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Development of new pretreatment approach for food safety screening

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Research Background

Food safety has been a global public health concern. Humans are seriously endangered by numerous contaminants in foodstuffs.

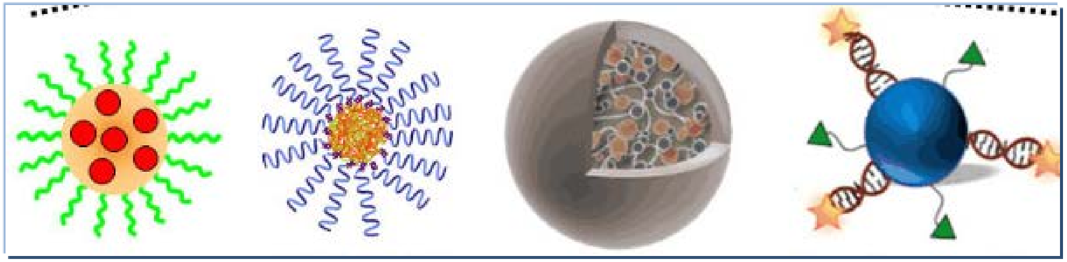
Owning to the complexity of food matrices and trace level of food contaminant, sample pretreatment is an essential step in food safety screening（sensitivity, accuracy and analytical speed）

The available approaches (e.g. solid phase extraction (SPE), solid phase microextraction (SPME))often show some limitations such as time consuming, complicated operation, low affinity and selectivity to targeted analytes.

Research Background

The rapid development of the nanotechnology has brought many opportunities for food sample pretreatment.

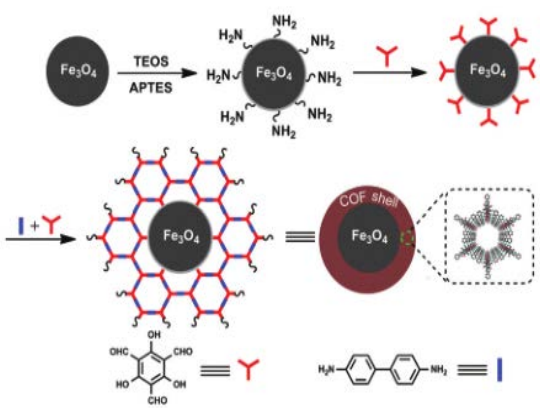
Nanomaterials were synthesized from organic or inorganic materials, and their typical size range is between about 0.2-100 nm Nanomaterials are considered as great adsorbents due to their ultra-small size, large surface area, unique structure, and functional properties, allowing for the efficient isolation and pre-concentration of contaminants from foodstuffs



Research Background

The application of nanomaterials as adsorbents has become a promising trend in the field of food safety screening. Diverse types of nanomaterials have been evaluated in food sample pretreatment, such as metal-organic frameworks (MOFs), ordered mesoporous silicas (OMSs) , polydopamine-derived materials (PDA) , carbon-based materials, molecularly imprinted polymers (MIPs) as well as other novel nanomaterials.

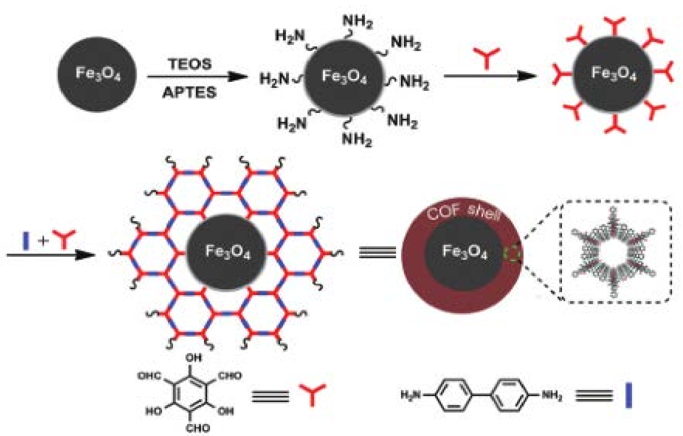
The emerging nanomaterials have presented a better performance for the extraction and pre-concentration of food contaminants, which significantly improve the detection sensitivity and selectivity .



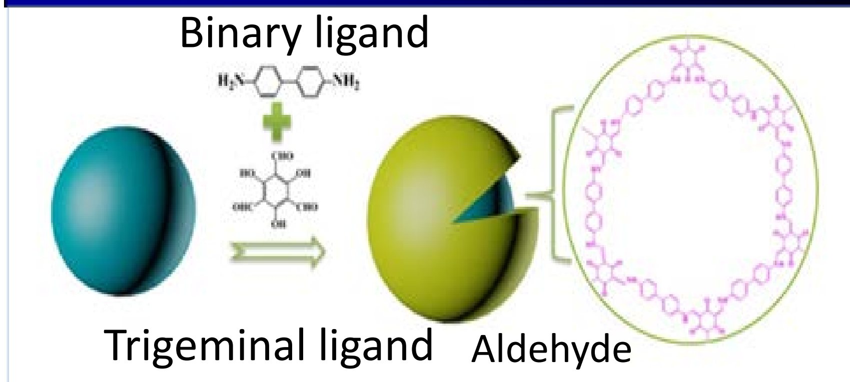
Research Background

Covalent organic frameworks (COFs) are an emerging group of microporous materials. COFs have attracted increasing attention in sample pretreatment due to their properties such as high surface area, tunable pore size, good chemical selectivity and thermal stability.

Recently, we developed a serious of magnetic COFs for enrichment of Polycyclic Aromatic Hydrocarbons (PAHs), plant growth regulators （PGRs） and fluoroquinolones（FQs）

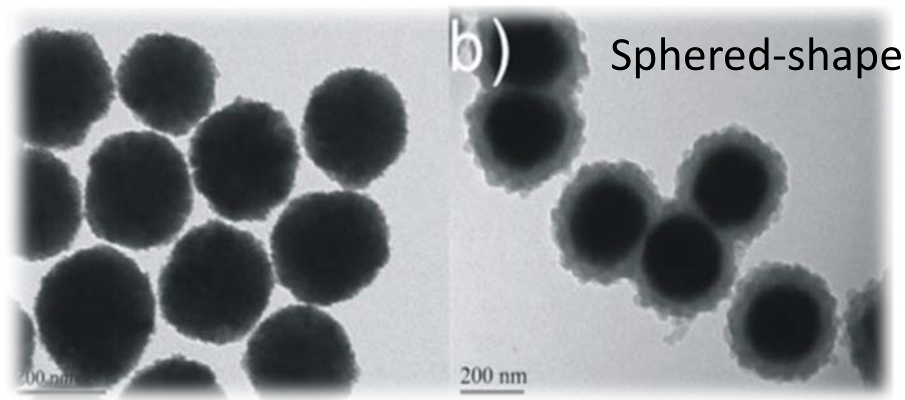


1. Effective Enrichment and Detection of Trace Polycyclic Aromatic Hydrocarbons in Food Samples based on Magnetic Covalent Organic Framework Hybrid Microspheres

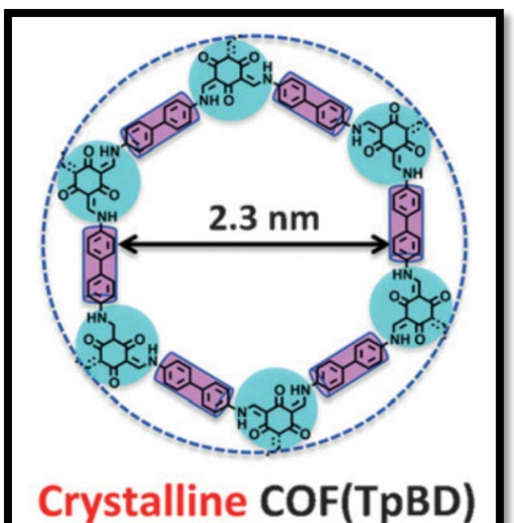


Schiff base reaction

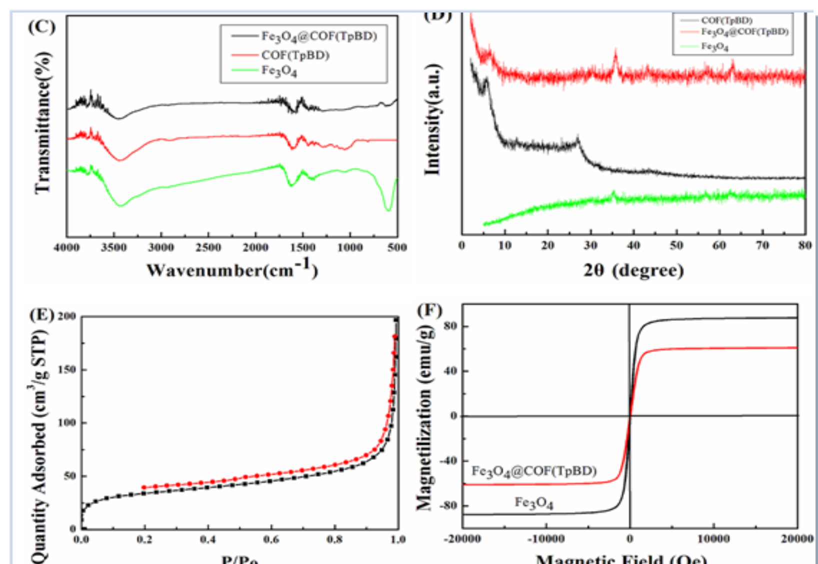
Hydrothermal synthesis process

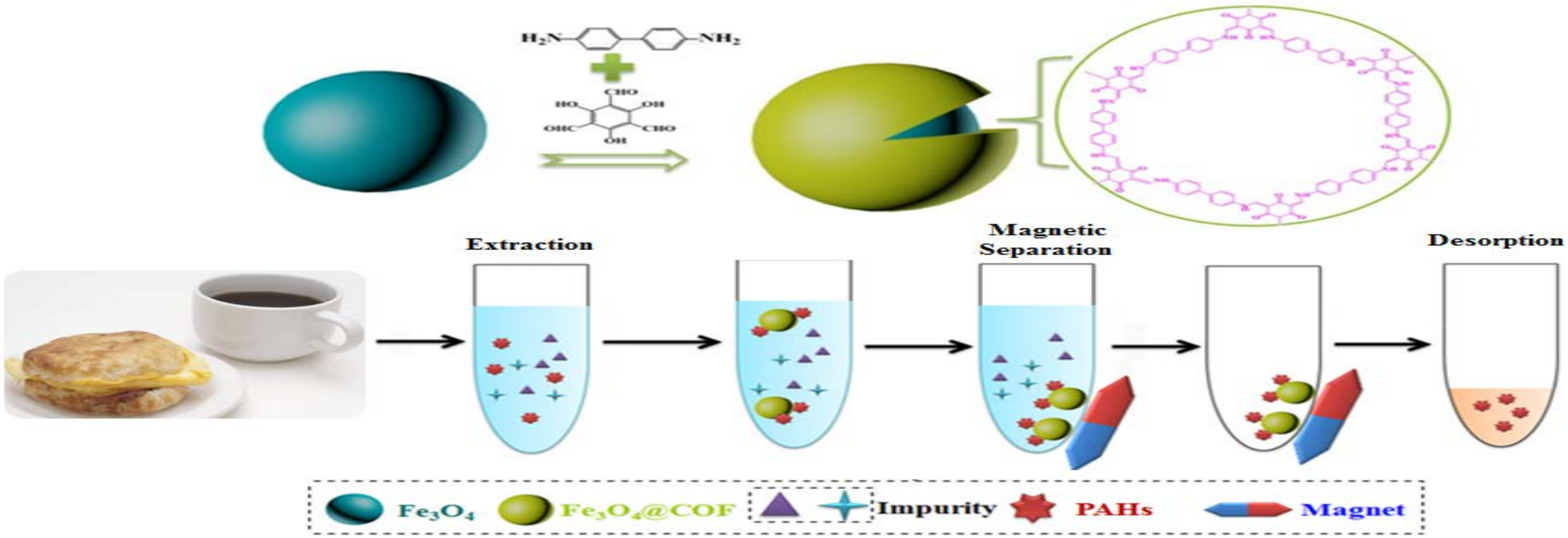


TEM

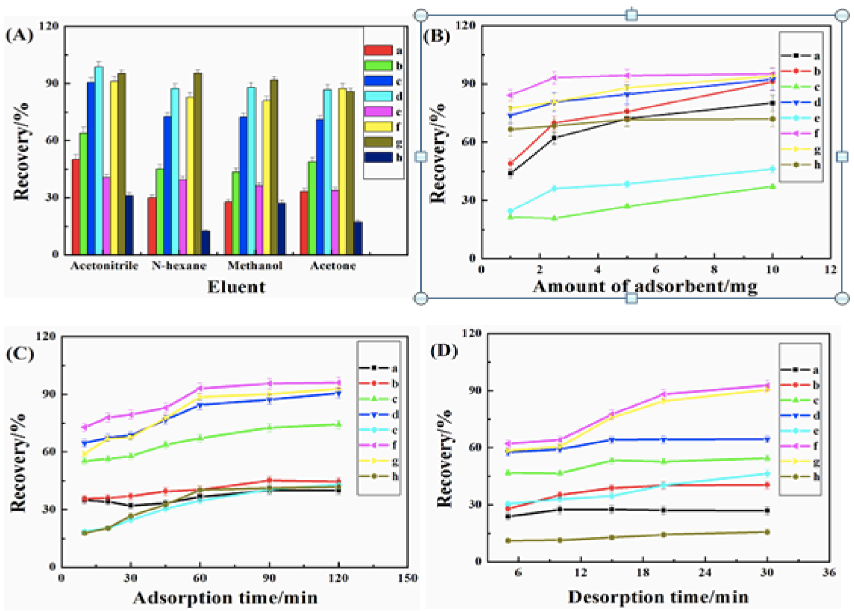


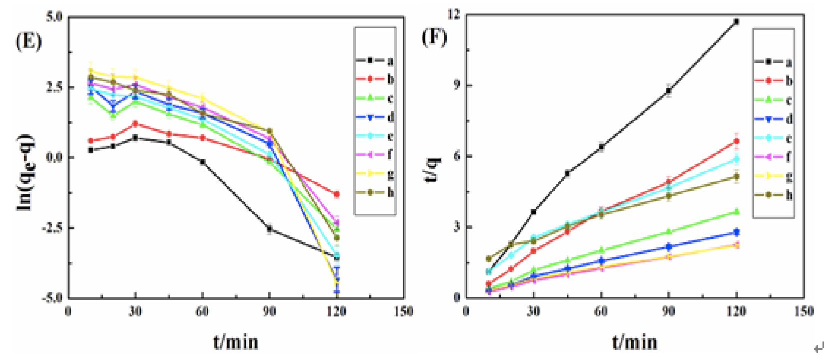
Topology





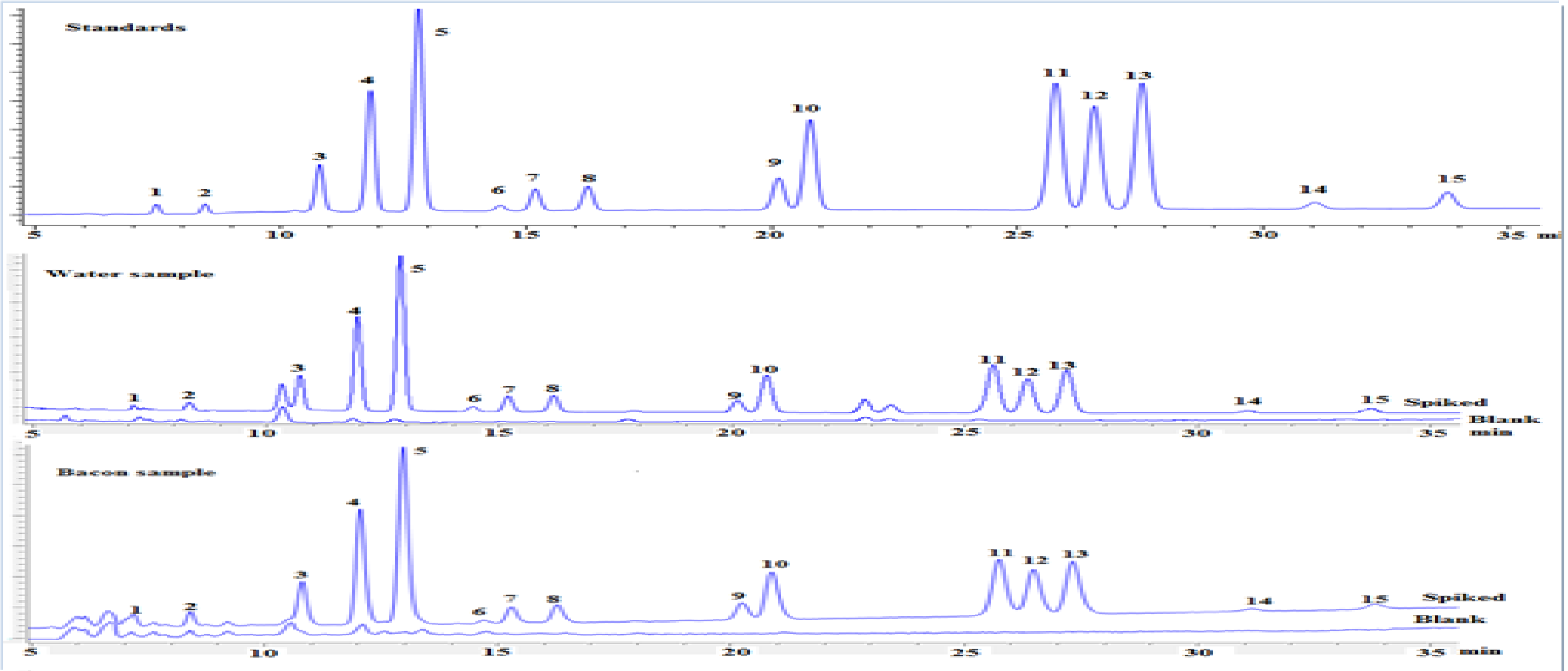
Effective Enrichment and Detection of Trace Polycyclic Aromatic Hydrocarbons in Food Samples based on Magnetic Covalent Organic Framework Hybrid Microspheres





Optimization of conditions

Amount of COFs： 5 mg； elution ： Acetonitrile； enrichment time： 15 min； elution time： 10 mins



Typical chromatograms obtained after MSPE from spiked real samples.
Peak identification: **1**, naphthalene; **2**, acenaphthylene; **3**, fluorene; **4**, phenanthrene; **5**, anthracene; **6**, fluoranthene; **7**, pyrene; **8**, perylene; **9**, benzo[*a*]anthracene; **10**, chrysene; **11**, benzo[*b*]fluoranthene; **12**, benzo[*k*]fluorathene; **13**, benzoapyrene; **14**, dibenz[*a,h*]anthracene; **15**, benzo[*g,h,i*]peryrene.

HPLC-DAD ；Hypersil GOLD column (150×4.6 mm, 3μm, Thermo, USA)；
Detection limits : 0.83-11.7 ng/L；Recovery：86.7-104.5%

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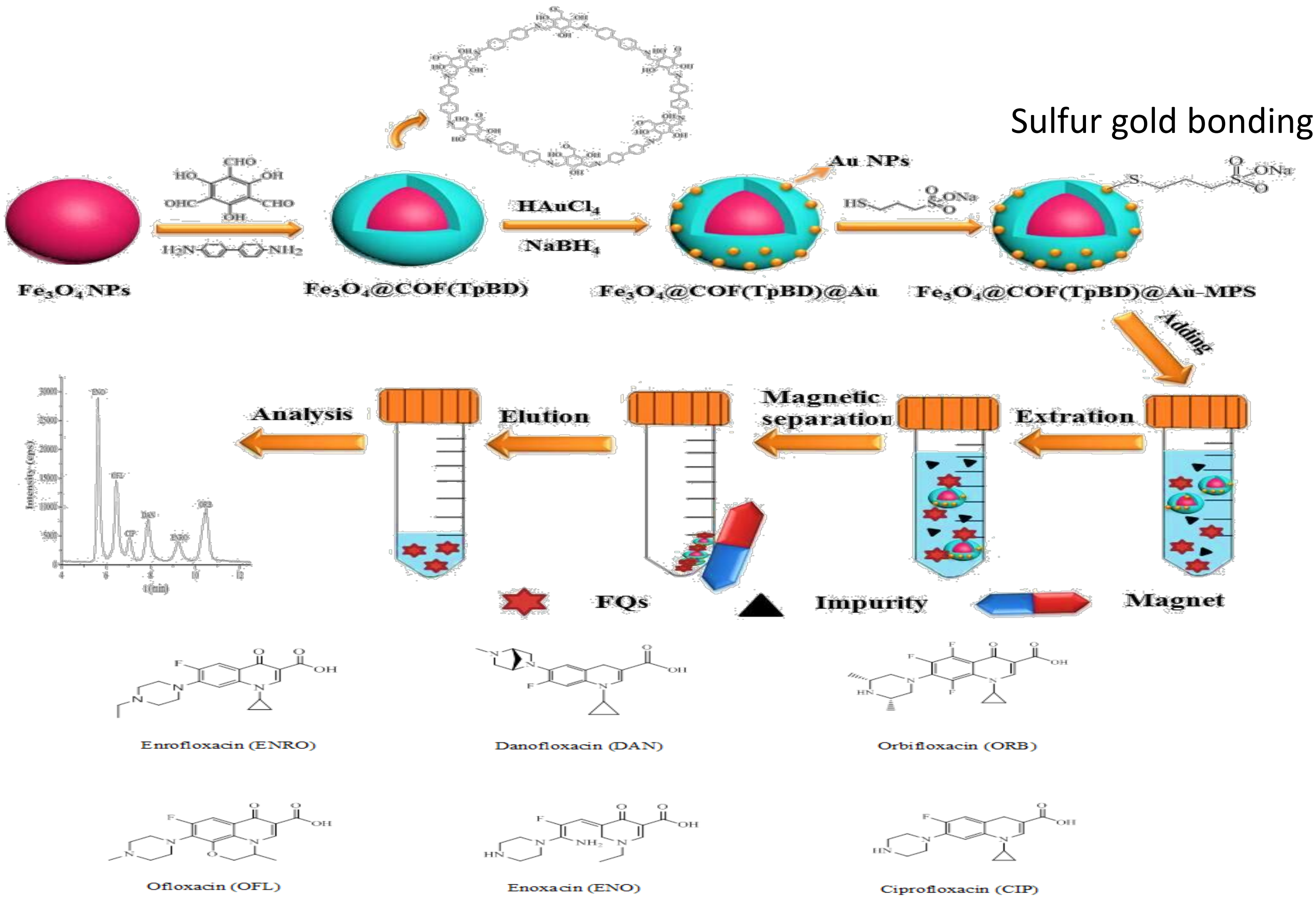
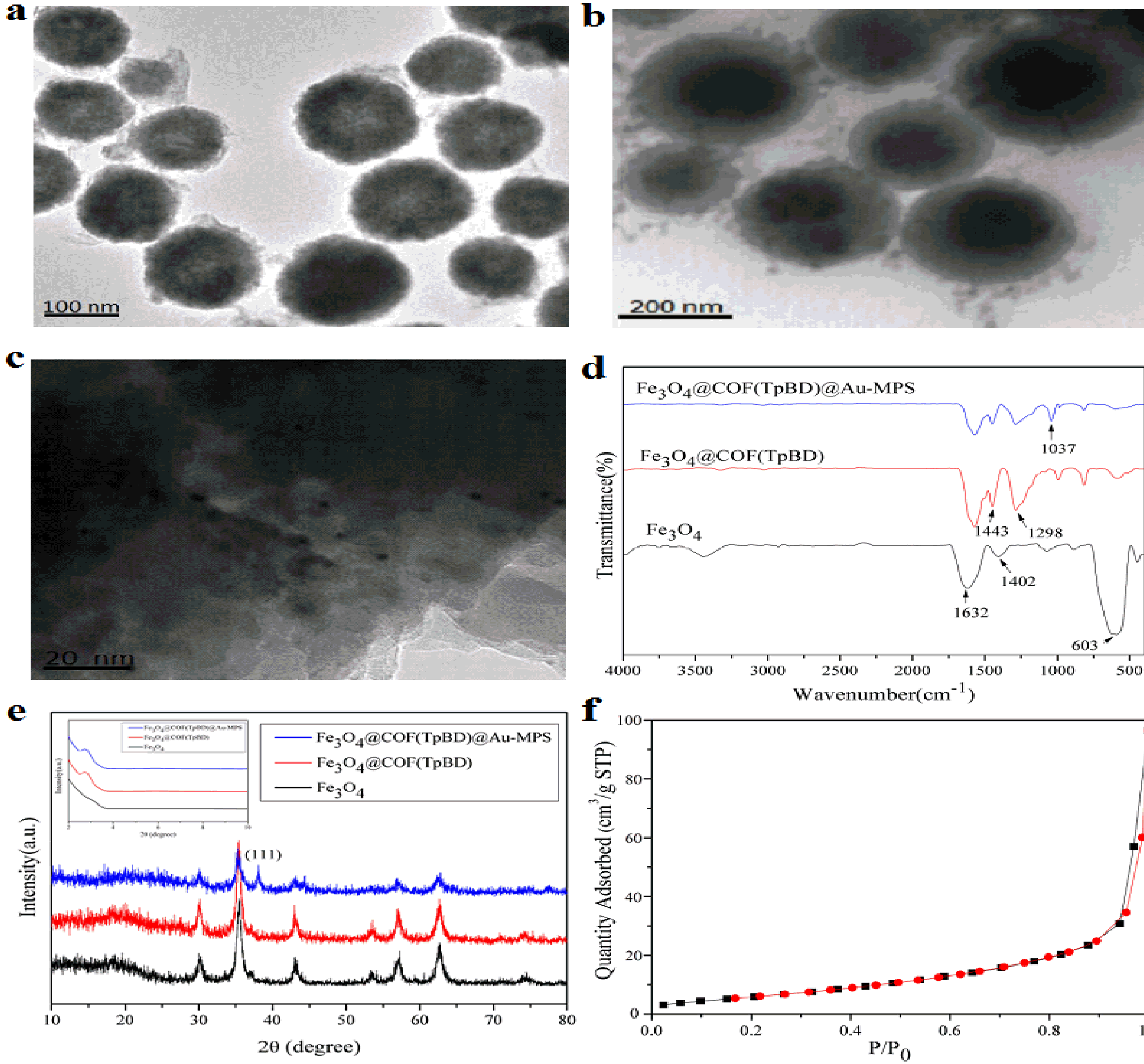
Cite This: *J. Agric. Food Chem.* 2018, 66, 3572−3580

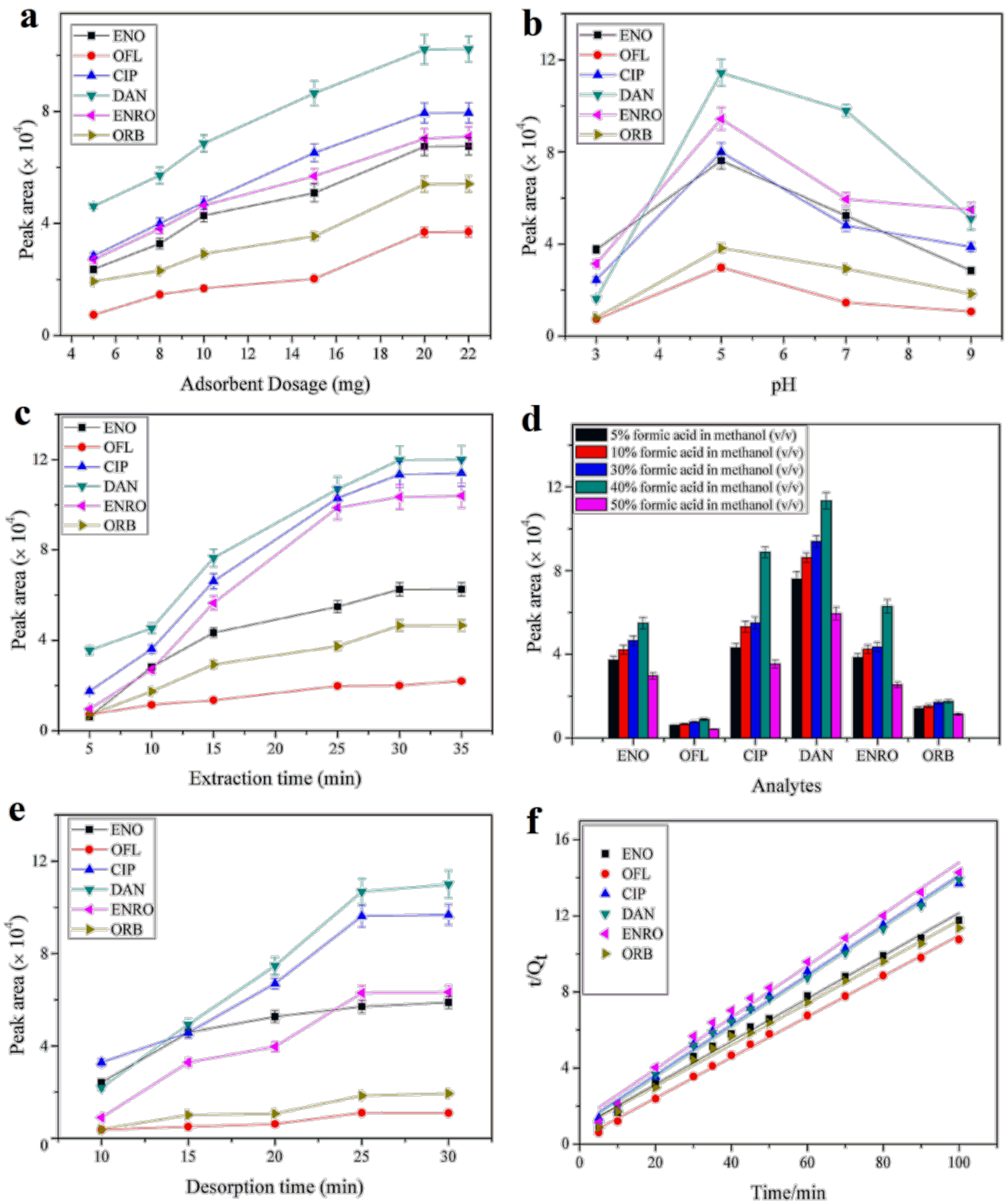
ESI Highly cited paper

2. Sulphonate functionalized covalent organic framework-based magnetic sorbent for effective solid phase extraction and determination of fluoroquinolones （FQs）





Characterization of materials(TEM, FT-IR spectra, BET surface area)



Adsorption kinetics

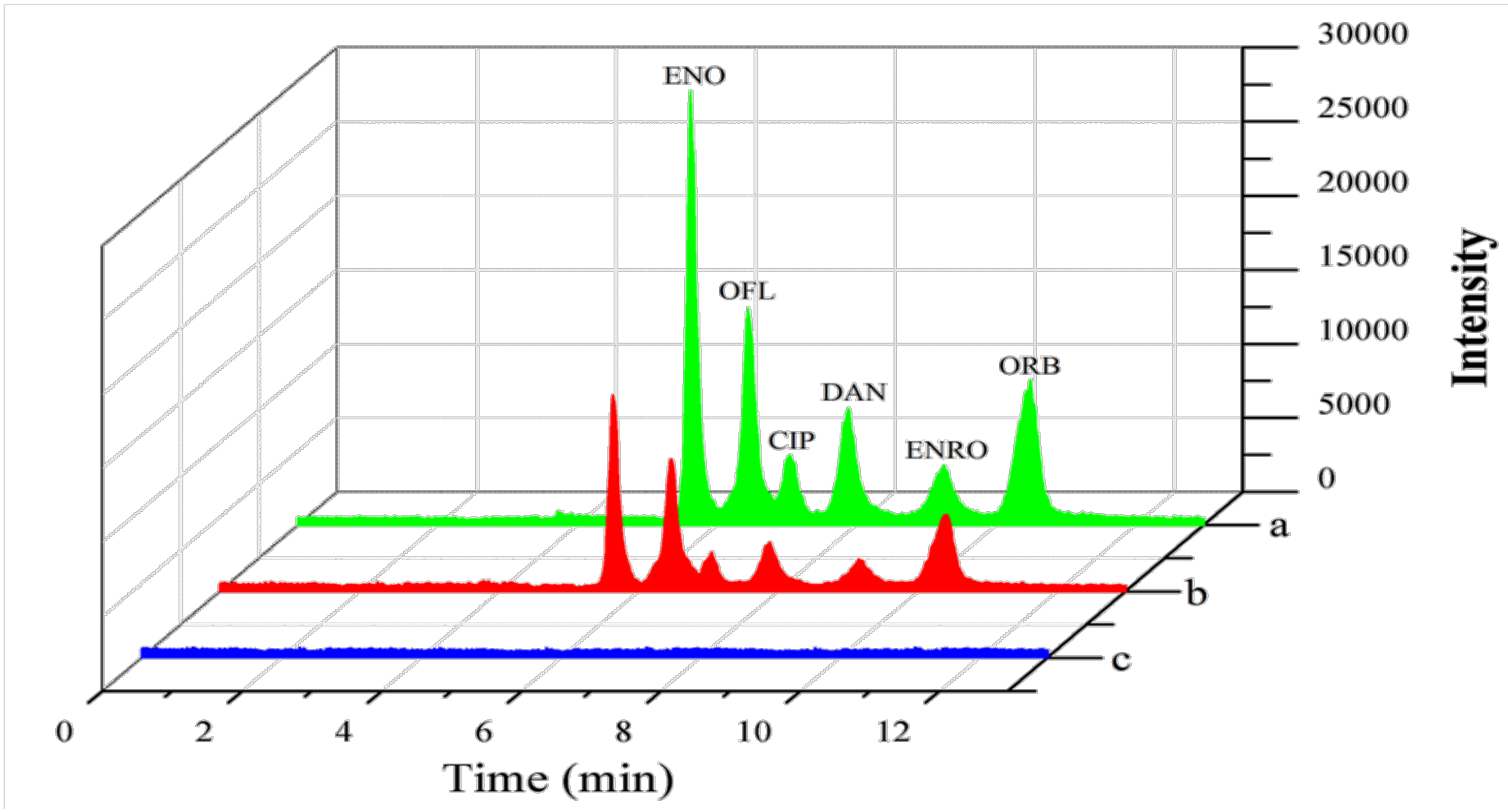
Adsorption kinetics

Comparison of the pseudo-first-order and pseudo-second-order models for FQs.

Analytes	Q_e (mg/g)	Pseudo-first-order model			Pseudo-second-order model		
		K_1	Qe,cal (mg/g)	R	K_2	Qe,cal (mg/g)	R
ENO	8.52	0.029	4.02	0.9376	0.014	8.89	0.9912
OFL	9.28	0.023	1.59	0.8861	0.039	9.37	0.9982
CIP	7.34	0.033	9.29	0.9318	0.017	7.63	0.9939
DAN	7.24	0.053	17.40	0.7138	0.018	7.63	0.9949
ENRO	7.01	0.027	8.51	0.8858	0.015	7.37	0.9902
ORB	8.76	0.028	4.17	0.9599	0.013	9.19	0.9918

Validation parameters of the proposed method in a pork sample.

Analytes	Linear range ($\mu g\ kg^{-1}$)	Calibration equation	Correlation coefficient (R^2)	LOD ($\mu g\ kg^{-1}$)	LOQs ($\mu g\ kg^{-1}$)
ENO	2-200	$y = 2960x-1.38 \times 10^3$	0.9993	1.0	3.0
OFL	2-200	$y = 759x-1.03 \times 10^3$	0.9990	0.5	1.7
CIP	2-200	$y = 1560x+1.21 \times 10^4$	0.9989	0.8	2.6
DAN	2-200	$y = 1990x-1.21 \times 10^3$	0.9991	0.7	2.3
ENRO	1-200	$y = 1160x+6.03 \times 10^3$	0.9995	0.3	1.0
ORB	1-200	$y =485x+2.37 \times 10^3$	0.9999	0.1	0.3



The typical chromatograms of (a) standard solutions with the concentrations of 100 μg L^{-1}; (b) spiked (50 μg kg^{-1}) pork sample after MSPE; (c) blank pork sample.

FQs analytical results in meat samples.

Analytes	Added (µg/kg)	Pork				Chicken				Bovine			
		Found (µg kg^{-1})	Recovery (%)	ME[a] (%)	RSD (%)	Found (µg kg^{-1})	Recovery (%)	ME[a] (%)	RSD (%)	Found (µg kg^{-1})	Recovery (%)	ME[a] (%)	RSD (%)
ENO	0	ND				ND				ND			
	5	4.6	92.0	90.1	3.4	4.2	84.0	88.8	3.2	4.3	86.0	95.7	4.1
	50	47.4	94.7	92.5	2.7	41.4	82.7	89.1	3.8	46.9	93.8	93.5	3.4
	100	95.6	95.6	94.5	4.6	90.3	90.3	89.9	1.7	82.9	82.9	94.1	4.5
OFL	0	ND				ND				ND			
	5	4.8	96.0	98.7	4.7	4.8	96.4	90.4	5.5	4.6	92.3	98.6	2.7
	50	51.2	102.4	97.2	3.1	49.6	99.2	91.7	6.1	42.9	85.9	97.9	3.7
	100	110.2	110.2	99.0	4.5	101.3	101.3	93.4	4.6	98.8	98.8	99.4	4.9
CIP	0	ND				ND				ND			
	5	4.6	93.3	94.2	3.7	4.7	94.5	85.6	5.3	4.4	88.0	90.4	3.5
	50	48.7	97.4	93.7	3.8	48.1	96.2	88.1	2.3	49.9	99.8	89.9	3.1
	100	101.7	101.7	92.9	2.5	98.7	98.7	87.5	4.4	98.7	98.7	91.8	2.7
DAN	0	ND				ND				ND			
	5	4.7	94.0	95.1	3.2	4.3	86.0	88.2	5.4	4.8	96.0	91.6	3.4
	50	46.7	93.4	96.4	4.0	47.5	95.0	87.3	4.5	45.7	91.4	94.2	5.7
	100	96.5	96.5	93.8	5.1	88.9	88.9	86.4	2.7	93.2	93.2	93.9	5.5
ENRO	0	ND				ND				ND			
	5	4.6	92.0	99.2	5.7	4.2	84.0	92.5	3.9	4.8	96.0	97.2	4.0
	50	44.8	89.6	98.8	2.5	43.2	86.4	91.4	5.0	53.9	107.8	99.8	3.4
	100	91.5	91.5	97.1	3.2	87.5	87.5	94.3	4.2	82.2	82.2	97.4	4.5
ORB	0	ND				ND				ND			
	5	4.5	90.0	89.3	5.0	4.4	88.0	86.3	3.2	4.1	82.0	92.8	5.8
	50	44.4	88.8	90.9	3.8	45.5	91.0	85.9	3.7	47.3	94.6	91.9	6.0
	100	90.1	90.1	89.7	4.5	95.7	95.7	87.1	5.0	91.2	91.2	93.0	5.7

[a] Matrix effect

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In Press, Journal Pre-proof ; doi.org/10.1016/j.chroma.2019.460651

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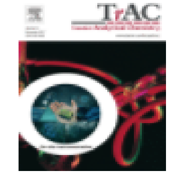
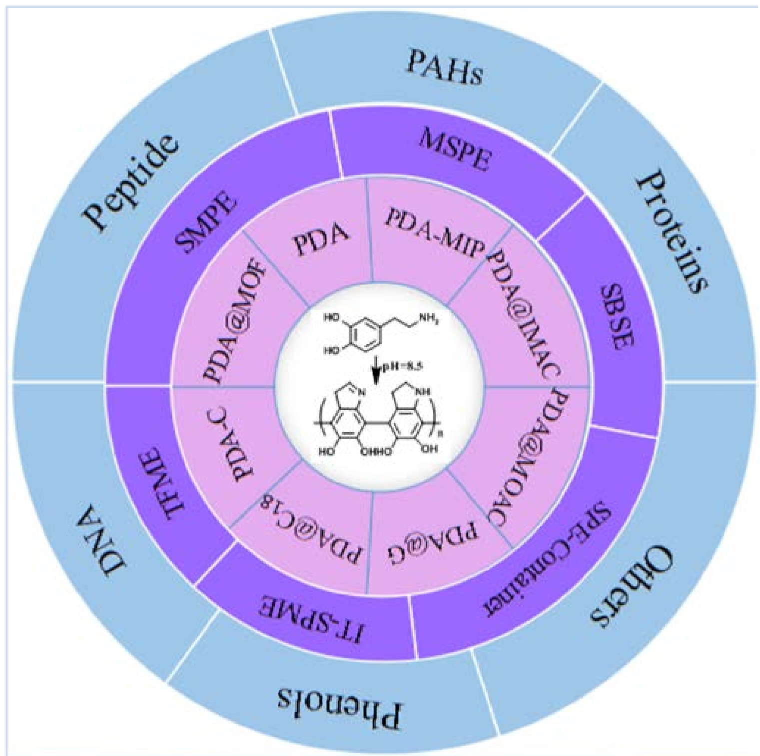
TrAC Trends in Analytical Chemistry

Volume 97, December 2017, Pages 1-14



Recent advances and applications of polydopamine-derived adsorbents for sample pretreatment



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TrAC Trends in Analytical Chemistry
Volume 108, November 2018, Pages 154-166

Recent advances in facile synthesis and applications of covalent organic framework materials as superior adsorbents in sample pretreatment

Na Li [a, b, 1], Junjie Du [b, 1], Di Wu [e], Jichao Liu [a], Ning Li [c], Zhiwei Sun [c], Guoliang Li [a, c, d], Yongning Wu [d]

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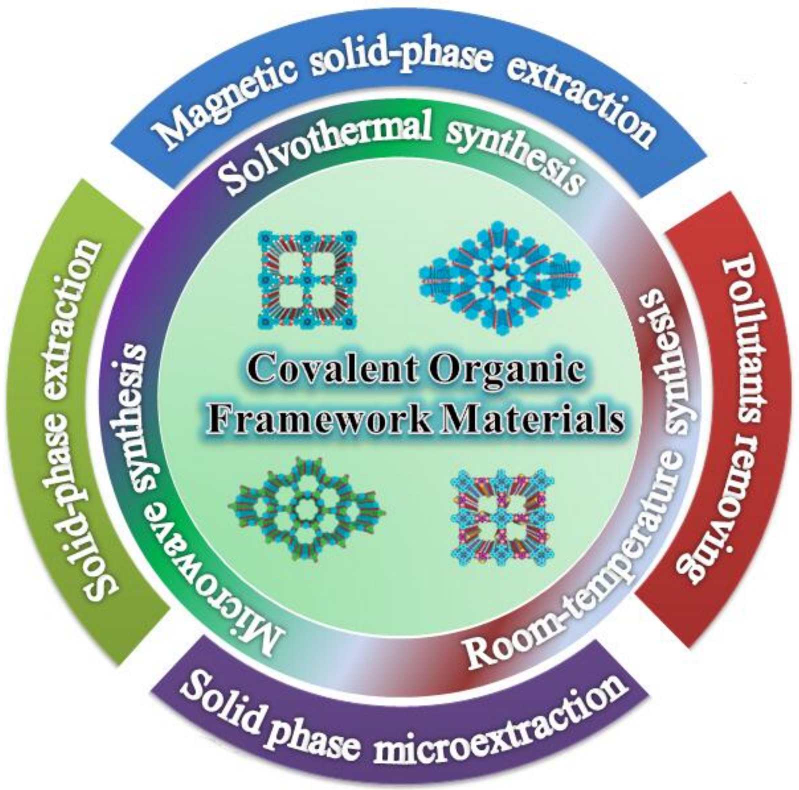

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TrAC Trends in Analytical Chemistry
Volume 121, December 2019, 115669

Recent advances in emerging nanomaterials based food sample pretreatment methods for food safety screening

Yueyao Zhang [a], Guoliang Li [a, d], Di Wu [e], Xiuting Li [c], Yanxin Yu [a], Pengjie Luo [b], Jian Chen [a], Chunji Dai [a], Yongning Wu [b]

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Conclusion

The sensitive determination of contaminants with low concentration in complicated foodstuffs is still a challenging work.

COFs with unique advantages have been considered as potential adsorbents in food sample pretreatment. But COFs still have many deficiencies as adsorbents and new COFs with functional structure, excellent adsorption ability and better selectivity to target compounds with different polarities should be further developed.

The combination of COFs with other functional materials may further enhance their adsorption ability

Recent Publications

First Author or Corresponding Author :

1. **Biosensors and Bioelectronics,** 2019, 145, 111699.（**IF 9.518**）
2. **Biosensors and Bioelectronics,** 2019, 111691.（**IF 9.518**）
3. **Biosensors and Bioelectronics,** 2019,137(15) :178-198（**IF 9.518**）
4. **TrAC Trends in Analytical Chemistry,** 2019, 115668.（**IF 8.428**）
5. **TrAC Trends in Analytical Chemistry,** 2019, 115669.（**IF 8.428**）
6. **TrAC Trends in Analytical Chemistry,** 2018, (108)154-166（**IF 8.428)**
7. **Analytical Chemistry**, 2019, 91 (18), 11687-11695.（**IF 6.350**）
8. **Analytical Chemistry**, 2016, 88(5): 2720-2726 （**IF 6.320 ESI Highly cited paper** ）
9. **Food Chemistry,** 2019, 125455.（**IF5.399**）
10. **Biosensors and Bioelectronics,** 2016, 79: 728-735. （**IF 9.518**）
11. **Biosensors and Bioelectronics,** 2018. 99: 653-659（**IF 9.518**）
12. **Biosensors and Bioelectronics** 85 (2016): 358-362. （**IF 9.518**）
13. **Analytica Chimica Acta**, 2017,973: 91-99 （**IF 5.256 top**）
14. **Food Chemistry,** 2017, 234(1): 408-415（**IF 5.399 top**）
15. **Journal of agricultural and food chemistry,** 2018 (66): 3572-80. **IF 3.41 ESI Hot paper**
16. **Microchimica Acta**, 2017, 184(7): 1923–1931（**IF 5.479**）
17. **Talanta**, 2017, 165(1):677–684（**IF 4.244**）
18. **Talanta,** 2018,190, 0039-9140（**IF 4.244**）

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Thank you for your attentions !

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