

Supplementary Material

ZIF-67 Derived Hollow Nanomaterials as Solid Phase Microextraction Coatings for Rapid Capture of Polycyclic Aromatic Hydrocarbons from Water Samples

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Figure S1 The large-scale TEM image of HO-ZIF-67

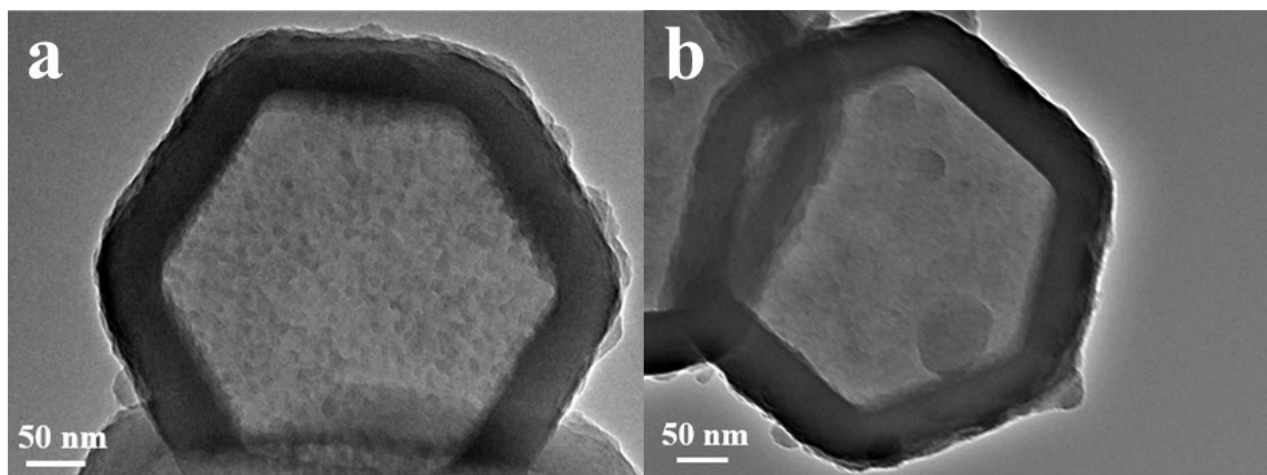


Figure S2 EDX spectrum of ZIF-67 (a) and HO-ZIF-67(b)

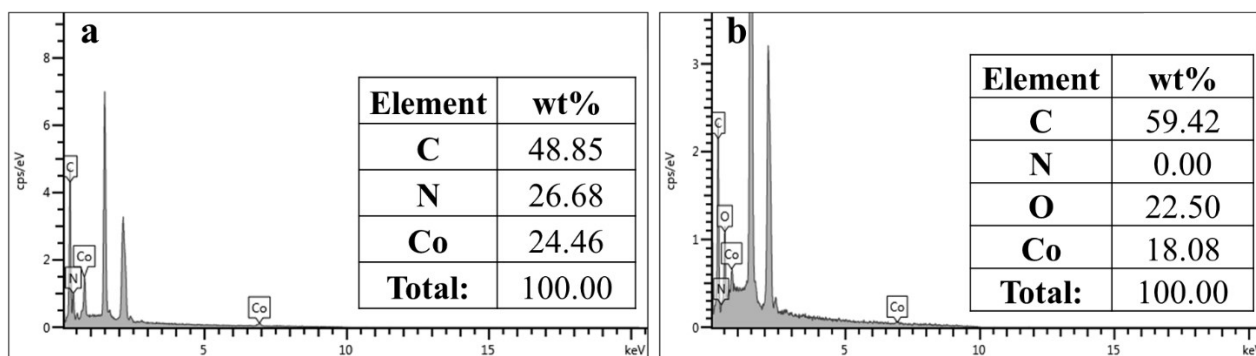


Figure S3 XRD pattern of tannic acid

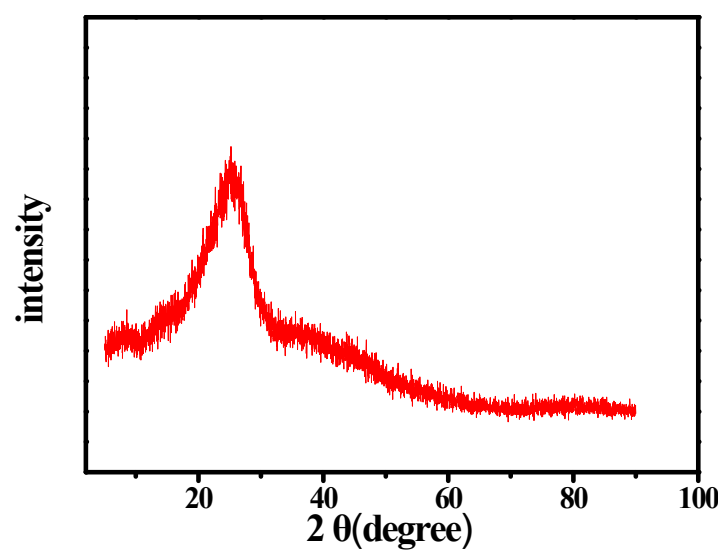


Figure S4 Surface zeta-potentials before and after the reaction

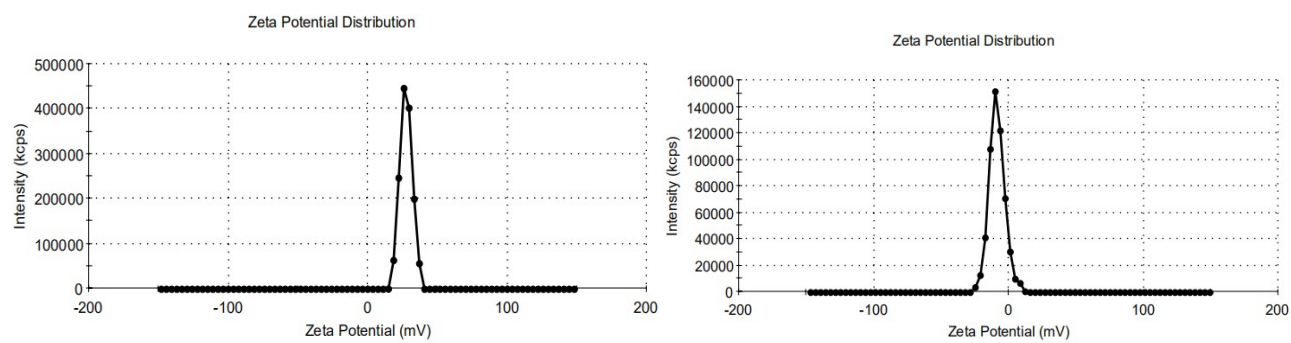
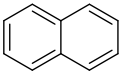
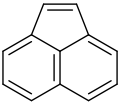
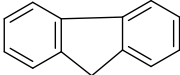
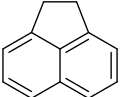
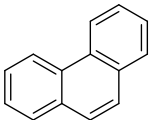
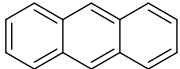
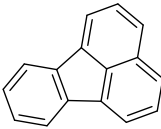
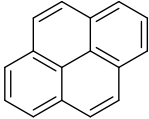
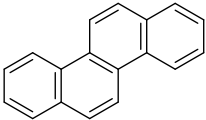
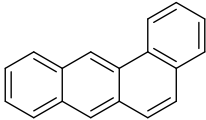
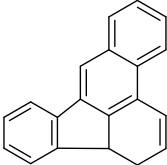


Table S1. The structure and properties of fifteen polycyclic aromatic hydrocarbons

Component	CAS#	Molecular formula	Molecular weight	Molecular Structure	Boiling point (°C)
Nap	91-20-3	C ₁₀ H ₈	128		217
Acy	208-96-8	C ₁₂ H ₈	152		270
Flu	86-73-7	C ₁₃ H ₁₀	166		294
Ace	83-32-9	C ₁₂ H ₁₀	154		279
Phe	85-01-8	C ₁₄ H ₁₀	178		340
Ant	120-12-7	C ₁₄ H ₁₀	178		340
Flt	206-44-0	C ₁₆ H ₁₀	202		383
Pyr	129-00-0	C ₁₆ H ₁₀	202		393
Chr	218-01-9	C ₁₈ H ₁₂	228		441
BaA	56-55-3	C ₁₈ H ₁₂	228		437
BbF	205-99-2	C ₂₀ H ₁₂	252		357

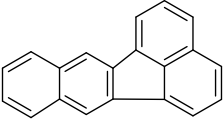
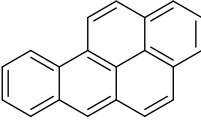
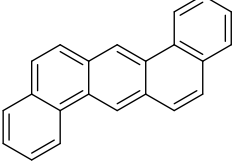
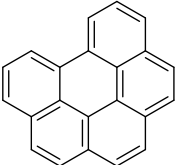
BkF	07-08-9	$C_{20}H_{12}$	252		480
BaP	50-32-8	$C_{20}H_{12}$	252		475
DahA	53-70-3	$C_{22}H_{14}$	278		524
Bpe	191-24-2	$C_{22}H_{12}$	276		542

Table S 2. Gradient elution procedure

Time/min	Water (%)	Acetonitrile (%)	Flow rate (ml/min)
0	20	80	1
13	50	50	1
14	45	55	1.5
18	50	50	1.8
23	35	65	1.6
24	30	70	1.8
35	30	70	1.8

Table S 3. Orthogonal design experiment L₂₅(5⁵)-Nap-Pyr

	Et/min	Dt/min	ET/°C	Sr/r/min	NaCl/%	Nap	Acy	Flu	Ace	Phe	Ant	Flt	Pyr
1	10	2	20	200	0	0.5500	5.000	3.950	34.60	173.1	11.40	5.450	300.8
2	10	4	25	300	5	1.400	7.450	4.600	45.80	176.9	8.550	4.200	248.8
3	10	6	30	400	10	2.000	9.500	5.700	57.75	211.9	10.20	5.000	307.2
4	10	8	35	500	15	1.550	7.500	4.500	39.60	189.8	8.900	6.150	324.4
5	10	10	40	600	20	3.550	11.60	5.500	59.55	192.9	9.700	4.550	259.7
6	20	2	20	400	15	4.900	17.15	8.450	86.55	321.8	13.05	9.000	523.4
7	20	4	25	500	20	5.750	18.25	9.000	93.25	335.4	13.35	9.700	585.7
8	20	6	30	600	0	1.800	5.450	4.800	38.65	293.6	18.05	17.10	1091
9	20	8	35	200	5	1.400	6.350	5.300	43.80	279.2	16.10	11.65	715.4
10	20	10	40	300	10	1.950	8.250	6.900	56.20	357.6	21.20	14.55	864.3
11	30	2	20	600	5	2.500	9.450	7.500	63.25	386.4	11.60	13.90	892.1
12	30	4	25	200	10	3.200	11.60	8.200	77.80	354.2	14.95	9.850	601.2
13	30	6	30	300	15	4.000	15.25	11.70	107.8	494.8	14.55	15.00	890.9
14	30	8	35	400	20	3.500	12.15	7.250	68.70	294.0	5.750	6.900	432.4
15	30	10	40	500	0	0.7950	2.650	2.700	18.90	187.1	3.500	14.45	992.6
16	40	2	20	300	20	5.350	18.15	9.950	102.5	388.4	9.500	10.45	642.3
17	40	4	25	400	0	1.500	4.600	4.150	34.15	264.4	10.00	16.30	1077
18	40	6	30	500	5	1.450	6.200	6.000	41.80	383.8	3.000	17.70	1135
19	40	8	35	600	10	1.950	7.500	7.100	52.55	422.6	5.200	20.45	1320
20	40	10	40	200	15	1.550	6.100	6.100	47.30	367.4	4.450	16.50	1062
21	50	2	20	500	10	2.800	10.90	8.900	78.45	438.2	12.45	14.85	907.2
22	50	4	25	600	15	3.850	11.65	9.600	78.45	475.5	12.90	14.85	938.6
23	50	6	30	200	20	4.500	15.35	10.50	100.8	445.7	12.30	12.60	789.6
24	50	8	35	300	0	0.900	3.350	3.400	24.10	236.1	8.350	18.15	1264
25	50	10	40	400	5	1.095	3.850	3.700	26.95	241.7	10.60	14.90	993.2
I ₁₀	Et					1.810	8.210	4.850	47.46	188.9	9.750	5.070	288.2
I ₂₀						3.160	11.09	6.890	63.69	317.5	16.35	12.40	756.1
I ₃₀						2.799	10.22	7.470	67.29	343.3	10.07	12.02	761.9
I ₄₀						2.360	8.510	6.660	55.66	365.3	6.430	16.28	1047
I ₅₀						2.629	9.020	7.220	61.74	367.4	11.32	15.07	978.6
I _{Et}						1.350	2.880	2.620	19.83	178.5	9.920	11.21	759.2
I ₂	Dt					2.039	7.920	5.710	50.95	275.6	9.730	10.64	670.5
I ₄						3.140	10.71	7.110	65.89	321.3	11.95	10.98	690.3
I ₆						2.750	10.35	7.740	69.35	366.0	11.62	13.48	842.8
I ₈						1.940	7.190	5.410	44.72	287.2	9.250	13.75	886.6

I ₁₀		1.788	6.490	4.980	41.78	269.4	9.890	12.99	834.4
I _{Dt}		1.352	4.220	2.760	27.57	96.61	2.700	3.110	216.1
I _{T20}		3.220	12.13	7.750	73.07	341.6	11.60	10.73	653.2
I _{T25}		3.140	10.71	7.110	65.89	321.3	11.95	10.98	690.4
I _{T30}	ET	2.750	10.35	7.740	69.35	366.0	11.62	13.48	842.8
I _{T35}		1.860	7.370	5.510	45.75	284.3	8.860	12.66	811.4
I _{T40}		1.788	6.490	4.980	41.78	269.4	9.890	12.99	834.4
I _{ET}		1.432	5.640	2.770	31.29	96.61	3.090	2.750	189.6
I ₂₀₀		2.240	8.880	6.810	60.85	323.9	11.84	11.21	693.8
I ₃₀₀		2.720	10.49	7.310	67.28	330.8	12.43	12.47	782.2
I ₄₀₀	Sr	2.599	9.450	5.850	54.82	266.8	9.920	10.42	666.8
I ₅₀₀		2.469	9.100	6.220	54.40	306.9	8.240	12.57	788.9
I ₆₀₀		2.730	9.130	6.900	58.49	354.2	11.49	14.17	900.5
I _{Sr}		0.4900	1.610	1.460	12.88	87.41	4.190	3.750	233.7
I ₀		1.109	4.210	3.800	30.08	230.7	10.26	14.29	945.4
I ₅		1.569	6.660	5.420	44.32	293.6	9.970	12.47	796.8
I ₁₀	NaCl	2.380	9.550	7.360	64.55	356.9	12.80	12.94	800.0
I ₁₅		3.170	11.53	8.070	71.94	369.9	10.77	12.30	747.9
T ₂₀		4.530	15.10	8.440	84.95	331.3	10.12	8.840	542.0
I		3.421	10.89	4.640	54.87	139.0	2.830	5.450	403.5

Orthogonai design experiment L₂₅(5⁵)-Chr-Bpe

	Et/min	Dt/min	ET/°C	Sr/r/min	NaCl/%	Chr	BaA	Bbf	BkF	Bap	DahA	Bpe
1	10	2	20	200	0	2.350	159.1	4.350	2.150	8.850	6.900	2.650
2	10	4	25	300	5	10.30	264.0	7.850	11.95	30.35	48.20	14.75
3	10	6	30	400	10	28.30	621.7	16.75	31.85	78.25	136.4	41.35
4	10	8	35	500	15	39.95	836.6	19.00	43.85	105.2	191.2	58.15
5	10	10	40	600	20	23.85	517.7	12.90	26.50	64.90	112.3	34.00
6	20	2	20	400	15	65.50	1385	36.50	72.10	177.1	314.8	108.0
7	20	4	25	500	20	54.70	1281	33.45	62.15	162.5	269.0	91.90
8	20	6	30	600	0	7.950	575.3	20.25	7.950	35.20	16.05	21.80
9	20	8	35	200	5	31.70	814.8	21.65	36.00	92.85	150.1	55.45
10	20	10	40	300	10	74.55	1638	41.00	81.00	202.8	355.4	118.0
11	30	2	20	600	5	37.05	913.9	21.30	42.70	108.0	175.8	60.85
12	30	4	25	200	10	30.20	668.0	13.90	30.95	76.05	138.8	45.55
13	30	6	30	300	15	90.90	1845	50.40	100.6	238.6	441.8	157.2
14	30	8	35	400	20	35.85	681.4	18.65	37.80	88.85	166.6	57.85
15	30	10	40	500	0	31.90	1392	29.70	14.90	94.35	24.45	12.45
16	40	2	20	300	20	69.65	1402	38.35	71.85	131.4	317.2	119.9

17	40	4	25	400	0	14.65	649.8	13.50	9.600	35.15	34.10	21.40
18	40	6	30	500	5	59.95	1098	39.80	59.75	134.4	231.4	92.10
19	40	8	35	600	10	48.85	1050	33.82	46.55	116.0	95.45	76.80
20	40	10	40	200	15	50.35	1093	29.15	46.35	123.2	189.0	69.55
21	50	2	20	500	10	44.50	931.5	21.50	45.05	88.30	195.2	66.65
22	50	4	25	600	15	42.85	920.8	21.00	42.30	81.50	183.0	65.00
23	50	6	30	200	20	78.20	1567	42.40	80.65	149.3	351.1	136.0
24	50	8	35	300	0	12.40	1054	16.25	8.900	46.60	11.95	6.100
25	50	10	40	400	5	29.00	1031	20.50	25.00	59.95	97.05	35.70
I ₁₀	Et					20.95	479.8	12.17	23.26	57.50	99.00	30.18
I ₂₀						46.88	1139	30.57	51.84	134.1	221.1	79.02
I ₃₀						45.18	1100	26.79	45.38	121.2	189.5	66.77
I ₄₀						48.69	1059	30.92	46.82	108.0	173.4	75.95
I ₅₀						41.39	1101	24.33	40.38	85.13	167.7	61.90
I _{Et}	Dt					27.74	659.1	18.75	28.58	76.59	122.1	48.84
I ₂						27.93	782.8	17.95	26.26	72.88	103.0	35.32
I ₄						30.54	757.0	17.94	31.39	77.11	134.6	47.72
I ₆						53.06	1141	33.92	56.15	127.2	235.3	89.69
I ₈						29.00	839.4	21.59	29.01	78.35	96.27	44.14
I ₁₀	ET					41.93	1134	26.65	38.75	109.0	155.6	53.94
I _{Dt}						25.13	384.4	15.98	29.89	54.27	139.1	54.37
I _{T20}						43.81	958.3	24.40	46.77	102.7	202.0	71.60
I _{T25}						30.54	757.0	17.94	31.39	77.11	134.6	47.72
I _{T30}						53.06	1141	33.92	56.15	127.6	235.3	89.69
I _{T35}	Sr					33.75	887.3	21.87	34.62	89.88	123.1	50.87
I _{T40}						41.93	1134	26.65	38.75	109.0	155.6	53.94
I _{ET}						22.52	384.4	15.98	24.76	50.04	112.3	41.97
I ₂₀₀						38.56	860.4	22.29	39.22	90.06	167.2	61.85
I ₃₀₀						51.56	1240	30.77	54.85	130.0	234.9	83.18
I ₄₀₀	NaCl					34.66	873.9	21.18	35.27	87.86	149.8	52.85
I ₅₀₀						46.20	1108	28.69	45.14	117.0	182.2	64.25
I ₆₀₀						32.11	795.6	21.85	33.20	81.11	116.5	51.69
I _{Sr}						19.45	444.9	9.590	21.65	48.84	118.4	31.49
I ₀						13.85	765.9	16.81	8.700	44.03	18.69	12.88
I ₅						33.60	824.5	22.22	35.08	85.12	140.5	51.77
I ₁₀						45.28	982.1	25.39	47.08	112.3	184.2	69.67
I ₁₅						57.91	1216	31.21	61.03	145.1	264.0	91.56
I ₂₀						52.45	1090	29.15	55.79	119.4	243.2	87.94
I						44.06	450.2	14.40	52.33	101.1	245.3	78.68

Notes: Et: Extraction time ET: Extraction temperature Dt: Desorption time Sr: Stirring rate