Electronic Supplementary Information (ESI)

Adsorptive removal of organic dyes from aqueous solution by a Zr-based metal-organic framework: Effects of Ce(III) doping

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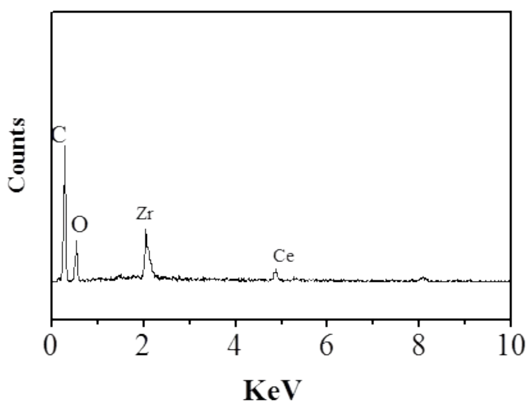

Fig. S1 EDS spectra of Ce(III)-doped UiO-66.

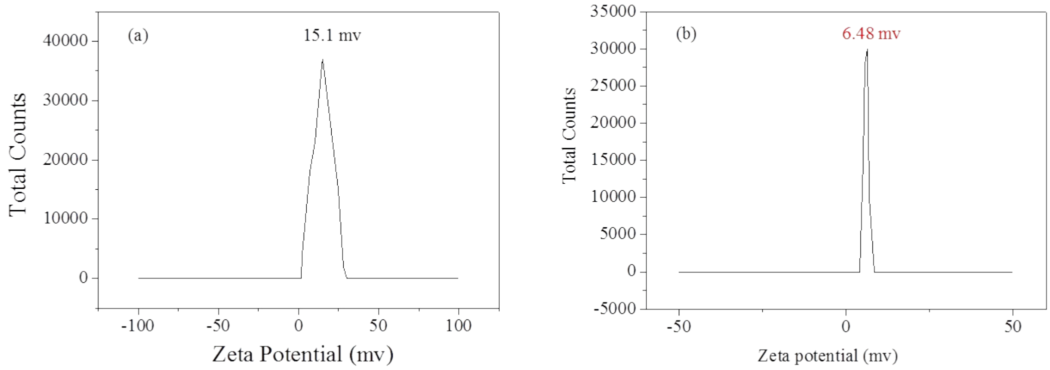

Fig. S2 Zeta potential of different nanoparticles directly dispersed in water: (a) UiO-66 and (b) Ce(III)-doped UiO-66.

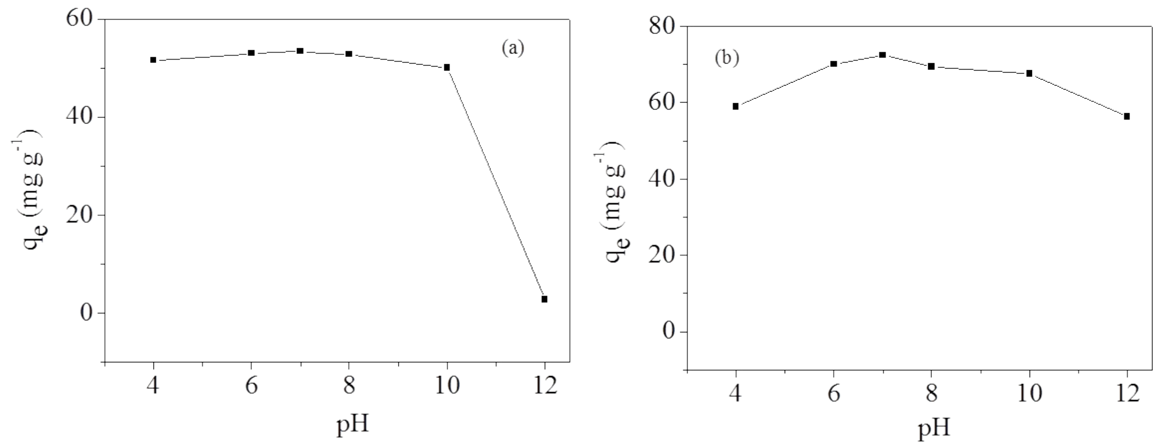

Fig. S3 Effect of pH on dye adsorption on the Ce(III)-doped UiO-66 nanocrystals: (a) MB and (b) MO.

Table S1 Summary of MB maximum adsorption capacities (*q*) on various adsorbents.

Type of adsorbent	q (mg g^{-1})	Reference
Ce(III)-doped UiO-66	145.1	This work
UiO-66-P composite	91.1	13
PZS nanotubes	69.2	34
FMAs	40	35
CS-MCM	31.8	36
Fe_3O_4@ZIF-8	20.2	37
HKUST-1	15.3	14

Table S2 Summary of MO maximum adsorption capacities (q) on various adsorbents.

Type of adsorbent	q (mg g^{-1})	Reference
Ce(III)-doped UiO-66	639.6	This work
MOF-235	477	15
MIL-100(Cr)	211	16
NMC-3-600	170.1	44
AC/ferrospinel composite	95.8	45
Acrylic acid grafted Ficus carica fiber	51.55	46
Functionalized CNTs loaded TiO	42.85	47

Table S3 Summary of CR maximum adsorption capacities (q) on various adsorbents.

Type of adsorbent	q (mg g^{-1})	Reference
Ce(III)-doped UiO-66	825.7	This work
In-based ICP hierarchical architectures	577	37
Hierarchical hollow NiO	440	39
a-FeOOH	275	40
Activated carbon	200	41
Graphene oxide/chitosan/silica fibers	120	42
Fe_3O_4@mTiO_2@GO microspheres	89.5	43

Table S4 Characteristic parameters of the adsorption of dyes on the Ce(III)-doped UiO-66 nanostructures.

		parameters	CR	MB	MO		AC
Adsorption kinetics	Pseudo-first-order	$q_{e,Exp}$ (mg g^{-1})	94.3	72.4	53.4		92.5
		$q_{e,Cal}$ (mg g^{-1})	20.1	47.5	22.1		56.6
		k_1 (min^{-1})	0.0078	0.0083	0.00507		0.0121
		R^2	0.9234	0.9599	0.9898		0.9890
	Pseudo-second-order	$q_{e,Exp}$ (mg g^{-1})	94.3	72.4	53.4		92.5
		$q_{e,Cal}$ (mg g^{-1})	83.1	48.2	54.4		72.6
		k_2 (g mg^{-1} min^{-1})	0.0116	0.0207	0.0184		0.0138
		R^2	0.9999	0.9984	0.9995		0.9965
					Low content	High content	
Adsorption isotherm	Tempkin	A (L g^{-1})	2.64	28.41	0.298	0.028	16.22
		B	127.9	16.1	52.98	264.6	28.1
		R^2	0.9945	0.9609	0.9981	0.9834	0.9887
	Freundlich	n	2.96	2.70	1.81	1.63	5.65
		k_F (mg g^{-1} (L $mg^{-1})^{1/n}$)	143.6	62.6	16.3	10.2	86.7
		R^2	0.9639	0.9411	0.9883	0.9973	0.9922
	Langmuir	$q_{m,Exp}$ (mg g^{-1})	826.7	145.3	276.9	639.6	245.4
		$q_{m,Cal}$ (mg g^{-1})	854.7	147.3	227.6	2041.3	250.6
		b (L mg^{-1})	0.0986	0.1313	0.0342	0.0018	0.0680
		R^2	0.9994	0.9999	0.9998	0.9739	0.9991
Thermodynamic constant		ΔG (kJ mol^{-1})	-5.7	-5.0	-8.4	-15.7	-6.7

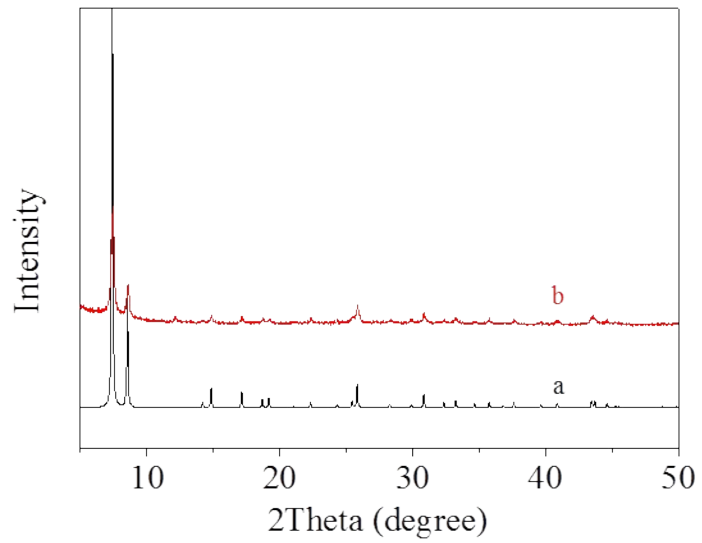

Fig. S4 PXRD patterns of (a) simulation and (b)Ce(III)-doped UiO-66@CR composites

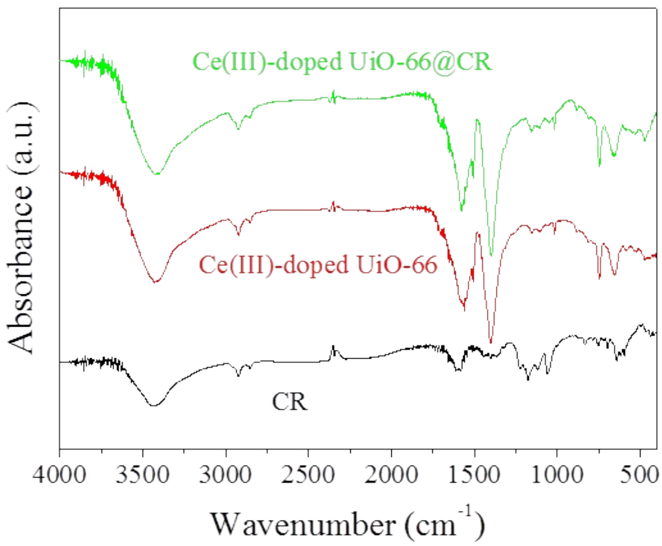

Fig.S5 FT-IR spectra of CR, Ce(III)-doped UiO-66 and Ce(III)-doped UiO-66@CR composites

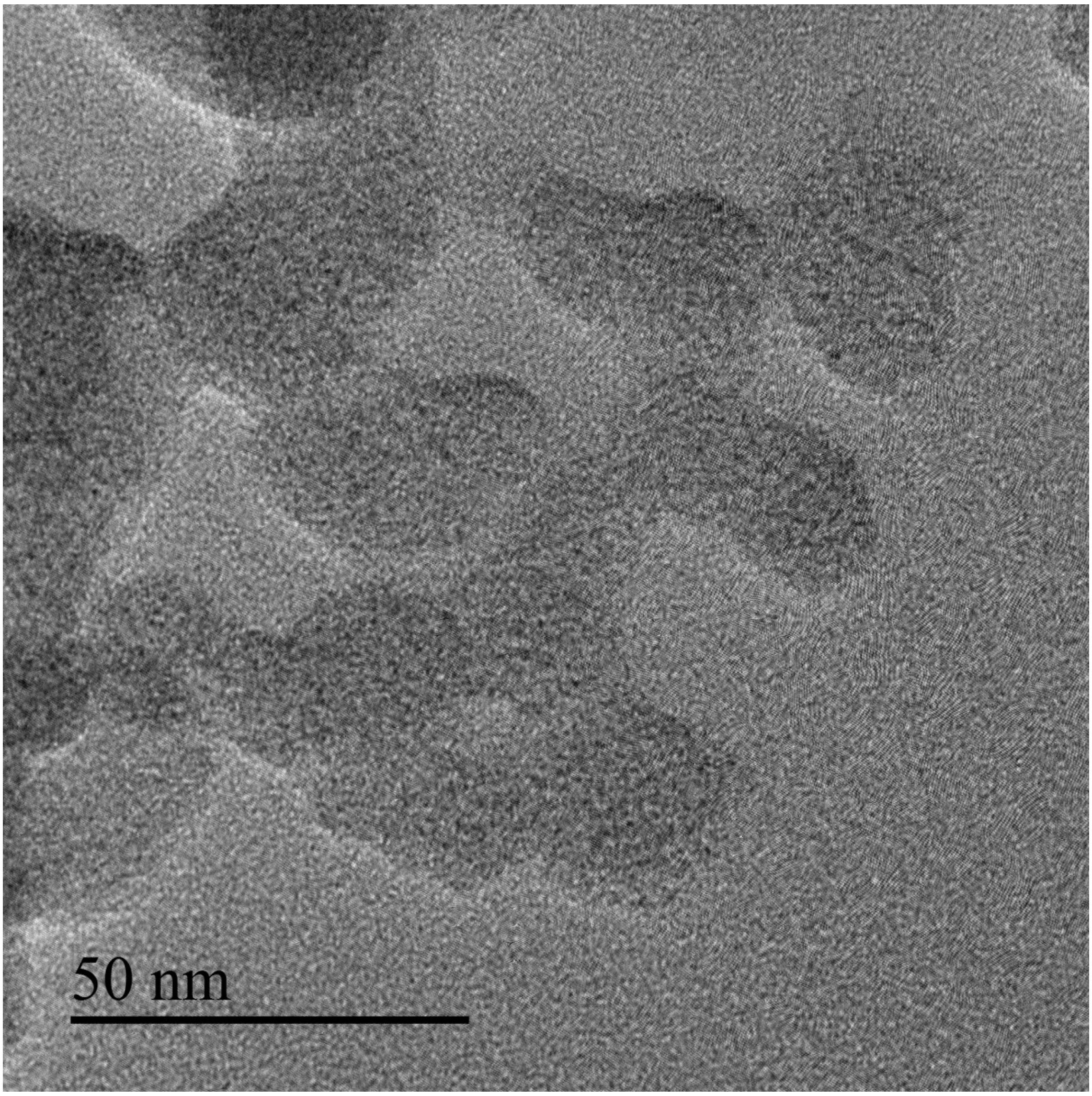

Fig. S6 TEM images of Ce(III)-doped UiO-66@CR composites.

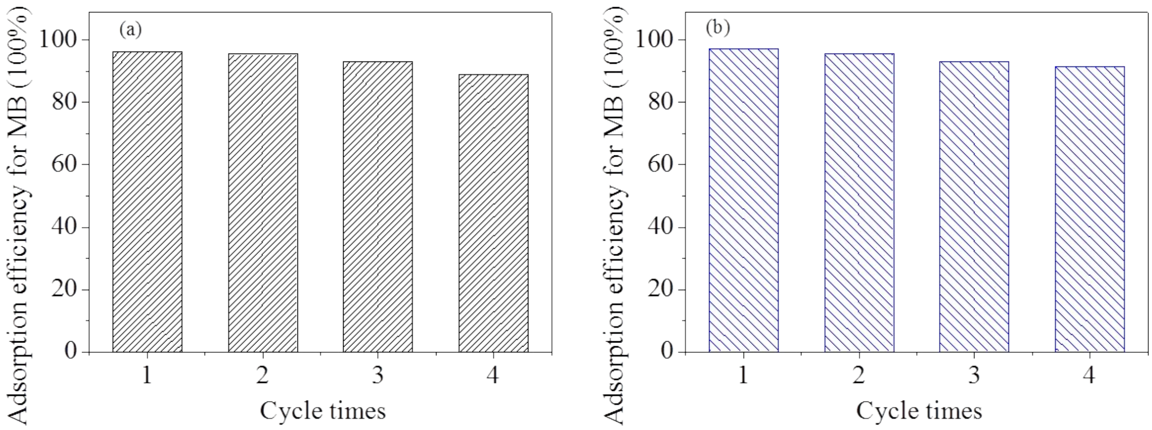

Fig. S7 Recycle of the removal efficiency of (a) Ce(III)-doped UiO-66 for MB and (b) Ce(III)-doped UiO-66 for MO.