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Supporting Information

A wear and heat resistant hydrophobic coating based on modified nanoparticles and waterborne-modified polyacrylic resin

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1.Supplementary results:

Table S1. Orthogonal Experiment 1

	BA(g)	Initiator(g)	solvent(mL)	ST(g)
1	6	1	100	7
2	1.5	0.1	25	1.75
3	24	10	400	28

Experiment number	BA	Initiator	solvent	ST	Value
1	1	1	1	1	0
2	1	2	2	2	5
3	1	3	3	3	3
4	2	1	2	3	0
5	2	2	3	1	1
6	2	3	1	2	0
7	3	1	3	2	2
8	3	2	1	3	4
9	3	3	2	1	6
T_{1j}	8	2	4	7	
T_{2j}	1	10	11	7	
T_{3j}	12	9	6	7	
R_j	11	8	7	0	

factor importance ranking：BA、Initiator、solvent、ST

best combination:BA_3、$Initiator_2$、$solvent_2$、ST_2

Evaluation standard: according to the slope of the fitting curve of the material (mass percentage of loss per unit friction circle)

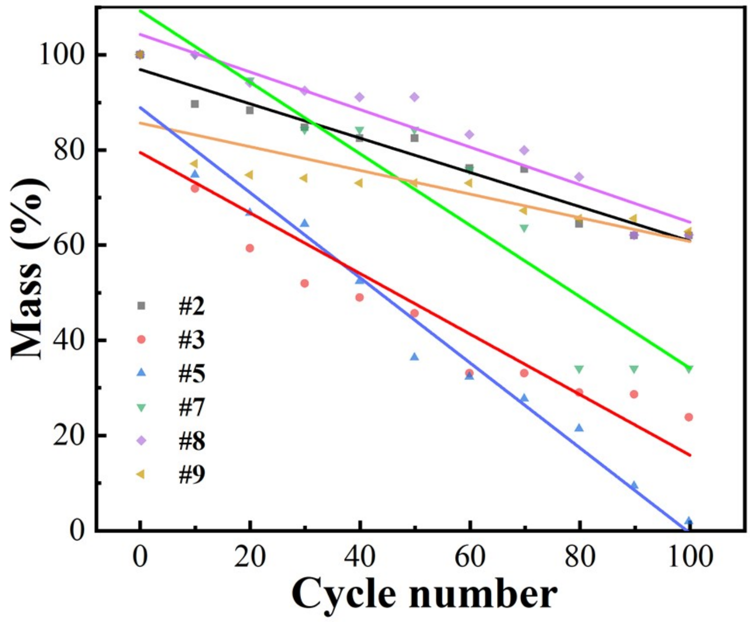

Figure S1. The friction experiment diagram of orthogonal experiment 1

There are six groups of data in the figure.S1, missing # 1, # 4 and # 6, because the three groups of test schemes cannot form a normal film during the preparation of the coating. It can be considered that the preparation scheme cannot synthesize normal acrylic resin. Therefore, the assignment in the orthogonal experiment table is 0.

Table S2. Orthogonal Experiment 2

	Solvent(mL)	Initiator(g)	AA(g)	HEMA(g)
1	15	0.1	0.8	0.4
2	25	0.3	4	2
3	40	0.5	20	10

Experiment number	Solvent	Initiator	AA	HEMA	Value
1	1	1	1	1	0
2	1	2	2	2	4
3	1	3	3	3	0
4	2	1	2	3	0
5	2	2	3	1	0

6	2	3	1	2	2
7	3	1	3	2	5
8	3	2	1	3	3
9	3	3	2	1	1
T_{1j}	4	5	5	1	
T_{2j}	2	7	5	11	
T_{3j}	9	3	5	3	
R_j	7	4	0	10	

factor importance ranking：HEMA、Initiator、Solvent、AA

best combination: $HEMA_2$、$Initiator_2$、$Solvent_3$、AA_1

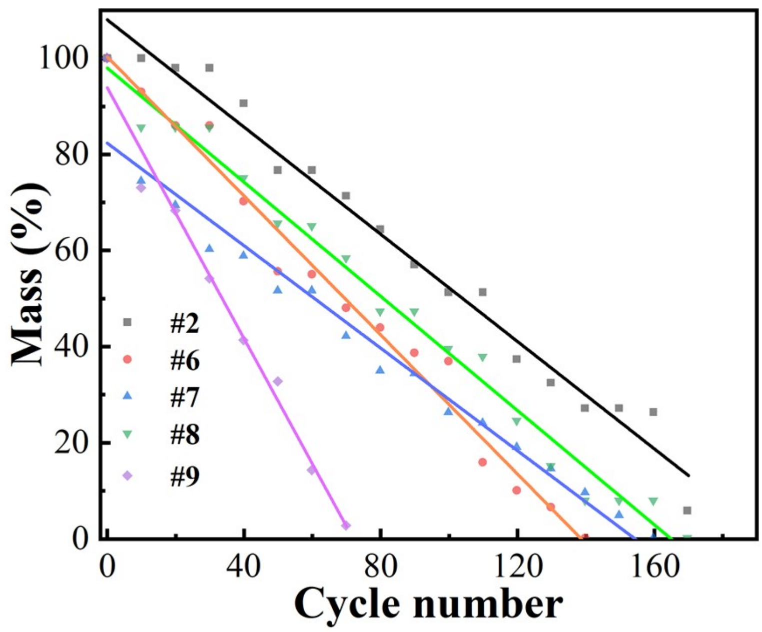

Figure S2. The friction experiment diagram of orthogonal experiment 2

There are five groups of data in the figure.S2, missing # 1, # 3, # 4, # 5, because the four groups of test schemes cannot form a normal film during the preparation of the coating. It can be considered that the preparation scheme cannot synthesize normal acrylic resin. Therefore, the assignment in the orthogonal experiment table is 0.

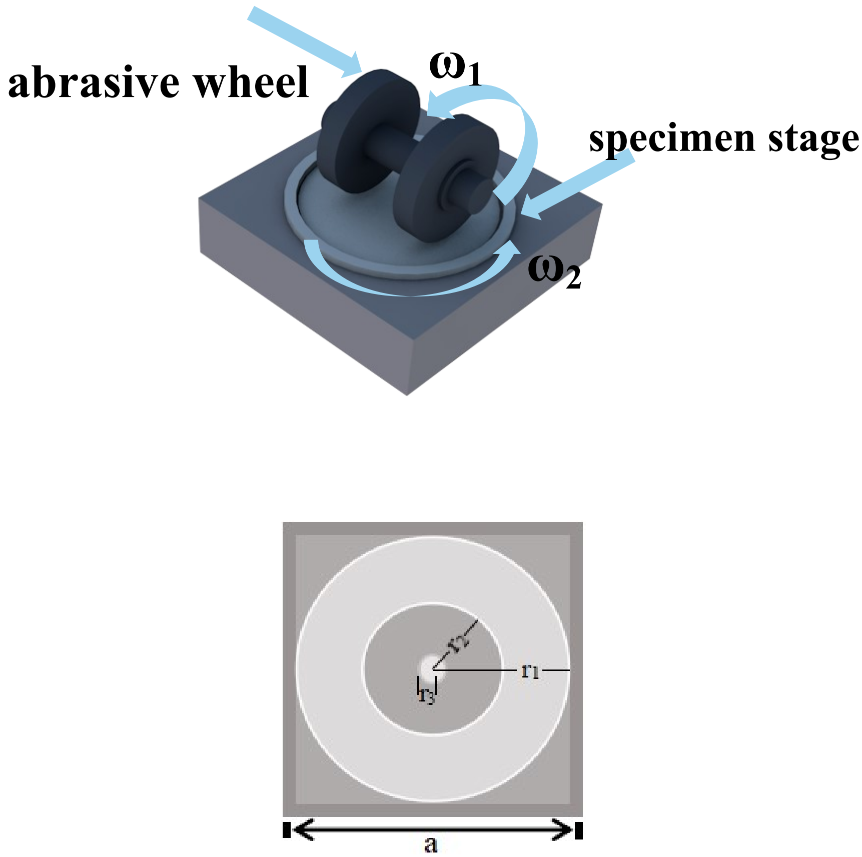

Figure S3. Schematic diagram of friction test

Calculation formula of friction area:

$S_f = \pi \times (r1^2 - r2^2)$ (1)

The mass calculation formula of friction area:

The coating is uniform, then $\frac{mass\ of\ friction\ area}{mass\ of\ the\ coating} = \frac{friction\ area}{coating\ area}$,

So $M_f = (S_f \div S_C) \times M_c$

$$= \frac{\pi \times (r1^2 - r2^2)}{a^2 - \pi r3^2} \times M_c \qquad (2)$$

In the experiment, M_f=9.97%M_c

Table S3. Fitting results of wear tests

Figure	Sample	Fitting result
Figure S1	#2	y=96.9-0.3604x
	#3	y=79.5-0.6360x
	#5	y=88.9-0.8940x
	#7	y=109.2-0.7510x
	#8	y=104.3-0.3945x
	#9	y= 85.7-0.2487x
Figure S2	#2	y=108.0-0.5577x
	#6	y=100.3-0.7233x
	#7	y=82.3-0.5333x
	#8	y=98.0-0.5938x
	#9	y=93.9-1.3044x
Figure 6.a	ZJ1 best	y=100.6-0.3759x
	ZJ2 best	y=90.1-0.7628x
Figure 6.b	ZJ1 best	y=100.6-0.3759x
	1:15	y=87.4-0.2082x
	1:10	92.5-0.3444x
	1:5	y=90.9-0.1500x
	1:3	y=96.7-0.9950x
	1:1	y=88.8-3.3818x
Figure 6.c	1:1	y=-0.93x+99.52
	1:3	y=-0.68x+91.05
	1:5	y=-0.529x+100.03
	1:10	y=-0.57x+85.0
	1:15	y=-0.535x+84.89

Figure 6.d	1:1	y=-1.19x+64.7
	1:3	y=-1.06x+87.4
	1:5	y=-0.42x+85.6
	1:10	y=-0.79x+74.6
	1:15	y=-0.76x+110.4
Figure 6.f	ZJ2 best	y=90.1-0.76x
	1:15	y=75.7-0.34x
	1:10	y=87.1-0.63x
	1:5	y=83.5-0.86x
	1:3	y=86.3-5x
	1:1	y=101.4-2.30x
Figure 6.g	1:1	y=-2.43x+93.0
	1:3	y=-2.04x+96.3
	1:5	y=-1.30x+93.0
	1:10	y=-1.22x+96.4
	1:15	y=-0.78x+90.5
Figure 6.h	1:1	y=-0.94x+89.7
	1:3	y=-1.07x+98.4
	1:5	y=-0.76x+99.3
	1:10	y=-0.69x+97.9
	1:15	y=-0.45x+73.6

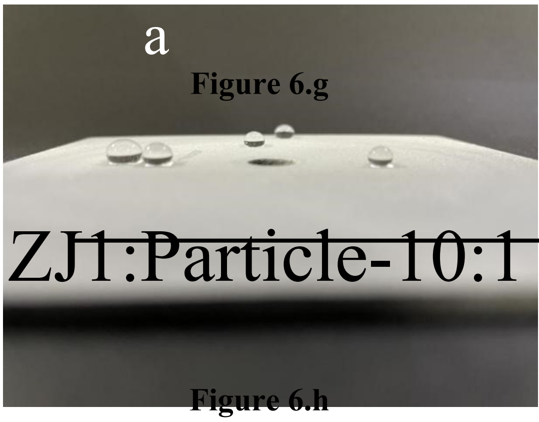

Figure S4. (a).Picture of water droplets on composite coating (b).Photos of samples after wear

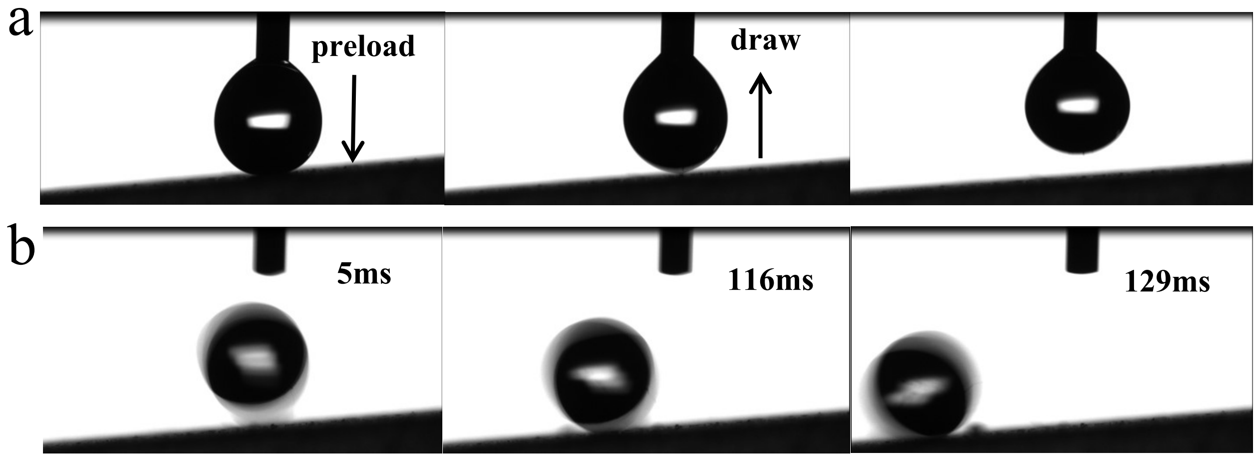

Figure S5. (a).Time-resolved images of a 7.0 μL water droplet spreading quickly on the composite coating within 129ms (tilting angle < 5°). (b). The contact, deformation and departure processes of a water droplet on the composite coating.