.6100±0.0021	0.1400
0.6109±0.0021		
0.6092±0.0021		
28 mL		
0.6777±0.0023	0.6772±0.0023	0.1377
0.6779±0.0023		
0.6762±0.0023		
30 mL		
0.7231±0.0013	0.7227±0.0013	0.0764
0.7221±0.0013		
0.7230±0.0013		
32 mL		
0.7679±0.0010	0.7674±0.0010	0.0537
0.7671±0.0010		
0.7674±0.0010		
34 mL		
0.8155±0.0019	0.8157±0.0019	0.0953
0.8151±0.0019		
0.8166±0.0019		
36 mL		
0.8712±0.0016	0.8709±0.0016	0.0739
0.8702±0.0016		
0.8714±0.0016		
38 mL		
0.9162±0.0005	0.9160±0.0005	0.0231
0.9158±0.0005		
0.9161±0.0005		
40 mL		
0.9644±0.0018	0.9647±0.0018	0.0786

0.9642±0.0018		
0.9656±0.0018		
42 mL		
0.9995±0.0027	0.9999±0.0027	0.1115
0.9991±0.0027		
1.0012±0.0027		
44 mL		
1.0433±0.0007	1.0430±0.0007	0.0295
1.0431±0.0007		
1.0427±0.0007		

Trendline of T = 80°C: y = 0.0238x + 0.0044 with R^2 = 0.9972.

Table S34. Error of condensed temperature (T = 100°C)

Optical density	Average OD	CV
26 mL		
0.6131±0.0021	0.6130±0.0021	0.1393
0.6139±0.0021		
0.6122±0.0021		
28 mL		
0.6459±0.0011	0.6454±0.0011	0.0710
0.6455±0.0011		
0.6450±0.0011		
30 mL		
0.7169±0.0004	0.7167±0.0004	0.0220
0.7166±0.0004		
0.7167±0.0004		
32 mL		
0.7508±0.0010	0.7504±0.0010	0.0565
0.7506±0.0010		
0.7500±0.0010		
34 mL		
0.7906±0.0008	0.7902±0.0008	0.0410
0.7901±0.0008		
0.7900±0.0008		
36 mL		
0.8377±0.0012	0.8376±0.0012	0.0602
0.8371±0.0012		
0.8381±0.0012		
38 mL		
0.8854±0.0008	0.8857±0.0008	0.0399
0.8857±0.0008		
0.8861±0.0008		
40 mL		
0.9466±0.0017	0.9467±0.0017	0.0750

0.9461±0.0017		
0.9475±0.0017		
42 mL		
0.9985±0.0010	0.9985±0.0010	0.0400
0.9981±0.0010		
0.9989±0.0010		
44 mL		
1.0599±0.0010	1.0598±0.0010	0.0383
1.0594±0.0010		
1.0602±0.0010		

Trendline of T = 100^{o}C: y = 0.0245x – 0.0343 with R^2 = 0.9952.

Table S35. Error of condensed time (t = 2h)

Optical density	Average OD	CV
26 mL		
0.6243±0.0013	0.6243±0.0013	0.0884
0.6249±0.0013		
0.6238±0.0013		
28 mL		
0.7288±0.0009	0.7284±0.0009	0.0494
0.7285±0.0009		
0.7281±0.0009		
30 mL		
0.7825±0.0006	0.7822±0.0006	0.0299
0.7821±0.0006		
0.7821±0.0006		
32 mL		
0.8290±0.0004	0.8288±0.0004	0.0208
0.8287±0.0004		
0.8289±0.0004		
34 mL		
0.8833±0.0008	0.8835±0.0008	0.0366
0.8839±0.0008		
0.8836±0.0008		
36 mL		
0.9229±0.0008	0.9225±0.0008	0.0383
0.9222±0.0008		
0.9225±0.0008		
38 mL		
0.9819±0.0022	0.9810±0.0022	0.0920
0.9811±0.0022		
0.9801±0.0022		
40 mL		
1.0368±0.0004	1.0366±0.0004	0.0152

1.0366±0.0004		
1.0365±0.0004		
42 mL		
1.0888±0.0026	1.0880±0.0026	0.0992
1.0885±0.0026		
1.0868±0.0026		
44 mL		
1.1309±0.0011	1.1304±0.0011	0.0400
1.1304±0.0011		
1.1300±0.0011		

Trendline of t = 2h: y = 0.0268x – 0.037 with R^2= 0.9915.

Table S36. Error of condensed time (t = 4h)

Optical density	Average OD	CV
26 mL		
0.6191±0.0015	0.6196±0.0015	0.0988
0.6195±0.0015		
0.6203±0.0015		
28 mL		
0.6566±0.0014	0.6568±0.0014	0.0847
0.6565±0.0014		
0.6575±0.0014		
30 mL		
0.7333±0.0009	0.7337±0.0009	0.0518
0.7339±0.0009		
0.7340±0.0009		
32 mL		
0.7733±0.0020	0.7738±0.0020	0.1057
0.7735±0.0020		
0.7748±0.0020		
34 mL		
0.8128±0.0007	0.8125±0.0007	0.0379
0.8122±0.0007		
0.8126±0.0007		
36 mL		
0.8705±0.0008	0.8701±0.0008	0.0406
0.8701±0.0008		
0.8698±0.0008		
38 mL		
0.9291±0.0007	0.9288±0.0007	0.0332
0.9285±0.0007		
0.9289±0.0007		
40 mL		
0.9799±0.0016	0.9791±0.0016	0.0696

0.9789±0.0016		
0.9786±0.0016		
42 mL		
1.0122±0.0008	1.0125±0.0008	0.0349
1.0129±0.0008		
1.0125±0.0008		
44 mL		
1.0604±0.0010	1.0600±0.0010	0.0383
1.0601±0.0010		
1.0596±0.0010		

Trendline of t = 4h: y= 0.0249x - 0.0253 with R^2 = 0.9964.

Table S37. Error of condensed time (t = 6h)

Optical density	Average OD	CV
26 mL		
0.6105±0.0012	0.6100±0.0012	0.0827
0.6101±0.0012		
0.6095±0.0012		
28 mL		
0.6777±0.0011	0.6772±0.0011	0.0676
0.6773±0.0011		
0.6768±0.0011		
30 mL		
0.7277±0.0047	0.7273±0.0047	0.2653
0.7273±0.0047		
0.7300±0.0047		
32 mL		
0.7677±0.0008	0.7674±0.0008	0.0432
0.7671±0.0008		
0.7676±0.0008		
34 mL		
0.8155±0.0005	0.8157±0.0005	0.0260
0.8158±0.0005		
0.8159±0.0005		
36 mL		
0.8712±0.0009	0.8709±0.0009	0.0437
0.8705±0.0009		
0.8711±0.0009		
38 mL		
0.9165±0.0010	0.9160±0.0010	0.0456
0.9159±0.0010		
0.9157±0.0010		
40 mL		
0.9644±0.0445	0.9647±0.0445	1.8963

0.9649±0.0445		
0.9649±0.0445		
42 mL		
0.9999±0.0021	0.9999±0.0021	0.0851
0.9991±0.0021		
1.0008±0.0021		
44 mL		
1.0430±0.0014	1.0430±0.0014	0.0529
1.0436±0.0014		
1.0425±0.0014		

Trendline of t = 6h: y= 0.0238x + 0.0044 with R^2=0.9972.

Table S38. Error of condensed time (t = 8h)

Optical density	Average OD	CV
26 mL		
0.6101±0.0004	0.6102±0.0004	0.0259
0.6102±0.0004		
0.6104±0.0004		
28 mL		
0.6778±0.0011	0.6772±0.0011	0.0708
0.6771±0.0011		
0.6769±0.0011		
30 mL		
0.7221±0.0014	0.7227±0.0014	0.0788
0.7229±0.0014		
0.7232±0.0014		
32 mL		
0.7675±0.0020	0.7671±0.0020	0.1063
0.7677±0.0020		
0.7662±0.0020		
34 mL		
0.8154±0.0010	0.8158±0.0010	0.0497
0.8159±0.0010		
0.8162±0.0010		
36 mL		
0.8708±0.0009	0.8705±0.0009	0.0437
0.8701±0.0009		
0.8707±0.0009		
38 mL		
0.9161±0.0008	0.9161±0.0008	0.0385
0.9165±0.0008		
0.9158±0.0008		
40 mL		
0.9645±0.0012	0.9648±0.0012	0.00513

0.9646±0.0012		
0.9654±0.0012		
42 mL		
0.9991±0.0014	0.9995±0.0014	0.0587
0.9993±0.0014		
1.0002±0.0014		
44 mL		
1.0439±0.0015	1.0432±0.0015	0.0587
1.0431±0.0015		
1.0427±0.0015		

Trendline of t = 8h: $y=0.0238x + 0.0045$ with $R^2 = 0.9972$.

Table S39. Error of pH adsoprtion solution (pH = 1)

Optical density	Average OD	CV
26 mL		
0.5525±0.0028	0.5513±0.0028	0.2087
0.5513±0.0028		
0.5502±0.0028		
28 mL		
0.6119±0.0017	0.6111±0.0017	0.1162
0.6110±0.0017		
0.6105±0.0017		
30 mL		
0.6448±0.0016	0.6441±0.0016	0.1012
0.6441±0.0016		
0.6435±0.0016		
32 mL		
0.6992±0.0012	0.6986±0.0012	0.0736
0.6985±0.0012		
0.6982±0.0012		
34 mL		
0.7576±0.0010	0.7572±0.0010	0.0536
0.7571±0.0010		
0.7568±0.0010		
36 mL		
0.7935±0.0028	0.7933±0.0028	0.1461
0.7944±0.0028		
0.7921±0.0028		
38 mL		
0.8528±0.0012	0.8527±0.0012	0.0592
0.8532±0.0012		
0.8522±0.0012		
40 mL		
0.8942±0.0026	0.8932±0.0026	0.1200

0.8935±0.0026		
0.8921±0.0026		
42 mL		
0.9331±0.0012	0.9325±0.0012	0.0552
0.9321±0.0012		
0.9324±0.0012		
44 mL		
0.9773±0.0012	0.9775±0.0012	0.0506
0.9781±0.0012		
0.9772±0.0012		

Trendline of pH = 1: $y = 0.0237x - 0.0592$ with $R^2 = 0.9976$.

Table S40. Error of pH adsoprtion solution (pH = 2)

Optical density	Average OD	CV
26 mL		
0.5889±0.0021	0.5887±0.0021	0.1466
0.5895±0.0021		
0.5878±0.0021		
28 mL		
0.6263±0.0015	0.6268±0.0015	0.0970
0.6275±0.0015		
0.6268±0.0015		
30 mL		
0.6817±0.0034	0.6831±0.0034	0.2052
0.6845±0.0034		
0.6832±0.0034		
32 mL		
0.7249±0.0022	0.7240±0.0022	0.1246
0.7231±0.0022		
0.7239±0.0022		
34 mL		
0.7788±0.0024	0.7777±0.0024	0.1250
0.7769±0.0024		
0.7775±0.0024		
36 mL		
0.8302±0.0021	0.8292±0.0021	0.1044
0.8291±0.0021		
0.8285±0.0021		
38 mL		
0.8747±0.0020	0.8744±0.0020	0.0953
0.8751±0.0020		
0.8735±0.0020		
40 mL		

0.9318±0.0017	0.9311±0.0017	0.0755
0.9312±0.0017		
0.9304±0.0017		
42 mL		
0.9807±0.0010	0.9803±0.0010	0.0414
0.9804±0.0010		
0.9799±0.0010		
44 mL		
1.0223±0.0005	1.0220±0.0005	0.0218
1.0220±0.0005		
1.0219±0.0005		

Trendline of pH = 2: $y = 0.0246x - 0.0572$ with $R^2 = 0.9992$.

Table S41. Error of pH adsoprtion solution (pH = 3).

Optical density	Average OD	CV
26 mL		
0.5488±0.0030	0.5491±0.0030	0.2248
0.5505±0.0030		
0.5481±0.0030		
28 mL		
0.6045±0.0024	0.6035±0.0024	0.1661
0.6036±0.0024		
0.6025±0.0024		
30 mL		
0.6395±0.0021	0.6386±0.0021	0.1337
0.6387±0.0021		
0.6378±0.0021		
32 mL		
0.7020±0.0019	0.7011±0.0019	0.1109
0.7009±0.0019		
0.7005±0.0019		
34 mL		
0.7486±0.0015	0.7479±0.0015	0.0818
0.7478±0.0015		
0.7474±0.0015		
36 mL		
0.7778±0.0021	0.7769±0.0021	0.1095
0.7769±0.0021		
0.7761±0.0021		
38 mL		
0.8409±0.0031	0.8396±0.0031	0.1492
0.8397±0.0031		
0.8384±0.0031		
40 mL		
0.8756±0.0013	0.8750±0.0013	0.0636

0.8751±0.0013		
0.8745±0.0013		
42 mL		
0.9308±0.0023	0.9298±0.0023	0.1023
0.9298±0.0023		
0.9289±0.0023		
44 mL		
0.9707±0.0018	0.9701±0.0018	0.0760
0.9704±0.0018		
0.9693±0.0018		

Trendline of pH = 3: $y = 0.0233x - 0.0535$ with $R^2 = 0.9978$.

Table S42. Error of pH adsoprtion solution (pH = 4)

Optical density	Average OD	CV
26 mL		
0.5806±0.0021	0.5796±0.0021	0.1494
0.5795±0.0021		
0.5789±0.0021		
28 mL		
0.6397±0.0014	0.6390±0.0014	0.0919
0.6386±0.0014		
0.6388±0.0014		
30 mL		
0.6619±0.0018	0.6611±0.0018	0.1136
0.6611±0.0018		
0.6604±0.0018		
32 mL		
0.7221±0.0014	0.7216±0.0014	0.0790
0.7210±0.0014		
0.7218±0.0014		
34 mL		
0.7712±0.0020	0.7710±0.0020	0.1053
0.7702±0.0020		
0.7718±0.0020		
36 mL		
0.8258±0.0021	0.8250±0.0021	0.1046
0.8252±0.0021		
0.8241±0.0021		
38 mL		
0.8578±0.0013	0.8572±0.0013	0.0644
0.8572±0.0013		
0.8567±0.0013		
40 mL		
0.9092±0.0026	0.9081±0.0026	0.1157

0.9071±0.0026		
0.9081±0.0026		
42 mL		
0.9638±0.0014	0.9637±0.0014	0.0596
0.9629±0.0014		
0.9638±0.0014		
44 mL		
1.0115±0.0017	1.0108±0.0017	0.0696
1.0101±0.0017		
1.0109±0.0017		

Trendline of pH = 4: $y = 0.0238x - 0.0388$ with $R^2 = 0.9974$.

Table S43. Error of pH adsoprtion solution (pH = 5)

Optical density	Average OD	CV
26 mL		
0.6025±0.0012	0.6019±0.0012	0.0855
0.6015±0.0012		
0.6018±0.0012		
28 mL		
0.6605±0.0024	0.6593±0.0024	0.1521
0.6581±0.0024		
0.6594±0.0024		
30 mL		
0.7005±0.0025	0.7000±0.0025	0.1463
0.7008±0.0025		
0.6989±0.0025		
32 mL		
0.7441±0.0021	0.7433±0.0021	0.1161
0.7424±0.0021		
0.7435±0.0021		
34 mL		
0.7982±0.0022	0.7973±0.0022	0.1132
0.7974±0.0022		
0.7964±0.0022		
36 mL		
0.8411±0.0020	0.8405±0.0020	0.0970
0.8409±0.0020		
0.8396±0.0020		
38 mL		
0.8845±0.0015	0.8851±0.0015	0.0682
0.8857±0.0015		
0.8852±0.0015		
40 mL		
0.9394±0.0034	0.9394±0.0034	0.1494

0.9409±0.0034		
0.9381±0.0034		
42 mL		
0.9917±0.0016	0.9917±0.0016	0.0657
0.9924±0.0016		
0.9911±0.0016		
44 mL		
1.0365±0.0016	1.0364±0.0016	0.0632
1.0371±0.0016		
1.0358±0.0016		

Trendline of pH = 5: $y = 0.0239x - 0.0187$ with $R^2 = 0.9992$.

Table S44. Error of pH adsoprtion solution (pH = 6)

Optical density	Average OD	CV
26 mL		
0.6051±0.0022	0.6060±0.0022	0.1489
0.6061±0.0022		
0.6069±0.0022		
28 mL		
0.6532±0.0018	0.6533±0.0018	0.1155
0.6525±0.0018		
0.6540±0.0018		
30 mL		
0.6910±0.0011	0.6905±0.0011	0.0655
0.6901±0.0011		
0.6905±0.0011		
32 mL		
0.7425±0.0013	0.7419±0.0013	0.0744
0.7414±0.0013		
0.7419±0.0013		
34 mL		
0.7681±0.0012	0.7676±0.0012	0.0676
0.7678±0.0012		
0.7671±0.0012		
36 mL		
0.8279±0.0013	0.8275±0.0013	0.0667
0.8278±0.0013		
0.8269±0.0013		
38 mL		
0.8689±0.0015	0.8682±0.0015	0.0700
0.8682±0.0015		
0.8677±0.0015		
40 mL		
0.9369±0.0014	0.9362±0.0014	0.0613

0.9361±0.0014		
0.9358±0.0014		
42 mL		
0.9739±0.0013	0.9735±0.0013	0.0567
0.9729±0.0013		
0.9738±0.0013		
44 mL		
1.0298±0.0014	1.0292±0.0014	0.0536
1.0287±0.0014		
1.0292±0.0014		

Trendline of pH = 6: $y = 0.0234x - 0.0091$ with $R^2 = 0.9956$.

Table S45. Error of adsorption solution's temperature (T = 30^{o}C)

Optical density	Average OD	CV
26 mL		
0.6058±0.0012	0.6053±0.0012	0.0834
0.6054±0.0012		
0.6048±0.0012		
28 mL		
0.6495±0.0022	0.6486±0.0022	0.1391
0.6485±0.0022		
0.6477±0.0022		
30 mL		
0.6975±0.0012	0.6970±0.0012	0.0724
0.6971±0.0012		
0.6965±0.0012		
32 mL		
0.7331±0.0012	0.7325±0.0012	0.0702
0.7324±0.0012		
0.7321±0.0012		
34 mL		
0.7908±0.0008	0.7904±0.0008	0.0447
0.7904±0.0008		
0.7901±0.0008		
36 mL		
0.8225±0.0015	0.8218±0.0015	0.0740
0.8218±0.0015		
0.8213±0.0015		
38 mL		
0.8789±0.0012	0.8783±0.0012	0.0586
0.8782±0.0012		
0.8779±0.0012		
40 mL		

0.9112±0.0008	0.9108±0.0008	0.0395
0.9105±0.0008		
0.9109±0.0008		
42 mL		
0.9653±0.0021	0.9645±0.0021	0.0883
0.9642±0.0021		
0.9641±0.0021		
44 mL		
1.0425±0.0012	1.0420±0.0012	0.0484
1.0421±0.0012		
1.0415±0.0012		

Trendline of T = 30^{o}C: y = 0.0233x – 0.0054 with R^2 = 0.9941.

Table S46. Error of adsorption solution's temperature (T = 40°C)

Optical density	Average OD	CV
26 mL		
0.6088±0.0013	0.6085±0.0013	0.0907
0.6089±0.0013		
0.6079±0.0013		
28 mL		
0.6592±0.0014	0.6587±0.0014	0.0865
0.6581±0.0014		
0.6589±0.0014		
30 mL		
0.6991±0.0005	0.6992±0.0005	0.0335
0.6995±0.0005		
0.6991±0.0005		
32 mL		
0.7549±0.0014	0.7547±0.0014	0.0755
0.7552±0.0014		
0.7541±0.0014		
34 mL		
0.7932±0.0008	0.7928±0.0008	0.0445
0.7925±0.0008		
0.7928±0.0008		
36 mL		
0.8479±0.0025	0.8476±0.0025	0.1211
0.8465±0.0025		
0.8485±0.0025		
38 mL		
0.8897±0.0017	0.8890±0.0017	0.0791
0.8883±0.0017		
0.8891±0.0017		
40 mL		

0.9152±0.0008	0.9148±0.0008	0.0386
0.9145±0.0008		
0.9148±0.0008		
42 mL		
0.9826±0.0018	0.9820±0.0018	0.0775
0.9824±0.0018		
0.9812±0.0018		
44 mL		
1.0105±0.0007	1.0104±0.0007	0.0305
1.0107±0.0007		
1.0101±0.0007		

Trendline of T = 40^{o}C: y = 0.0225x + 0.0292 with R^2 = 0.9969.

Table S47. Error of adsorption solution's temperature (T = 50°C)

Optical density	Average OD	CV
26 mL		
0.5969±0.0010	0.5965±0.0010	0.0680
0.5966±0.0010		
0.5961±0.0010		
28 mL		
0.6448±0.0005	0.6450±0.0005	0.0328
0.6452±0.0005		
0.6451±0.0005		
30 mL		
0.6942±0.0010	0.6938±0.0010	0.0585
0.6939±0.0010		
0.6934±0.0010		
32 mL		
0.7281±0.0008	0.7277±0.0008	0.0445
0.7276±0.0008		
0.7275±0.0008		
34 mL		
0.7899±0.0005	0.7897±0.0005	0.0268
0.7895±0.0005		
0.7898±0.0005		
36 mL		
0.8431±0.0009	0.8429±0.0009	0.0421
0.8432±0.0009		
0.8425±0.0009		
38 mL		
0.8932±0.0008	0.8928±0.0008	0.0403
0.8925±0.0008		
0.8929±0.0008		
40 mL		
0.9582±0.0011	0.9579±0.0011	0.0484

0.9574±0.0011		
0.9582±0.0011		
42 mL		
0.9917±0.0016	0.9915±0.0016	0.0672
0.9921±0.0016		
0.9908±0.0016		
44 mL		
1.0292±0.0010	1.0288±0.0010	0.0394
1.0288±0.0010		
1.0285±0.0010		

Trendline of T = 50^{o}C: y = 0.0248x – 0.0515 with R^2 = 0.9968.

Table S48. Error of adsorption solution's temperature (T = 60°C)

Optical density	Average OD	CV
26 mL		
0.5977±0.0014	0.5975±0.0014	0.0954
0.5969±0.0014		
0.5980±0.0014		
28 mL		
0.6135±0.0019	0.6127±0.0019	0.1310
0.6128±0.0019		
0.6119±0.0019		
30 mL		
0.6679±0.0018	0.6670±0.0018	0.1111
0.6668±0.0018		
0.6665±0.0018		
32 mL		
0.7139±0.0011	0.7137±0.0011	0.0664
0.7141±0.0011		
0.7132±0.0011		
34 mL		
0.7692±0.0016	0.7686±0.0016	0.0867
0.7688±0.0016		
0.7679±0.0016		
36 mL		
0.8183±0.0008	0.8179±0.0008	0.0396
0.8178±0.0008		
0.8177±0.0008		
38 mL		
0.8789±0.0012	0.8784±0.0012	0.0591
0.8786±0.0012		
0.8779±0.0012		
40 mL		
0.9195±0.0012	0.9190±0.0012	0.0594

0.9191±0.0012		
0.9185±0.0012		
42 mL		
0.9794±0.0011	0.9789±0.0011	0.0462
0.9785±0.0011		
0.9789±0.0011		
44 mL		
1.0157±0.0010	1.0152±0.0010	0.0406
1.0152±0.0010		
1.0149±0.0010		

Trendline of T = 60^{o}C: y = 0.0246x – 0.065 with R^2 = 0.9952.

Table S49. Error of adsorption solution's temperature (T = 70°C)

Optical density	Average OD	CV
26 mL		
0.5549±0.0017	0.5542±0.0017	0.1288
0.5535±0.0017		
0.5544±0.0017		
28 mL		
0.6262±0.0013	0.6256±0.0013	0.0882
0.6256±0.0013		
0.6251±0.0013		
30 mL		
0.6665±0.0016	0.6658±0.0016	0.0979
0.6658±0.0016		
0.6652±0.0016		
32 mL		
0.6999±0.0005	0.6997±0.0005	0.0303
0.6995±0.0005		
0.6998±0.0005		
34 mL		
0.7555±0.0009	0.7556±0.0009	0.0512
0.7561±0.0009		
0.7554±0.0009		
36 mL		
0.7909±0.0020	0.7902±0.0020	0.1055
0.7905±0.0020		
0.7893±0.0020		
38 mL		
0.8578±0.0011	0.8576±0.0011	0.0553
0.8571±0.0011		
0.8580±0.0011		
40 mL		
0.8899±0.0016	0.8898±0.0016	0.0736

0.8905±0.0016		
0.8892±0.0016		
42 mL		
0.9559±0.0010	0.9555±0.0010	0.0425
0.9551±0.0010		
0.9556±0.0010		
44 mL		
1.0163±0.0011	1.0158±0.0011	0.0451
1.0159±0.0011		
1.0154±0.0011		

Trendline of T = 70^{o}C: y = 0.0245x – 0.0773 with R^2 = 0.9947.

Table S50. Error of adsorption solution's temperature (T = 80°C)

Optical density	Average OD	CV
26 mL		
0.6069±0.0013	0.6065±0.0013	0.0910
0.6068±0.0013		
0.6059±0.0013		
28 mL		
0.6205±0.0012	0.6199±0.0012	0.0830
0.6198±0.0012		
0.6195±0.0012		
30 mL		
0.6921±0.0011	0.6918±0.0011	0.0693
0.6919±0.0011		
0.6915±0.0011		
32 mL		
0.7235±0.0014	0.7230±0.0014	0.0788
0.7232±0.0014		
0.7224±0.0014		
34 mL		
0.7939±0.0008	0.7935±0.0008	0.0445
0.7932±0.0008		
0.7935±0.0008		
36 mL		
0.8354±0.0011	0.8350±0.0011	0.0568
0.8352±0.0011		
0.8345±0.0011		
38 mL		
0.8877±0.0012	0.8876±0.0012	0.0568
0.8881±0.0012		
0.8871±0.0012		
40 mL		
0.9449±0.0017	0.9442±0.0017	0.0745

0.9443±0.0017		
0.9435±0.0017		
42 mL		
0.9819±0.0015	0.9812±0.0015	0.0619
0.9812±0.0015		
0.9807±0.0015		
44 mL		
1.0655±0.0012	1.0650±0.0012	0.0474
1.0651±0.0012		
1.0645±0.0012		

Trendline of T = 80^{o}C: y =0.0256x – 0.0817 with R^2 = 0.9926.

Table S51. Error of adsorption time (t = 10 minues)

Optical density	Average OD	CV
26 mL		
0.6342±0.0022	0.6332±0.0022	0.1430
0.6332±0.0022		
0.6324±0.0022		
28 mL		
0.6857±0.0021	0.6847±0.0021	0.1277
0.6840±0.0021		
0.6845±0.0021		
30 mL		
0.7351±0.0010	0.7355±0.0010	0.0552
0.7356±0.0010		
0.7359±0.0010		
32 mL		
0.7995±0.0016	0.7992±0.0016	0.0806
0.7985±0.0016		
0.7997±0.0016		
34 mL		
0.8599±0.0014	0.8595±0.0014	0.0642
0.8589±0.0014		
0.8598±0.0014		
36 mL		
0.9165±0.0007	0.9165±0.0007	0.0327
0.9162±0.0007		
0.9168±0.0007		
38 mL		
0.9790±0.0019	0.9789±0.0019	0.0820
0.9797±0.0019		
0.9781±0.0019		
40 mL		
1.0310±0.0008	1.0306±0.0008	0.0314

1.0305±0.0008		
1.0304±0.0008		
42 mL		
1.0879±0.0005	1.0876±0.0005	0.0205
1.0876±0.0005		
1.0875±0.0005		
44 mL		
1.1121±0.0001	1.1120±0.0001	0.0063
1.1120±0.0001		
1.1120±0.0001		

Trendline of t = 10 minutes: $y = 0.0297x - 0.0921$ with $R^2 = 0.9965$.

Table S52. Error of adsorption time (t = 20 minues)

Optical density	Average OD	CV
26 mL		
0.7093±0.0003	0.7093±0.0003	0.0222
0.7095±0.0003		
0.7092±0.0003		
28 mL		
0.7995±0.0011	0.7991±0.0011	0.0593
0.7986±0.0011		
0.7993±0.0011		
30 mL		
0.8519±0.0003	0.8517±0.0003	0.0185
0.8516±0.0003		
0.8517±0.0003		
32 mL		
0.8889±0.0006	0.8889±0.0006	0.0286
0.8887±0.0006		
0.8892±0.0006		
34 mL		
0.9435±0.0023	0.9432±0.0023	0.0986
0.9422±0.0023		
0.9440±0.0023		
36 mL		
0.9975±0.0023	0.9965±0.0023	0.0954
0.9956±0.0023		
0.9965±0.0023		
38 mL		
1.0536±0.0023	1.0533±0.0023	0.0883
1.0541±0.0023		
1.0523±0.0023		
40 mL		
1.1015±0.0011	1.1016±0.0011	0.0435

1.1022±0.0011		
1.1013±0.0011		
42 mL		
1.1542±0.0028	1.1540±0.0028	0.1004
1.1551±0.0028		
1.1528±0.0028		
44 mL		
1.1895±0.0012	1.1899±0.0012	0.0432
1.1898±0.0012		
1.1905±0.0012		

Trendline of t = 20 minutes: $y = 0.0261x + 0.056$ with $R^2 = 0.9947$.

Table S53. Error of adsorption time (t = 30 minues)

Optical density	Average OD	CV
26 mL		
0.6128±0.0022	0.6126±0.0022	0.1487
0.6135±0.0022		
0.6117±0.0022		
28 mL		
0.6549±0.0016	0.6548±0.0016	0.1001
0.6542±0.0016		
0.6555±0.0016		
30 mL		
0.6925±0.0026	0.6924±0.0026	0.1521
0.6935±0.0026		
0.6914±0.0026		
32 mL		
0.7536±0.0024	0.7535±0.0024	0.1330
0.7545±0.0024		
0.7525±0.0024		
34 mL		
0.7955±0.0026	0.7952±0.0026	0.1348
0.7962±0.0026		
0.7941±0.0026		
36 mL		
0.8288±0.0005	0.8287±0.0005	0.0255
0.8289±0.0005		
0.8285±0.0005		
38 mL		
0.8694±0.0011	0.8689±0.0011	0.0521
0.8685±0.0011		
0.8689±0.0011		
40 mL		
0.9471±0.0016	0.9471±0.0016	0.0688

0.9478±0.0016		
0.9465±0.0016		
42 mL		
0.9835±0.0039	0.9827±0.0039	0.1623
0.9838±0.0039		
0.9809±0.0039		
44 mL		
1.0211±0.0012	1.0205±0.0012	0.0485
1.0202±0.0012		
1.0203±0.0012		

Trendline of t = 30 minutes: $y = 0.0231x + 0.0075$ with $R^2 = 0.9955$.

Table S54. Error of adsorption time (t = 40 minues)

Optical density	Average OD	CV
26 mL		
0.6088±0.0016	0.6081±0.0016	0.1072
0.6075±0.0016		
0.6081±0.0016		
28 mL		
0.6625±0.0055	0.6599±0.0055	0.3390
0.6589±0.0055		
0.6584±0.0055		
30 mL		
0.6906±0.0032	0.6895±0.0032	0.1907
0.6885±0.0032		
0.6895±0.0032		
32 mL		
0.7475±0.0022	0.7474±0.0022	0.1207
0.7483±0.0022		
0.7465±0.0022		
34 mL		
0.7802±0.0076	0.7801±0.0076	0.0395
0.7804±0.0076		
0.7798±0.0076		
36 mL		
0.8310±0.0024	0.8298±0.0024	0.1211
0.8295±0.0024		
0.8291±0.0024		
38 mL		
0.8820±0.0020	0.8825±0.0020	0.0951
0.8835±0.0020		
0.8821±0.0020		
40 mL		
0.9395±0.0004	0.9396±0.0004	0.0184

0.9398±0.0004		
0.9397±0.0004		
42 mL		
0.9715±0.0021	0.9714±0.0021	0.0879
0.9723±0.0021		
0.9706±0.0021		
44 mL		
1.0382±0.0016	1.0375±0.0016	0.0628
1.0375±0.0016		
1.0369±0.0016		

Trendline of t = 40 minutees: y = 0.0235x - 0.0075 with R^2 = 0.9965.

Table S55. Error of adsorption time (t = 50 minues)

Optical density	Average OD	CV
26 mL		
0.6059±0.0016	0.6053±0.0016	0.1102
0.6046±0.0016		
0.6055±0.0016		
28 mL		
0.6505±0.0017	0.6502±0.0017	0.1054
0.6495±0.0017		
0.6508±0.0017		
30 mL		
0.6952±0.003	0.6940±0.003	0.1741
0.6942±0.003		
0.6928±0.003		
32 mL		
0.7425±0.0016	0.7418±0.0016	0.0883
0.7419±0.0016		
0.7412±0.0016		
34 mL		
0.7905±0.0008	0.7901±0.0008	0.0447
0.7898±0.0008		
0.7901±0.0008		
36 mL		
0.8219±0.0018	0.8213±0.0018	0.0898
0.8205±0.0018		
0.8216±0.0018		
38 mL		
0.8735±0.0018	0.8733±0.0018	0.00875
0.8725±0.0018		
0.8740±0.0018		
40 mL		
0.9104±0.0013	0.9109±0.0013	0.0606

0.9115±0.0013		
0.9109±0.0013		
42 mL		
0.9642±0.0012	0.9636±0.0012	0.0534
0.9632±0.0012		
0.9635±0.0012		
44 mL		
1.0505±0.0017	1.0502±0.0017	0.0652
1.0495±0.0017		
1.0508±0.0017		

Trendline of t = 50 minutes: $y = 0.0234x - 0.0075$ with $R^2 = 0.9917$.

Table S56. Error of adsorption time (t = 60 minues)

Optical density	Average OD	CV
26 mL		
0.6030±0.0012	0.6033±0.0012	0.0820
0.6039±0.0012		
0.6031±0.0012		
28 mL		
0.6489±0.0042	0.6486±0.0042	0.2645
0.6468±0.0042		
0.6502±0.0042		
30 mL		
0.6975±0.0012	0.6970±0.0012	0.0724
0.6965±0.0012		
0.6971±0.0012		
32 mL		
0.7329±0.0017	0.7325±0.0017	0.0989
0.7330±0.0017		
0.7317±0.0017		
34 mL		
0.7909±0.0036	0.7904±0.0036	0.1865
0.7915±0.0036		
0.7887±0.0036		
36 mL		
0.8228±0.0023	0.8218±0.0023	0.1157
0.8209±0.0023		
0.8218±0.0023		
38 mL		
0.8784±0.0010	0.8783±0.0010	0.0462
0.8787±0.0010		
0.8779±0.0010		
40 mL		
0.9109±0.0016	0.9108±0.0016	0.0719

0.9102±0.0016		
0.9115±0.0016		
42 mL		
0.9657±0.00027	0.9645±0.0027	0.1147
0.9644±0.0027		
0.9635±0.0027		
44 mL		
1.0415±0.0022	1.0420±0.0022	0.0887
1.0431±0.0022		
1.0415±0.0022		

Trendline of t = 60 minutes: $y = 0.0233x - 0.0075$ with $R^2 = 0.9943$.

Table S57. Error of speed of centrifugal shaker (80RPM)

Optical density	Average OD	CV
26 mL		
0.6092±0.0006	0.6089±0.0006	0.0418
0.6087±0.0006		
0.6089±0.0006		
28 mL		
0.6479±0.0008	0.6478±0.0008	0.0556
0.6475±0.0008		
0.6482±0.0008		
30 mL		
0.6979±0.0017	0.6972±0.0017	0.1009
0.6973±0.0017		
0.6965±0.0017		
32 mL		
0.7477±0.0006	0.7474±0.0006	0.0353
0.7472±0.0006		
0.7475±0.0006		
34 mL		
0.7963±0.0008	0.7959±0.0008	0.0407
0.7958±0.0008		
0.7957±0.0008		
36 mL		
0.8302±0.0008	0.8303±0.0008	0.0390
0.8301±0.0008		
0.8307±0.0008		
38 mL		
0.8839±0.0010	0.8838±0.0010	0.0459
0.8834±0.0010		
0.8842±0.0010		
40 mL		
0.9285±0.0008	0.9281±0.0008	0.0380

0.9281±0.0008		
0.9278±0.0008		
42 mL		
0.9712±0.0008	0.9708±0.0008	0.0364
0.9708±0.0008		
0.9705±0.0008		
44 mL		
1.0282±0.0016	1.0280±0.0016	0.0648
1.0286±0.0016		
1.0273±0.0016		

Trendlin of 80RPM: $y = 0.0231x + 0.0045$ with $R^2 = 0.9990$.

Table S58. Error of speed of centrifugal shaker (160RPM)

Optical density	Average OD	CV
26 mL		
0.6032±0.0010	0.6027±0.0010	0.0694
0.6024±0.0010		
0.6026±0.0010		
28 mL		
0.6410±0.0010	0.6405±0.0010	0.0653
0.6404±0.0010		
0.6402±0.0010		
30 mL		
0.6912±0.0012	0.6906±0.0012	0.0716
0.6904±0.0012		
0.6903±0.0012		
32 mL		
0.7223±0.0018	0.7215±0.0018	0.1041
0.7215±0.0018		
0.7208±0.0018		
34 mL		
0.7729±0.0014	0.7722±0.0014	0.0744
0.7721±0.0014		
0.7718±0.0014		
36 mL		
0.8122±0.0009	0.8119±0.0009	0.0469
0.8115±0.0009		
0.8121±0.0009		
38 mL		
0.8711±0.0008	0.8707±0.0008	0.0406
0.8704±0.0008		
0.8707±0.0008		
40 mL		
0.9108±0.0009	0.9105±0.0009	0.0418

0.9101±0.0009		
0.9107±0.0009		
42 mL		
0.9668±0.0018	0.9665±0.0018	0.0763
0.9671±0.0018		
0.9657±0.0018		
44 mL		
1.0218±0.0008	1.0214±0.0008	0.0353
1.0215±0.0008		
1.0211±0.0008		

Trendline of 160RPM: $y = 0.0231x - 0.0091$ with $R^2 = 0.9966$.

Table S59. Error of speed of centrifugal shaker (240RPM)

Optical density	Average OD	CV
26 mL		
0.5815±0.0013	0.5809±0.0013	0.0950
0.5804±0.0013		
0.5809±0.0013		
28 mL		
0.6243±0.0013	0.6237±0.0013	0.0885
0.6237±0.0013		
0.6232±0.0013		
30 mL		
0.6741±0.0012	0.6740±0.0012	0.0749
0.6745±0.0012		
0.6735±0.0012		
32 mL		
0.7212±0.0008	0.7208±0.0008	0.0490
0.7208±0.0008		
0.7205±0.0008		
34 mL		
0.7729±0.0012	0.7724±0.0012	0.0653
0.7719±0.0012		
0.7725±0.0012		
36 mL		
0.8349±0.0015	0.8342±0.0015	0.0729
0.8342±0.0015		
0.8337±0.0015		
38 mL		
0.8729±0.0016	0.8722±0.0016	0.0747
0.8722±0.0016		
0.8716±0.0016		
40 mL		
0.9339±0.0014	0.9332±0.0014	0.0615

0.9331±0.0014		
0.9328±0.0014		
42 mL		
0.9789±0.0018	0.9780±0.0018	0.0758
0.9778±0.0018		
0.9775±0.0018		
44 mL		
1.0232±0.0015	1.0225±0.0015	0.0598
1.0224±0.0015		
1.0220±0.0015		

Trendline of 240RPM: $y = 0.0251x - 0.0756$ with $R^2 = 0.9989$.

Table S60. Error of speed of centrifugal shaker (320RPM)

Optical density	Average OD	CV
26 mL		
0.5709±0.0008	0.5706±0.0008	0.0619
0.5702±0.0008		
0.5706±0.0008		
28 mL		
0.6172±0.0006	0.6169±0.0006	0.0413
0.6167±0.0006		
0.6169±0.0006		
30 mL		
0.6623±0.0006	0.6620±0.0006	0.0385
0.6618±0.0006		
0.6620±0.0006		
32 mL		
0.7051±0.0019	0.7043±0.0019	0.1140
0.7044±0.0019		
0.7035±0.0019		
34 mL		
0.7552±0.0012	0.7546±0.0012	0.0675
0.7546±0.0012		
0.7542±0.0012		
36 mL		
0.7995±0.0056	0.7990±0.0056	0.2867
0.7991±0.0056		
0.7985±0.0056		
38 mL		
0.8569±0.0011	0.8564±0.0011	0.0528
0.8560±0.0011		
0.8564±0.0011		
40 mL		
0.8973±0.0008	0.8969±0.0008	0.0394

0.8969±0.0008		
0.8966±0.0008		
42 mL		
0.9486±0.0008	0.9487±0.0008	0.0341
0.9491±0.0008		
0.9485±0.0008		
44 mL		
1.0234±0.0008	1.0230±0.0008	0.0345
1.0227±0.0008		
1.0230±0.0008		

Trendline of 320RPM: y =0.0245x – 0.0726 with R^2 = 0.9965.

Table S61. Error of order of reaction at $[Cu^{2+}]$ = 100 g mL^{-1} in 10 minutes

Optical density	Average OD	CV
30 mL		
0.6918±0.0012	0.6912±0.0012	0.0716
0.6909±0.0012		
0.6910±0.0012		
32 mL		
0.7521±0.0008	0.7517±0.0008	0.0431
0.7515±0.0008		
0.7516±0.0008		
34 mL		
0.8061±0.0012	0.8055±0.0012	0.0639
0.8051±0.0012		
0.8054±0.0012		
36 mL		
0.8541±0.0012	0.8545±0.0012	0.0602
0.8544±0.0012		
0.8551±0.0012		
38 mL		
0.9010±0.0012	0.9005±0.0012	0.0560
0.9006±0.0012		
0.9000±0.0012		

Trendline: $y = 0.0261x - 0.0857$ with $R^2 = 0.9970$.

Table S62. Error of order of reaction at $[Cu^{2+}]$ = 100 g mL^{-1} in 15 minutes

Optical density	Average OD	CV
30 mL		
0.6931±0.0027	0.6938±0.0027	0.1588
0.6933±0.0027		
0.6951±0.0027		
32 mL		
0.7533±0.0009	0.7537±0.0009	0.0505
0.7539±0.0009		
0.7540±0.0009		
34 mL		
0.8088±0.0009	0.8085±0.0009	0.0470
0.8081±0.0009		
0.8087±0.0009		
36 mL		
0.8522±0.0010	0.8525±0.0010	0.0490
0.8530±0.0010		
0.8524±0.0010		
38 mL		
0.9019±0.0010	0.9014±0.0010	0.0464
0.9011±0.0010		
0.9013±0.0010		

Trendline: $y = 0.0257x - 0.0718$ with $R^2 = 0.9965$.

Table S63. Error of order of reaction at $[Cu^{2+}]$ = 100 g mL^{-1} in 20 minutes

Optical density	Average OD	CV
30 mL		
0.7119±0.0017	0.7111±0.0017	0.0999
0.7110±0.0017		
0.7105±0.0017		
32 mL		
0.7692±0.0015	0.7688±0.0015	0.0827
0.7681±0.0015		
0.7692±0.0015		
34 mL		
0.8151±0.0007	0.8148±0.0007	0.0378
0.8145±0.0007		
0.8149±0.0007		
36 mL		
0.8619±0.0010	0.8614±0.0010	0.0485
0.8611±0.0010		
0.8613±0.0010		
38 mL		
0.9200±0.0016	0.9207±0.0016	0.0724
0.9209±0.0016		
0.9213±0.0016		

Trendline $y = 0.0256x - 0.0547$ with $R^2 = 0.9977$.

Table S64. Error of order of reaction at $[Cu^{2+}]$ = 100 g mL^{-1} in 25 minutes

Optical density	Average OD	CV
30 mL		
0.7288±0.0016	0.7281±0.0016	0.0895
0.7281±0.0016		
0.7275±0.0016		
32 mL		
0.7782±0.0015	0.7778±0.0015	0.0818
0.7771±0.0015		
0.7782±0.0015		
34 mL		
0.8299±0.0017	0.8298±0.0017	0.0847
0.8291±0.0017		
0.8305±0.0017		
36 mL		
0.8810±0.0012	0.8804±0.0012	0.0562
0.8801±0.0012		
0.8802±0.0012		
38 mL		
0.9301±0.0014	0.9307±0.0014	0.0612
0.9309±0.0014		
0.9312±0.0014		

Trendline: $y = 0.0254x - 0.0339$ with $R^2 = 0.9999$.

Table S65. Error of order of reaction at $[Cu^{2+}]$ = 100 g mL^{-1} in 30 minutes

Optical density	Average OD	CV
30 mL		
0.7288±0.0016	0.7281±0.0016	0.0895
0.7281±0.0016		
0.7275±0.0016		
32 mL		
0.7782±0.0015	0.7778±0.0015	0.0818
0.7771±0.0015		
0.7782±0.0015		
34 mL		
0.8299±0.0017	0.8298±0.0017	0.0847
0.8291±0.0017		
0.8305±0.0017		
36 mL		
0.8810±0.0012	0.8804±0.0012	0.0562
0.8801±0.0012		
0.8802±0.0012		
38 mL		
0.9301±0.0014	0.9307±0.0014	0.0612
0.9309±0.0014		
0.9312±0.0014		

Trendline: $y = 0.024x + 0.0044$ with $R^2 = 0.9990$.

Table S66. Error of order of reaction at $[Cu^{2+}]$ = 75 g mL^{-1} in 10 minutes

Optical density	Average OD	CV
30 mL		
0.7089±0.0010	0.7085±0.0010	0.0573
0.7081±0.0010		
0.7086±0.0010		
32 mL		
0.7550±0.0027	0.7541±0.0027	0.1455
0.7545±0.0027		
0.7529±0.0027		
34 mL		
0.8055±0.0022	0.8051±0.0022	0.1128
0.8058±0.0022		
0.8041±0.0021		
36 mL		
0.8520±0.0017	0.8519±0.0017	0.0825
0.8512±0.0017		
0.8526±0.0017		
38 mL		
0.9159±0.0010	0.9154±0.0010	0.0456
0.9151±0.0010		
0.9153±0.0010		

Trendline $y = 0.0256x - 0.0627$ with $R^2 = 0.9963$.

Table S67. Error of order of reaction at $[Cu^{2+}]$ = 75 g mL^{-1} in 15 minutes

Optical density	Average OD	CV
30 mL		
0.6966±0.0012	0.6961±0.0012	0.0725
0.6962±0.0012		
0.6956±0.0012		
32 mL		
0.7489±0.0019	0.7480±0.0019	0.1039
0.7474±0.0019		
0.7478±0.0019		
34 mL		
0.8028±0.0008	0.8024±0.0008	0.0403
0.8022±0.0008		
0.8023±0.0008		
36 mL		
0.8559±0.0010	0.8554±0.0010	0.0489
0.8551±0.0010		
0.8553±0.0010		
38 mL		
0.8922±0.0014	0.8928±0.0014	0.0638
0.8933±0.0014		
0.8930±0.0014		

Trendline: $y = 0.025x - 0.0524$ with $R^2 = 0.9960$.

Table S68. Error of order of reaction at $[Cu^{2+}]$ = 75 g mL^{-1} in 20 minutes

Optical density	Average OD	CV
30 mL		
0.6988±0.0008	0.6984±0.0008	0.0506
0.6981±0.0008		
0.6984±0.0008		
32 mL		
0.7612±0.0014	0.7607±0.0014	0.0749
0.7601±0.0014		
0.7609±0.0014		
34 mL		
0.8018±0.0008	0.8014±0.0008	0.0404
0.8012±0.0008		
0.8013±0.0008		
36 mL		
0.8621±0.0003	0.8619±0.0003	0.0183
0.8618±0.0003		
0.8619±0.0003		
38 mL		
0.8961±0.0010	0.8965±0.0010	0.0453
0.8969±0.0010		
0.8966±0.0010		

Trendline $y = 0.0249x - 0.0418$ with $R^2 = 0.9920$.

Table S69. Error of order of reaction at $[Cu^{2+}]$ = 75 g mL^{-1} in 25 minutes

Optical density	Average OD	CV
30 mL		
0.7100±0.0023	0.7107±0.0023	0.1331
0.7104±0.0023		
0.7118±0.0023		
32 mL		
0.7655±0.0020	0.7652±0.0020	0.1089
0.7659±0.0020		
0.7643±0.0020		
34 mL		
0.8099±0.0023	0.8091±0.0023	0.1149
0.8094±0.0023		
0.8081±0.0023		
36 mL		
0.8577±0.0009	0.8575±0.0009	0.0444
0.8571±0.0009		
0.8578±0.0009		
38 mL		
0.8958±0.0018	0.8952±0.0018	0.0824
0.8955±0.0018		
0.8944±0.0018		

Trendline: $y = 0.0231x + 0.0233$ with $R^2 = 0.9966$.

Table S70. Error of order of reaction at $[Cu^{2+}]$ = 75 g mL^{-1} in 30 minutes

Optical density	Average OD	CV
30 mL		
0.6829±0.0010	0.6824±0.0010	0.0595
0.6822±0.0010		
0.6822±0.0010		
32 mL		
0.7401±0.0021	0.7407±0.0021	0.1149
0.7404±0.0021		
0.7417±0.0021		
34 mL		
0.7844±0.0005	0.7843±0.0005	0.0270
0.7841±0.0005		
0.7845±0.0005		
36 mL		
0.8349±0.0010	0.8345±0.0010	0.0486
0.8341±0.0010		
0.8346±0.0010		
38 mL		
0.8661±0.0012	0.8663±0.0012	0.0571
0.8669±0.0012		
0.8660±0.0012		

Trendline $y = 0.0231x - 0.0031$ with $R^2 = 0.9914$.

Table S71. Error of order of reaction at $[Cu^{2+}]$ = 50 g mL^{-1} in 10 minutes

Optical density	Average OD	CV
30 mL		
0.7288±0.0005	0.7286±0.0005	0.0291
0.7284±0.0005		
0.7287±0.0005		
32 mL		
0.7688±0.0010	0.7683±0.0010	0.0528
0.7681±0.0010		
0.7681±0.0010		
34 mL		
0.8100±0.0020	0.8109±0.0020	0.1028
0.8112±0.0020		
0.8116±0.0020		
36 mL		
0.8544±0.0006	0.8541±0.0006	0.0298
0.8541±0.0006		
0.8539±0.0006		
38 mL		
0.9149±0.0008	0.9145±0.0008	0.0354
0.9144±0.0008		
0.9143±0.0008		

Trendline $y = 0.0229x + 0.0374$ with $R^2 = 0.9928$.

Table S72. Error of order of reaction at $[Cu^{2+}]$ = 50 g mL^{-1} in 15 minutes

Optical density	Average OD	CV
30 mL		
0.6958±0.0008	0.6954±0.0008	0.0508
0.6951±0.0008		
0.6954±0.0008		
32 mL		
0.7466±0.0017	0.7467±0.0017	0.0951
0.7461±0.0017		
0.7475±0.0017		
34 mL		
0.7951±0.0009	0.7948±0.0009	0.0479
0.7944±0.0009		
0.7950±0.0009		
36 mL		
0.8334±0.0012	0.8335±0.0012	0.0617
0.8331±0.0012		
0.8341±0.0012		
38 mL		
0.8754±0.0010	0.8750±0.0010	0.0464
0.8751±0.0010		
0.8746±0.0010		

Trendline $y = 0.0223x + 0.0309$ with $R^2 = 0.9966$.

Table S73. Error of order of reaction at $[Cu^{2+}]$ = 50 g mL^{-1} in 20 minutes

Optical density	Average OD	CV
30 mL		
0.7122±0.0008	0.7125±0.0008	0.0496
0.7129±0.0008		
0.7125±0.0008		
32 mL		
0.7699±0.0010	0.7695±0.0010	0.0527
0.7691±0.0010		
0.7696±0.0010		
34 mL		
0.8222±0.0023	0.8228±0.0023	0.1130
0.8224±0.0023		
0.8239±0.0023		
36 mL		
0.8677±0.0008	0.8673±0.0008	0.0373
0.8671±0.0008		
0.8672±0.0008		
38 mL		
0.9114±0.0008	0.9116±0.0008	0.0355
0.9120±0.0008		
0.9115±0.0008		

Trendline: $y = 0.0248x - 0.0265$ with $R^2 = 0.9965$.

Table S74. Error of order of reaction at $[Cu^{2+}]$ = 50 g mL^{-1} in 25 minutes

Optical density	Average OD	CV
30 mL		
0.7031±0.0029	0.7039±0.0029	0.1695
0.7034±0.0029		
0.7053±0.0029		
32 mL		
0.7566±0.0021	0.7568±0.0021	0.1155
0.7561±0.0021		
0.7578±0.0021		
34 mL		
0.8052±0.0019	0.8051±0.0019	0.0997
0.8059±0.0019		
0.8043±0.0019		
36 mL		
0.8400±0.0016	0.8406±0.0016	0.0789
0.8409±0.0016		
0.8410±0.0016		
38 mL		
0.8922±0.0011	0.8927±0.0011	0.0531
0.8931±0.0011		
0.8929±0.0011		

Trendline $y = 0.0231x + 0.0154$ with $R^2 = 0.9963$.

Table S75. Error of order of reaction at $[Cu^{2+}]$ = 50 g mL^{-1} in 30 minutes

Optical density	Average OD	CV
30 mL		
0.7112±0.0010	0.7113±0.0010	0.0588
0.7118±0.0010		
0.7110±0.0010		
32 mL		
0.7520±0.0017	0.7521±0.0017	0.0944
0.7529±0.0017		
0.7515±0.0017		
34 mL		
0.8028±0.0012	0.8022±0.0012	0.0641
0.8021±0.0012		
0.8018±0.0012		
36 mL		
0.8489±0.0018	0.8481±0.0018	0.0886
0.8481±0.0018		
0.8474±0.0018		
38 mL		
0.8993±0.0028	0.8987±0.0028	0.1290
0.8995±0.0028		
0.8974±0.0028		

Trendline: $y = 0.0235x + 0.0021$ with $R^2 = 0.9988$.

Table S76. Error of kinetic equation at $[Cu^{2+}]$ = 100 g mL^{-1}

Optical density	Average OD	CV
30 mL		
0.6991±0.0018	0.6999±0.0018	0.1035
0.7003±0.0018		
0.7004±0.0018		
32 mlL		
0.7508±0.0014	0.7501±0.0014	0.0783
0.7497±0.0014		
0.7499±0.0014		
34 mL		
0.8015±0.0012	0.8010±0.0012	0.0630
0.8011±0.0012		
0.8005±0.0012		
36 mL		
0.8482±0.0011	0.8479±0.0011	0.0546
0.8474±0.0011		
0.8482±0.0011		
38 mL		
0.8861±0.0012	0.8865±0.0012	0.0580
0.8871±0.0012		
0.8864±0.0012		

Trendline: $y = 0.0236x - 0.0036$ with $R^2 = 0.9973$.

Table S77. Error of kinetic equation at $[Cu^{2+}]$ = 90 g mL^{-1}

Optical density	Average OD	CV
30 mL		
0.7055±0.0022	0.7051±0.0022	0.1288
0.7058±0.0022		
0.7041±0.0022		
32 mL		
0.7421±0.0019	0.7420±0.0019	0.1082
0.7428±0.0019		
0.7412±0.0019		
34 mL		
0.7921±0.0012	0.7922±0.0012	0.0649
0.7928±0.0012		
0.7918±0.0012		
36 mL		
0.8403±0.0015	0.8397±0.0015	0.0719
0.8391±0.0015		
0.8398±0.0015		
38 mL		
0.8888±0.0012	0.8887±0.0012	0.0568
0.8892±0.0012		
0.8882±0.0012		

Trendline: $y = 0.0232x + 0.0032$ with $R^2 = 0.9976$.

Table S78. Error of kinetic equation at $[Cu^{2+}]$ = 80 g mL^{-1}

Optical density	Average OD	CV
30 mL		
0.6579±0.0012	0.6573±0.0012	0.0753
0.6571±0.0012		
0.6570±0.0012		
32 mL		
0.7025±0.0013	0.7019±0.0013	0.0786
0.7014±0.0013		
0.7019±0.0013		
34 mL		
0.7499±0.0010	0.7495±0.0010	0.0541
0.7491±0.0010		
0.7496±0.0010		
36 mL		
0.7912±0.0011	0.7909±0.0011	0.0586
0.7904±0.0011		
0.7912±0.0011		
38 mL		
0.8320±0.0012	0.8315±0.0012	0.0607
0.8310±0.0012		
0.8316±0.0012		

Trendline: $y = 0.0219 + 0.0026$ with $R^2 = 0.9990$.

Table S79. Error of kinetic equation at $[Cu^{2+}]$ = 70 g mL^{-1}

Optical density	Average OD	CV
30 mL		
0.7016±0.0009	0.7014±0.0009	0.0542
0.7010±0.0009		
0.7017±0.0009		
32 mL		
0.7569±0.0010	0.7565±0.0010	0.0560
0.7561±0.0010		
0.7567±0.0010		
34 mL		
0.7969±0.0017	0.7968±0.0017	0.0883
0.7961±0.0017		
0.7975±0.0017		
36 mL		
0.8391±0.0018	0.8389±0.0018	0.0911
0.8381±0.0018		
0.8396±0.0018		
38 mL		
0.8949±0.0022	0.8940±0.002	0.1009
0.8941±0.0022		
0.8931±0.0022		

Trendline: $y = 0.0234x + 0.0026$ with $R^2 = 0.9964$.

Table S80. Error of kinetic equation at $[Cu^{2+}]$ = 60 g mL^{-1}

Optical density	Average OD	CV
30 mL		
0.7722±0.0012	0.7727±0.0012	0.0653
0.7732±0.0012		
0.7728±0.0012		
32 mL		
0.8091±0.0012	0.8086±0.0012	0.0624
0.8081±0.0012		
0.8087±0.0012		
34 mL		
0.8699±0.0010	0.8694±0.0010	0.0481
0.8691±0.0010		
0.8693±0.0010		
36 mL		
0.9109±0.0013	0.9106±0.0013	0.0606
0.9110±0.0013		
0.9100±0.0013		
38 mL		
0.9771±0.0023	0.9761±0.0023	0.0974
0.9761±0.0023		
0.9752±0.0023		

Trendline $y = 0.0254x + 0.0025$ with $R^2 = 0.9914$.

Table S81. Error of kinetic equation at $[Cu^{2+}]$ = 50 g mL^{-1}

Optical density	Average OD	CV
30 mL		
0.7119±0.0023	0.7111±0.0023	0.1307
0.7101±0.0023		
0.7114±0.0023		
32 mL		
0.7744±0.0018	0.7742±0.0018	0.0987
0.7749±0.0018		
0.7734±0.0018		
34 mL		
0.8169±0.0012	0.8163±0.0012	0.0606
0.8161±0.0012		
0.8160±0.0012		
36 mL		
0.8699±0.0015	0.8692±0.0015	0.0704
0.8691±0.0015		
0.8697±0.0015		
38 mL		
0.9041±0.0011	0.9039±0.0011	0.0524
0.9034±0.0011		
0.9043±0.0011		

Trendline $y = 0.024x - 0.0021$ with $R^2 = 0.9912$.

Table S82. Error of kinetic equation at $[Cu^{2+}]$ = 40 g mL^{-1}

Optical density	Average OD	CV
30 mL		
0.7233±0.0025	0.7239±0.0025	0.1398
0.7234±0.0025		
0.7251±0.0025		
32 mL		
0.7555±0.0016	0.7553±0.0016	0.0883
0.7559±0.0016		
0.7546±0.0016		
34 mL		
0.8061±0.0012	0.8056±0.0012	0.0626
0.8051±0.0012		
0.8057±0.0012		
36 mL		
0.8549±0.0010	0.8545±0.0010	0.0475
0.8541±0.0010		
0.8546±0.0010		
38 mL		
0.9129±0.0019	0.9121±0.0019	0.0880
0.9122±0.0019		
0.9113±0.0019		

Trendline: $y = 0.0238x + 0.0018$ with $R^2 = 0.9908$.

Table S83. Error of kinetic equation at $[Cu^{2+}]$ = 30 g mL^{-1}

Optical density	Average OD	CV
30 mL		
0.7432±0.0022	0.7422±0.0022	0.1223
0.7421±0.0022		
0.7414±0.0022		
32 mL		
0.7841±0.0010	0.7845±0.0010	0.0517
0.7846±0.0010		
0.7849±0.0010		
34 mL		
0.8333±0.0024	0.8323±0.0024	0.1204
0.8324±0.0024		
0.8313±0.0024		
36 mL		
0.8781±0.0018	0.8789±0.0018	0.0870
0.8791±0.0018		
0.8796±0.0018		
38 mL		
0.9401±0.0014	0.9403±0.0014	0.0624
0.9410±0.0014		
0.9399±0.0014		

Trendline: $y = 0.0245x + 0.0016$ with $R^2 = 0.9953$.

Table S84. Error of kinetic equation at $[Cu^{2+}]$ = 20 g mL^{-1}

Optical density	Average OD	CV
30 mL		
0.6999±0.0011	0.6996±0.0011	0.0662
0.6991±0.0011		
0.6999±0.0011		
32 mL		
0.7419±0.0015	0.7412±0.0015	0.0826
0.7411±0.0015		
0.7407±0.0015		
34 mL		
0.7844±0.0008	0.7845±0.0008	0.0413
0.7849±0.0008		
0.7843±0.0008		
36 mL		
0.8302±0.0010	0.8298±0.0010	0.0489
0.8299±0.0010		
0.8294±0.0010		
38 mL		
0.8882±0.0014	0.8875±0.0014	0.0661
0.8871±0.0014		
0.8873±0.0014		

Trendline: $y = 0.0232x - 0.001$ with $R^2 = 0.9955$.

Table S85. Error of kinetic equation at $[Cu^{2+}]$ = 10 g mL^{-1}

Optical density	Average OD	CV
30 mL		
0.6859±0.0015	0.6852±0.0015	0.0893
0.6851±0.0015		
0.6847±0.0015		
32 mL		
0.7477±0.0028	0.7471±0.0028	0.1552
0.7479±0.0028		
0.7458±0.0028		
34 mL		
0.7892±0.0013	0.7886±0.0013	0.0700
0.7881±0.0013		
0.7886±0.0013		
36 mL		
0.8399±0.0014	0.8397±0.0014	0.0678
0.8402±0.0014		
0.8391±0.0014		
38 mL		
0.8709±0.0012	0.8703±0.0012	0.0591
0.8699±0.0012		
0.8702±0.0012		

Trendline: $y = 0.0231x - 0.0006$ with $R^2 = 0.9884$.

Table S86. Error of thermodynamic equation at solution's temperature T = 29°C

Optical density	Average OD	CV
30 mL		
0.7244±0.0033	0.7246±0.0033	0.1884
0.7234±0.0033		
0.7261±0.0033		
32 mL		
0.7681±0.0009	0.7678±0.0009	0.0495
0.7674±0.0009		
0.7680±0.0009		
34 mL		
0.8199±0.0016	0.8191±0.0016	0.0814
0.8187±0.0016		
0.8188±0.0016		
36 mL		
0.8759±0.0020	0.8752±0.0020	0.0952
0.8755±0.0020		
0.8743±0.0020		
38 mL		
0.9133±0.0021	0.9131±0.0021	0.0945
0.9139±0.0021		
0.9122±0.0021		

Trendline: $y = 0.0242x - 0.0035$ with $R^2 = 0.9967$.

Table S87. Error of thermodynamic equation at solution's temperature T = 31°C

Optical density	Average OD	CV
30 mL		
0.7239±0.0010	0.7235±0.0010	0.0561
0.7231±0.0010		
0.7236±0.0010		
32 mL		
0.7702±0.0026	0.7694±0.0026	0.1402
0.7699±0.0026		
0.7682±0.0026		
34 mL		
0.8199±0.0010	0.8194±0.0010	0.0510
0.8191±0.0010		
0.8193±0.0010		
36 mL		
0.8749±0.0007	0.8747±0.0007	0.0333
0.8744±0.0007		
0.8749±0.0007		
38 mL		
0.9109±0.0014	0.9102±0.0014	0.0645
0.9100±0.0014		
0.9098±0.0014		

Trendline $y = 0.0239x + 0.0057$ with $R^2 = 0.9963$.

Table S88. Error of thermodynamic equation at solution's temperature T = 33°C

Optical density	Average OD	CV
30 mL		
0.7339±0.0012	0.7333±0.0012	0.0675
0.7331±0.0012		
0.7330±0.0012		
32 mL		
0.7766±0.0030	0.7768±0.0030	0.1600
0.7761±0.0030		
0.7784±0.0030		
34 mL		
0.8309±0.0011	0.8306±0.0011	0.0558
0.8301±0.0011		
0.8309±0.0011		
36 mL		
0.8788±0.0008	0.8784±0.0008	0.0402
0.8781±0.0008		
0.8784±0.0008		
38 mL		
0.9288±0.0008	0.9284±0.0008	0.0380
0.9281±0.0008		
0.9284±0.0008		

Trendline: $y = 0.0246x - 0.0066$ with $R^2 = 0.9992$.

Table S89. Error of thermodynamic equation at solution's temperature T = 35°C

Optical density	Average OD	CV
30 mL		
0.7229±0.0010	0.7224±0.0010	0.0579
0.7221±0.0010		
0.7223±0.0010		
32 mL		
0.7805±0.0020	0.7799±0.0020	0.1045
0.7790±0.0020		
0.7803±0.0020		
34 mL		
0.8333±0.0019	0.8336±0.0019	0.0952
0.8331±0.0019		
0.8345±0.0019		
36 mL		
0.8849±0.0015	0.8843±0.0015	0.0683
0.8844±0.0015		
0.8849±0.0015		
38 mL		
0.9151±0.0011	0.9155±0.0011	0.0494
0.9155±0.0011		
0.9160±0.0011		

Trendline: $y = 0.0245x - 0.0069$ with $R^2 = 0.9897$.

Table S90. Error of thermodynamic equation at solution's temperature T = 37°C

Optical density	Average OD	CV
30 mL		
0.7211±0.0018	0.7214±0.0018	0.1051
0.7209±0.0018		
0.7223±0.0018		
32 mL		
0.7701±0.0017	0.7708±0.0017	0.0912
0.7709±0.0017		
0.7715±0.0017		
34 mL		
0.8249±0.0010	0.8245±0.0010	0.0492
0.8241±0.0010		
0.8246±0.0010		
36 mL		
0.8655±0.0008	0.8651±0.0008	0.0408
0.8651±0.0008		
0.8648±0.0008		
38 mL		
0.9139±0.0019	0.9130±0.0019	0.0851
0.9128±0.0019		
0.9124±0.0019		

Trendline: $y = 0.0239x + 0.0072$ with $R^2 = 0.9983$.

Table S91. Error of adsorption first time

Optical density	Average OD	CV
30 mL		
0.6991±0.0012	0.6985±0.0012	0.0736
0.6981±0.0012		
0.6984±0.0012		
32 mL		
0.7441±0.0012	0.7435±0.0012	0.0692
0.7431±0.0012		
0.7434±0.0012		
34 mL		
0.7988±0.0008	0.7984±0.0008	0.0442
0.7981±0.0008		
0.7984±0.0008		
36 mL		
0.8520±0.0020	0.8511±0.0020	0.0950
0.8510±0.0020		
0.8504±0.0020		
38 mL		
0.8799±0.0023	0.8791±0.0023	0.1057
0.8794±0.0023		
0.8781±0.0023		

Trendline $y = 0.0234x - 0.0028$ with $R^2 = 0.9903$.

Table S92. Error of desorption first time

Optical density	Average OD	CV
30 mL		
0.7150±0.0014	0.7143±0.0014	0.0822
0.7141±0.0014		
0.7139±0.0014		
32 mL		
0.7533±0.0011	0.7538±0.0011	0.0629
0.7542±0.0011		
0.7540±0.0011		
34 mL		
0.8095±0.0018	0.8089±0.0018	0.0912
0.8081±0.0018		
0.8092±0.0018		
36 mL		
0.8634±0.0007	0.8637±0.0007	0.0337
0.8639±0.0007		
0.8639±0.0007		
38 mL		
0.8977±0.0020	0.8978±0.0020	0.0901
0.8971±0.0020		
0.8987±0.0020		

Trendline: $y = 0.0238x - 0.003$ with $R^2 = 0.9938$.

Table S93. Error of adsorption second time

Optical density	Average OD	CV
30 mL		
0.7042±0.0027	0.7032±0.0027	0.1583
0.7030±0.0027		
0.7025±0.0027		
32 mL		
0.7559±0.0010	0.7554±0.0010	0.0553
0.7551±0.0010		
0.7553±0.0010		
34 mL		
0.7941±0.0018	0.7949±0.0018	0.0962
0.7951±0.0018		
0.7956±0.0018		
36 mL		
0.8351±0.0021	0.8349±0.0021	0.1033
0.8340±0.0021		
0.8357±0.0021		
38 mL		
0.8961±0.0024	0.8969±0.0024	0.1083
0.8967±0.0024		
0.8980±0.0024		

Trendline: $y = 0.0233x + 0.0033$ with $R^2 = 0.9932$.

Table S94. Error of desorption second time

Optical density	Average OD	CV
30 mL		
0.7175±0.0018	0.7169±0.0018	0.1029
0.7161±0.0018		
0.7172±0.0018		
32 mL		
0.7635±0.0012	0.7629±0.0012	0.0648
0.7626±0.0012		
0.7627±0.0012		
34 mL		
0.8168±0.0021	0.8158±0.0021	0.1072
0.8151±0.0021		
0.8156±0.0021		
36 mL		
0.8722±0.0024	0.8712±0.0024	0.1150
0.8713±0.0024		
0.8702±0.0024		
38 mL		
0.9021±0.0026	0.9033±0.0026	0.0078
0.9039±0.0026		
0.9040±0.0026		

Trendline: $y = 0.0241x - 0.0038$ with $R^2 = 0.9938$.

Table S95. Error of adsorption third time

Optical density	Average OD	CV
30 mL		
0.7099±0.0022	0.7094±0.0022	0.1264
0.7100±0.0022		
0.7084±0.0022		
32 mL		
0.7551±0.0038	0.7538±0.0038	0.2061
0.7521±0.0038		
0.7543±0.0038		
34 mL		
0.8081±0.0038	0.8088±0.0038	0.1901
0.8078±0.0038		
0.8106±0.0038		
36 mL		
0.8544±0.0016	0.8536±0.0016	0.0798
0.8531±0.0016		
0.8534±0.0016		
38 mL		
0.8944±0.0065	0.8974±0.0065	0.2953
0.8986±0.0065		
0.8993±0.0065		

Trendline $y = 0.0238x - 0.0043$ with $R^2 = 0.9984$.

Table S96. Error of desorption third time

Optical density	Average OD	CV
30 mL		
0.7088±0.0008	0.7084±0.0008	0.0499
0.7081±0.0008		
0.7084±0.0008		
32 mL		
0.7523±0.0013	0.7528±0.0013	0.0733
0.7534±0.0013		
0.7528±0.0013		
34 mL		
0.8108±0.0021	0.8098±0.0021	0.1080
0.8091±0.0021		
0.8096±0.0021		
36 mL		
0.8555±0.0032	0.8551±0.0032	0.1509
0.8562±0.0032		
0.8537±0.0032		
38 mL		
0.8932±0.0020	0.8923±0.0020	0.0907
0.8922±0.0020		
0.8916±0.0020		

Trendline: $y = 0.0235x + 0.0045$ with $R^2 = 0.9954$.

Table S97. Error of adsorption fourth time

Optical density	Average OD	CV
30 mL		
0.7074±0.0039	0.7089±0.0039	0.2263
0.7088±0.0039		
0.7106±0.0093		
32 mL		
0.7499±0.0021	0.7490±0.0021	0.1136
0.7482±0.0021		
0.7490±0.0021		
34 mL		
0.7974±0.0016	0.7966±0.0016	0.0856
0.7961±0.0016		
0.7964±0.0016		
36 mL		
0.8499±0.0022	0.8490±0.0022	0.1063
0.8491±0.0022		
0.8481±0.0022		
38 mL		
0.8965±0.0020	0.8955±0.0020	0.0937
0.8951±0.0020		
0.8950±0.0020		

Trendline: $y = 0.0237x - 0.0046$ with $R^2 = 0.9982$.

Table S98. Error of desorption fourth time

Optical density	Average OD	CV
30 mL		
0.7088±0.0020	0.7078±0.0020	0.1186
0.7074±0.0020		
0.7073±0.0020		
32 mL		
0.7499±0.0032	0.7495±0.0032	0.1721
0.7481±0.0032		
0.7506±0.0032		
34 mL		
0.7959±0.0014	0.7957±0.0014	0.0716
0.7951±0.0014		
0.7962±0.0014		
36 mL		
0.8499±0.0023	0.8488±0.0023	0.1114
0.8481±0.0023		
0.8485±0.0023		
38 mL		
0.8944±0.0008	0.8947±0.0008	0.0395
0.8951±0.0008		
0.8947±0.0008		

Trendline: $y = 0.0237x - 0.005$ with $R^2 = 0.9985$.

Table S99. Error of adsorption fifth time

Optical density	Average OD	CV
30 mL		
0.7039±0.0018	0.7031±0.0018	0.1069
0.7031±0.0018		
0.7024±0.0018		
32 mL		
0.7549±0.0029	0.7545±0.0029	0.1582
0.7555±0.0029		
0.7532±0.0029		
34 mL		
0.8059±0.0014	0.8057±0.0014	0.0707
0.8051±0.0014		
0.8062±0.0014		
36 mL		
0.8477±0.0002	0.8472±0.0002	0.0083
0.8471±0.0002		
0.8469±0.0002		
38 mL		
0.8943±0.0015	0.8938±0.0015	0.0720
0.8941±0.0015		
0.8931±0.0015		

Trendline $y = 0.0237x - 0.0051$ with $R^2 = 0.9983$.

Table S100. Error of desorption fifth time

Optical density	Average OD	CV
30 mL		
0.7045±0.0008	0.7041±0.0008	0.0460
0.7040±0.0008		
0.7039±0.0008		
32 mL		
0.7545±0.0023	0.7534±0.0023	0.1255
0.7531±0.0023		
0.7527±0.0023		
34 mL		
0.8055±0.0029	0.8051±0.0029	0.1482
0.8061±0.0029		
0.8038±0.0029		
36 mL		
0.8430±0.0124	0.8479±0.0124	0.5898
0.8478±0.0124		
0.8530±0.0124		
38 mL		
0.8945±0.0029	0.8941±0.0029	0.1335
0.8951±0.0029		
0.8928±0.0029		

Trendline: $y = 0.0237x - 0.0057$ with $R^2 = 0.9989$.

Table S101. Error of adsorption sixth time

Optical density	Average OD	CV
30 mL		
0.7058±0.0051	0.7077±0.0051	0.2911
0.7099±0.0051		
0.7075±0.0051		
32 mL		
0.7588±0.0009	0.7585±0.0009	0.0502
0.7581±0.0009		
0.7587±0.0009		
34 mL		
0.8125±0.0018	0.8119±0.0018	0.0909
0.8111±0.0018		
0.8122±0.0018		
36 mL		
0.8533±0.0007	0.8536±0.0007	0.0341
0.8538±0.0007		
0.8538±0.0007		
38 mL		
0.8955±0.0014	0.8953±0.0014	0.0636
0.8958±0.0014		
0.8947±0.0014		

Trendline: $y = 0.0235x + 0.0059$ with $R^2 = 0.9967$.

Table S102. Error of desorption sixth time

Optical density	Average OD	CV
30 mL		
0.7099±0.0025	0.7087±0.0025	0.1428
0.7081±0.0025		
0.7082±0.0025		
32 mL		
0.7600±0.0035	0.7594±0.0035	0.1892
0.7578±0.0035		
0.7605±0.0035		
34 mL		
0.8012±0.0029	0.8023±0.0029	0.1503
0.8022±0.0029		
0.8036±0.0029		
36 mL		
0.8499±0.0005	0.8498±0.0005	0.0249
0.8500±0.0005		
0.8496±0.0005		
38 mL		
0.9034±0.0028	0.9021±0.0028	0.1261
0.9012±0.0028		
0.9018±0.0028		

Trendline $y = 0.0239x - 0.0068$ with $R^2 = 0.9990$.

Table S103. Error of adsorption seventh time

Optical density	Average OD	CV
30 mL		
0.7178±0.0028	0.7166±0.0028	0.1606
0.7155±0.0028		
0.7166±0.0028		
32 mL		
0.7649±0.0022	0.7642±0.0022	0.1188
0.7632±0.0022		
0.7646±0.0022		
34 mL		
0.8145±0.0030	0.8135±0.0030	0.1580
0.8141±0.0030		
0.8122±0.0030		
36 mL		
0.8600±0.0016	0.8604±0.0016	0.0775
0.8612±0.0016		
0.8601±0.0016		
38 mL		
0.9099±0.0018	0.9096±0.0018	0.0811
0.9088±0.0018		
0.9102±0.0018		

Trendline: $y = 0.0241x - 0.0069$ with $R^2 = 0.9999$.

Table S104. Error of desorption seventh time

Optical density	Average OD	CV
30 mL		
0.7166±0.0018	0.7158±0.0018	0.1050
0.7151±0.0018		
0.7158±0.0018		
32 mL		
0.7576±0.0018	0.7569±0.0018	0.1010
0.7561±0.0018		
0.7571±0.0018		
34 mL		
0.8045±0.0020	0.8035±0.0020	0.1044
0.8031±0.0020		
0.8030±0.0020		
36 mL		
0.8606±0.0005	0.8604±0.0005	0.0246
0.8602±0.0005		
0.8605±0.0005		
38 mL		
0.9062±0.0049	0.9039±0.0049	0.2197
0.9031±0.0049		
0.9025±0.0049		

Trendline $y = 0.024x - 0.0074$ with $R^2 = 0.9972$.

Table S105. Error of adsorption eighth time

Optical density	Average OD	CV
30 mL		
0.7100±0.0011	0.7104±0.0011	0.0637
0.7109±0.0011		
0.7104±0.0011		
32 mL		
0.7566±0.0026	0.7555±0.0026	0.1391
0.7545±0.0026		
0.7555±0.0026		
34 mL		
0.7966±0.0038	0.7961±0.0038	0.1952
0.7974±0.0038		
0.7944±0.0038		
36 mL		
0.8536±0.0032	0.8522±0.0032	0.1532
0.8521±0.0032		
0.8510±0.0032		
38 mL		
0.9000±0.0011	0.9004±0.0011	0.0502
0.9009±0.0011		
0.9004±0.0011		

Trendline: $y = 0.0238x - 0.0075$ with $R^2 = 0.9973$.

Table S106. Error of desorption eighth time

Optical density	Average OD	CV
30 mL		
0.7122±0.0021	0.7112±0.0021	0.1229
0.7110±0.0021		
0.7105±0.0021		
32 mL		
0.7509±0.0020	0.7499±0.0020	0.1119
0.7494±0.0020		
0.7495±0.0020		
34 mL		
0.7991±0.0057	0.7982±0.0057	0.2912
0.8000±0.0057		
0.7956±0.0057		
36 mL		
0.8499±0.0026	0.8493±0.0026	0.1259
0.8500±0.0026		
0.8481±0.0026		
38 mL		
0.9000±0.0018	0.8996±0.0018	0.0805
0.8988±0.0018		
0.9001±0.0018		

Trendline: $y = 0.0238x - 0.0079$ with $R^2 = 0.9974$.

Table S107. Error of adsorption ninth time

Optical density	Average OD	CV
30 mL		
0.7077±0.0017	0.7070±0.0017	0.0995
0.7071±0.0017		
0.7063±0.0017		
32 mL		
0.7499±0.0018	0.7495±0.0018	0.0966
0.7500±0.0018		
0.7487±0.0018		
34 mL		
0.8002±0.0015	0.7998±0.0015	0.0795
0.7991±0.0015		
0.8002±0.0015		
36 mL		
0.8466±0.0042	0.8467±0.0042	0.2013
0.8451±0.0042		
0.8485±0.0042		
38 mL		
0.8922±0.0025	0.8910±0.0025	0.1169
0.8902±0.0025		
0.8907±0.0025		

Trendline: $y = 0.0233x + 0.0080$ with $R^2 = 0.9994$.

Table S108. Error of desorption ninth time

Optical density	Average OD	CV
30 mL		
0.7092±0.0015	0.7088±0.0015	0.0897
0.7081±0.0015		
0.7092±0.0015		
32 mL		
0.7361±0.0065	0.7365±0.0065	0.3565
0.7354±0.0065		
0.7381±0.0065		
34 mL		
0.7912±0.0016	0.7908±0.0016	0.0812
0.7901±0.0016		
0.7912±0.0016		
36 mL		
0.8392±0.0018	0.8383±0.0018	0.0904
0.8378±0.0018		
0.8380±0.0018		
38 mL		
0.8888±0.0029	0.8883±0.0029	0.1320
0.8892±0.0029		
0.8870±0.0029		

Trendline: $y = 0.0230x + 0.0092$ with $R^2 = 0.9913$.

Table S109. Error of adsorption tenth time

Optical density	Average OD	CV
30 mL		
0.7168±0.0018	0.7159±0.0018	0.1059
0.7156±0.0018		
0.7154±0.0018		
32 mL		
0.7590±0.0019	0.7589±0.0019	0.1058
0.7581±0.0019		
0.7597±0.0019		
34 mL		
0.8044±0.0022	0.8043±0.0022	0.1122
0.8052±0.0022		
0.8034±0.0022		
36 mL		
0.8562±0.0027	0.8552±0.0027	0.1315
0.8555±0.0027		
0.8540±0.0027		
38 mL		
0.9098±0.0035	0.9085±0.0035	0.1562
0.9088±0.0035		
0.9070±0.0035		

Trendline $y = 0.0241x - 0.010$ with $R^2 = 0.9979$.

Table S110. Error of desorption tenth time

Optical density	Average OD	CV
30 mL		
0.7165±0.0012	0.7159±0.0012	0.0719
0.7155±0.0012		
0.7158±0.0012		
32 mL		
0.7500±0.0007	0.7497±0.0007	0.0411
0.7494±0.0007		
0.7498±0.0007		
34 mL		
0.8098±0.0021	0.8088±0.0021	0.1081
0.8081±0.0021		
0.8086±0.0021		
36 mL		
0.8588±0.0031	0.8582±0.0031	0.1457
0.8591±0.0031		
0.8568±0.0031		
38 mL		
0.9032±0.0023	0.9022±0.0023	0.1054
0.9022±0.0023		
0.9013±0.0023		

Trendline: $y = 0.0241x - 0.0109$ with $R^2 = 0.9947$.

Table S111. ANOVA two variables

	F	**F_{crit}**
pH and time		
pH (A)	102773.9	3.40
Time (B)	124767.2	3.01
Interaction (AB)	13482.06	2.51
pH and temperature		
pH (A)	2.68×10^8	3.40
Temperature (B)	2.27×10^8	3.01
Interaction (AB)	16593125	2.51
Temperature and time		
Temperature (A)	8616299	2.92
Time (B)	16561113	2.92
Interaction (AB)	1499828	2.21

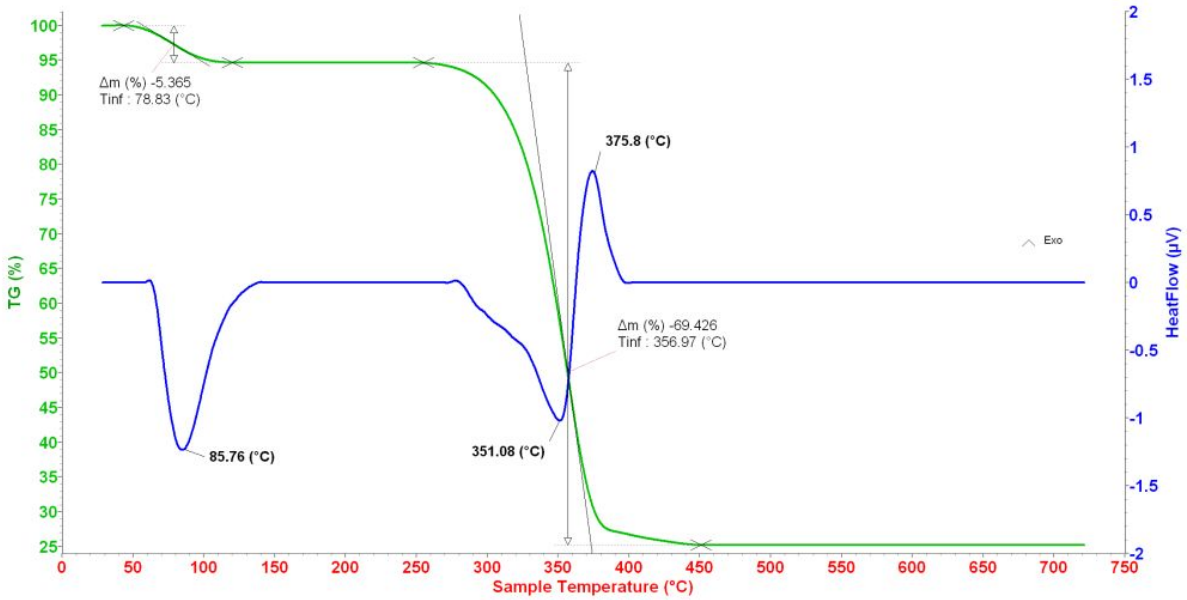

Figure S1. TGA/DSC curves of TCR

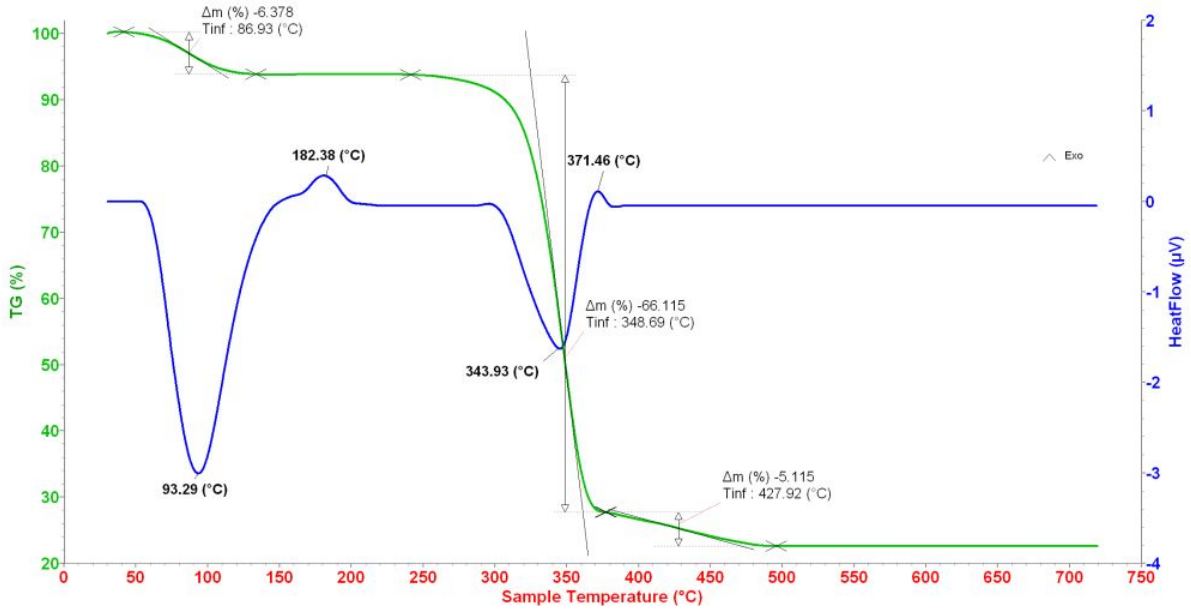

Figure S2. TGA/DSC curves of TC

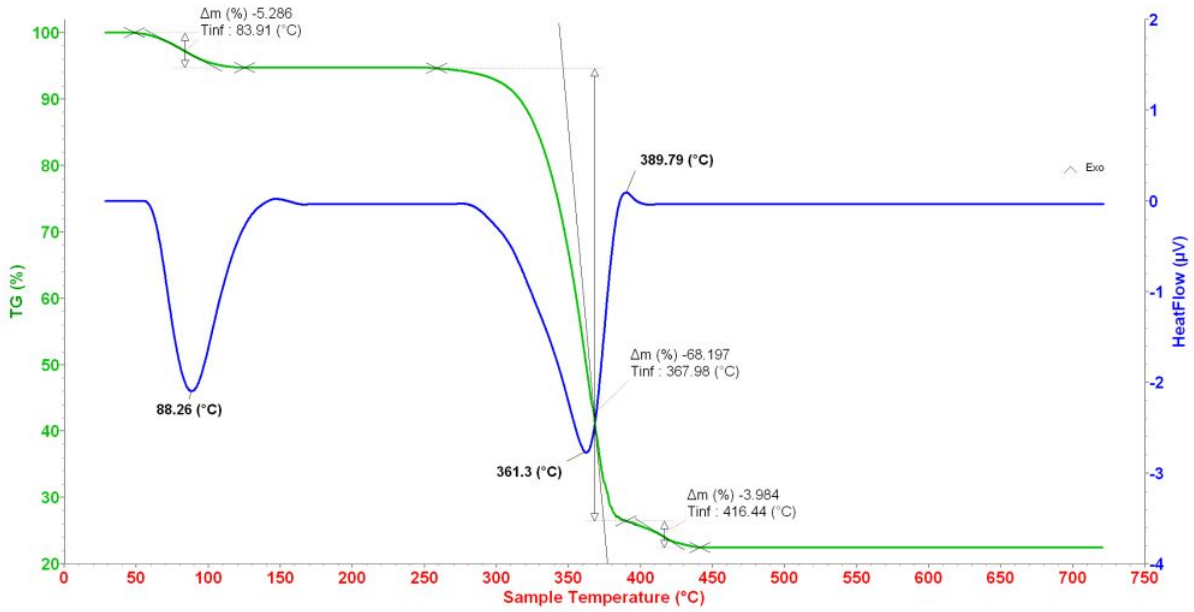

Figure S3. TGA/DSC curves of MTC

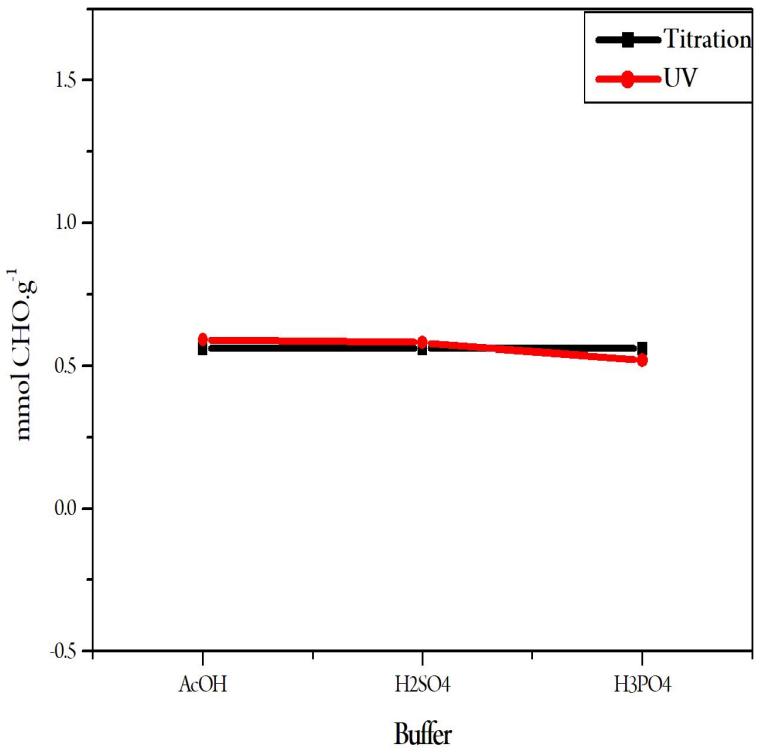

Figure S4. Effects of factors to the number of CHO groups, which analyzed by titration (the black line) and spectrophotometry (the red line): Elements of buffer solution

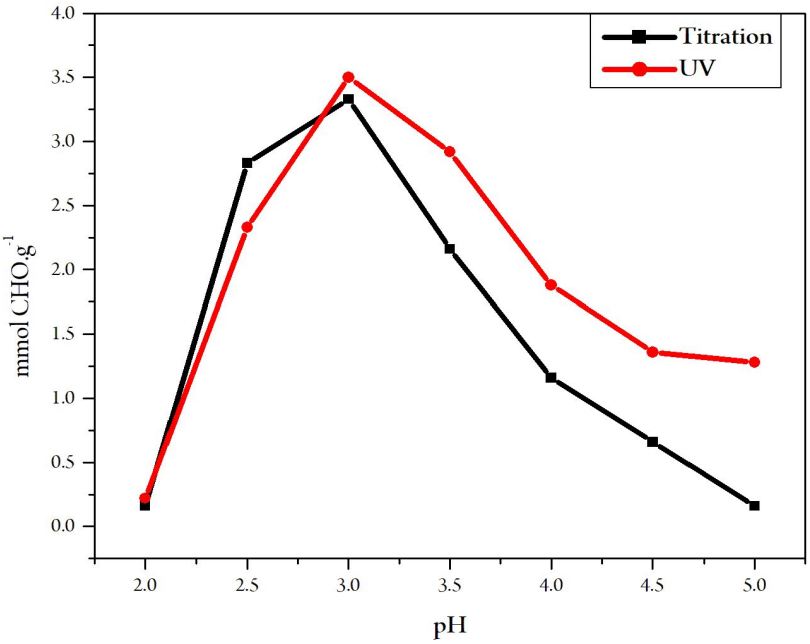

Figure S5. Effects of factors to the number of CHO groups, which analyzed by titration (the black line) and spectrophotometry (the red line): pH of buffer solution

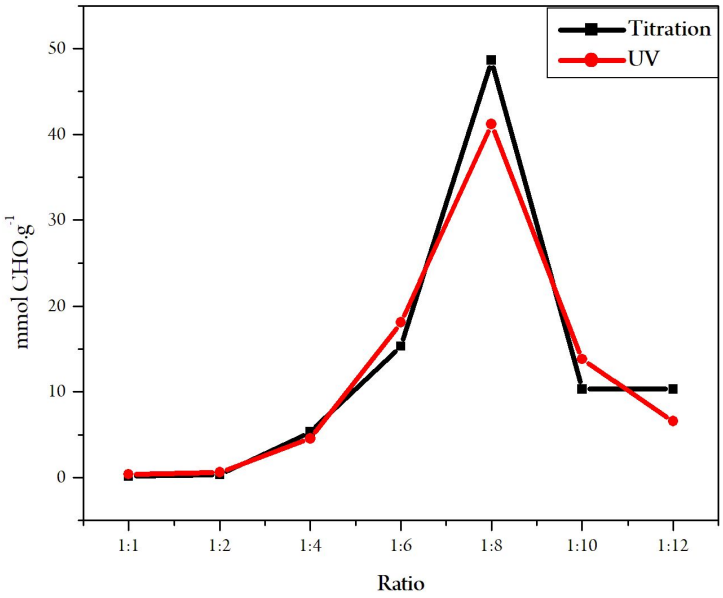

Figure S6. Effects of factors to the number of CHO groups, which analyzed by titration (the black line) and spectrophotometry (the red line): Mass ratio between TCR:KIO_4

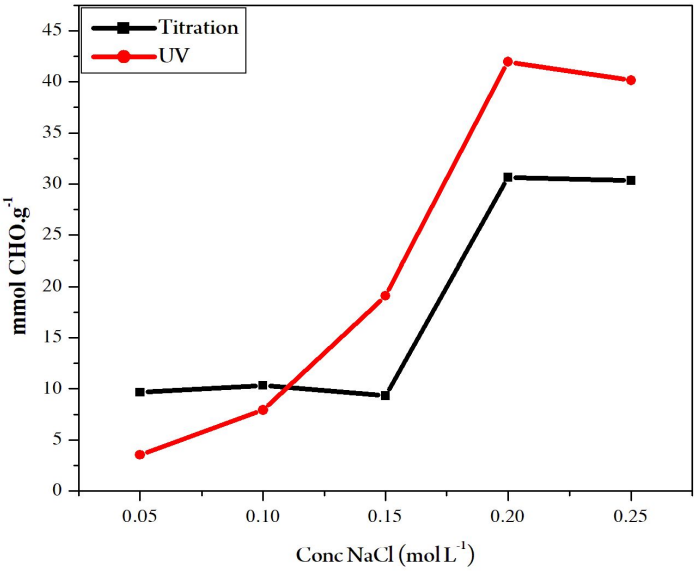

Figure S7. Effects of factors to the number of CHO groups, which analyzed by titration (the black line) and spectrophotometry (the red line): Ionic strength

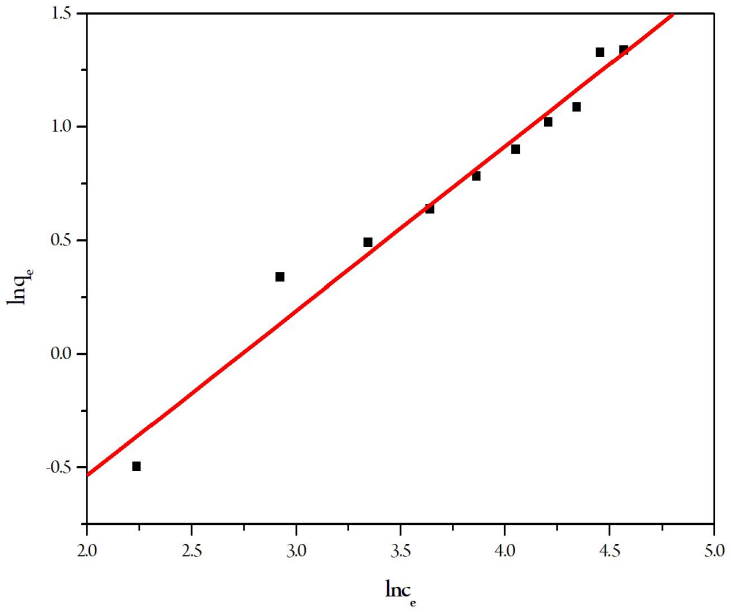

Figure S8. Paradigm of isotherm equation: Freundlich

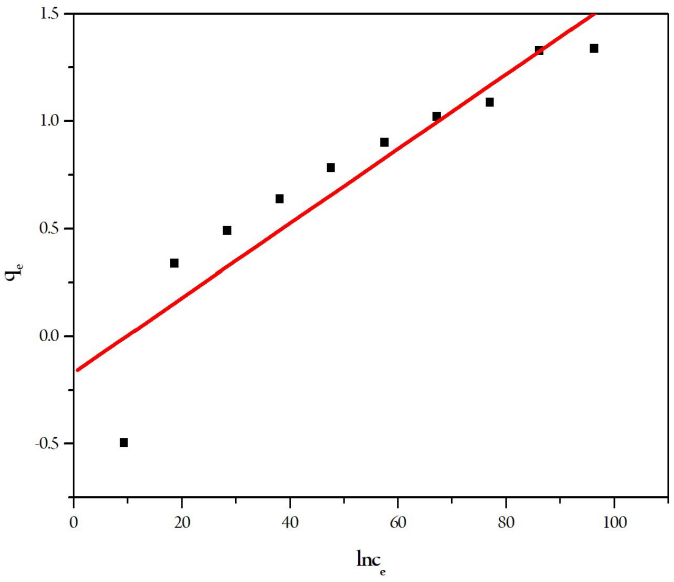

Figure S9. Paradigm of isotherm equation: Temkin

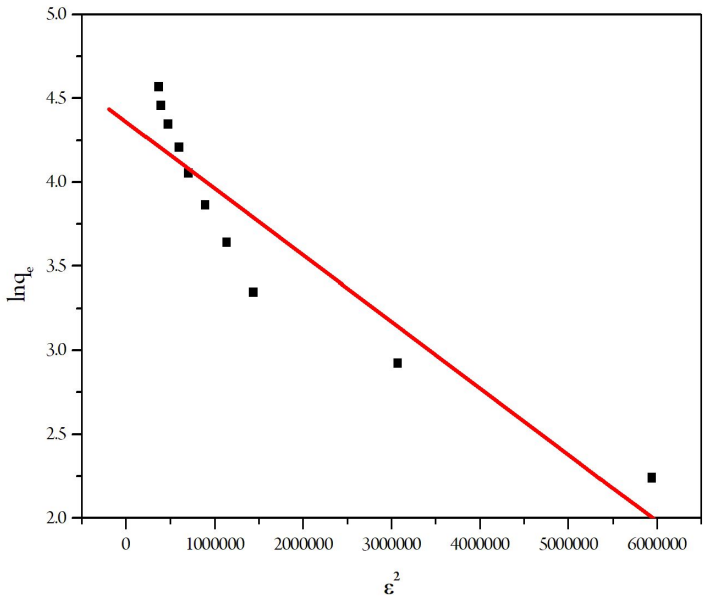

Figure S10. Paradigm of isotherm equation Dubinin – Radushkevich