Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

Efficient mineralization of phenol by temperature-responsive polyoxometalate catalyst under wet peroxide oxidation at lower temperature

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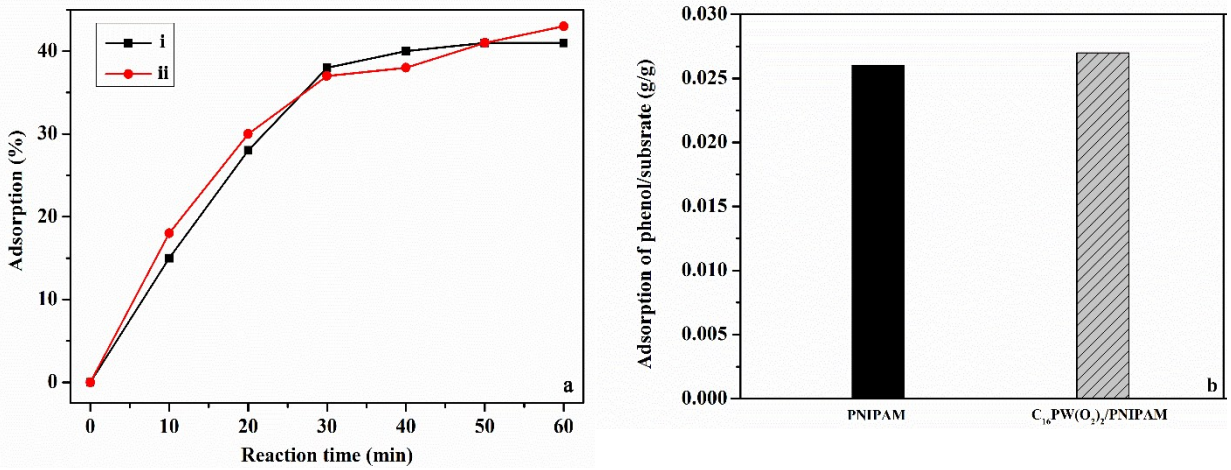


Fig. S1 (a) The changes of phenol adsorption on PNIPAM (i) and $C_{16}PW(O_2)_2$/PNIPAM (ii); (b) The maximum adsorption amount of phenol per gram of PNIPAM in pure polymer and in $C_{16}PW(O_2)_2$/PNIPAM. Reaction conditions: PNIPAM (0.0084 g), $C_{16}PW(O_2)_2$/PNIPAM (0.01 g), phenol solution (0.72 mM, 5 mL), 25 ºC.

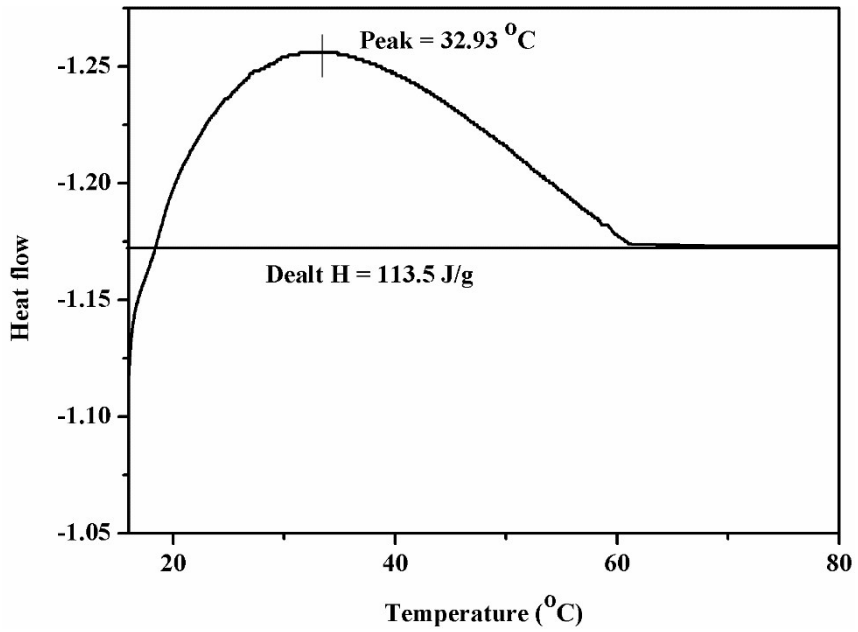


Fig. S2 The DSC curve of $C_{16}PW(O_2)_2$/PNIPAM.

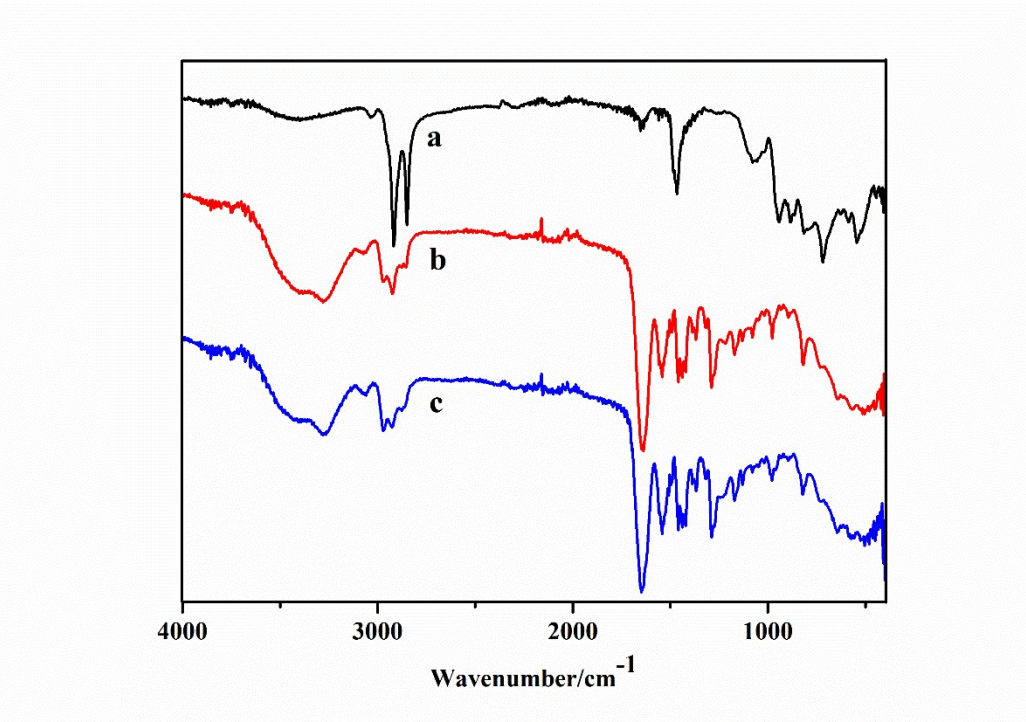


Fig. S3 The IR spectra of (a) $C_{16}PW(O_2)_2$, (b) $C_{16}PW(O_2)_2$/PNIPAM, and (c) $C_{16}PW(O_2)_2$/PNIPAM after the degradation of phenol.

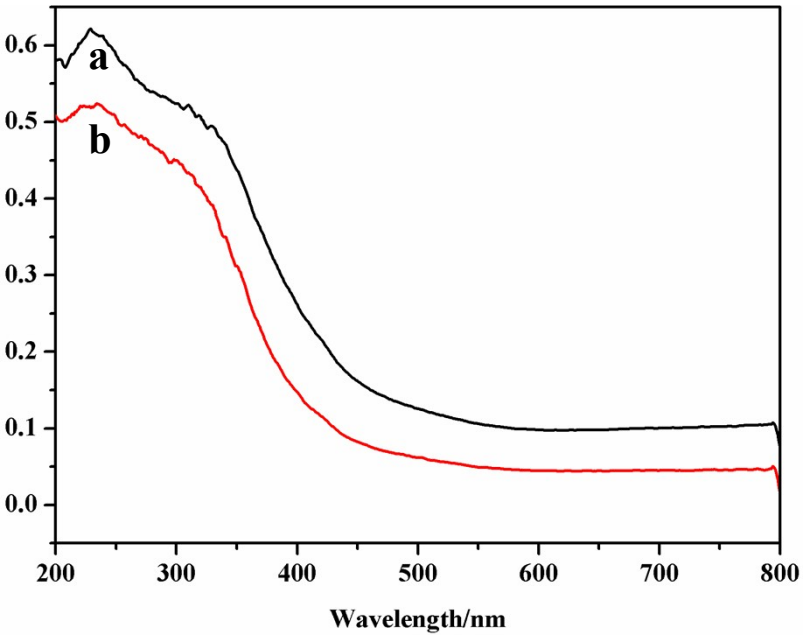


Fig. S4 The DR-UV-vis spectra of (a) $C_{16}PW(O_2)_2$/PNIPAM, and (b) $C_{16}PW(O_2)_2$/PNIPAM after the degradation of phenol

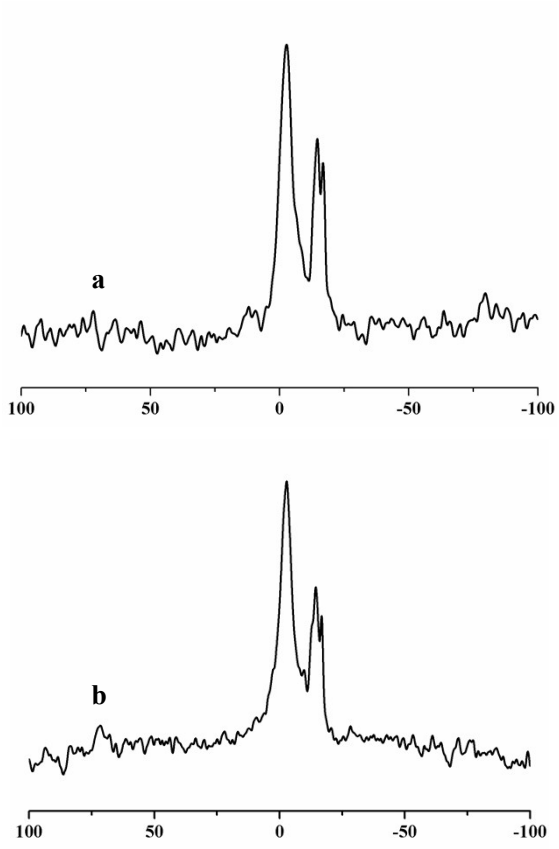


Fig. S5 ^{31}P MAS NMR spectrum of (a) $C_{16}PW(O_2)_2$/PNIPAM before the reaction, and (b) $C_{16}PW(O_2)$/PNIPAM after the reaction.

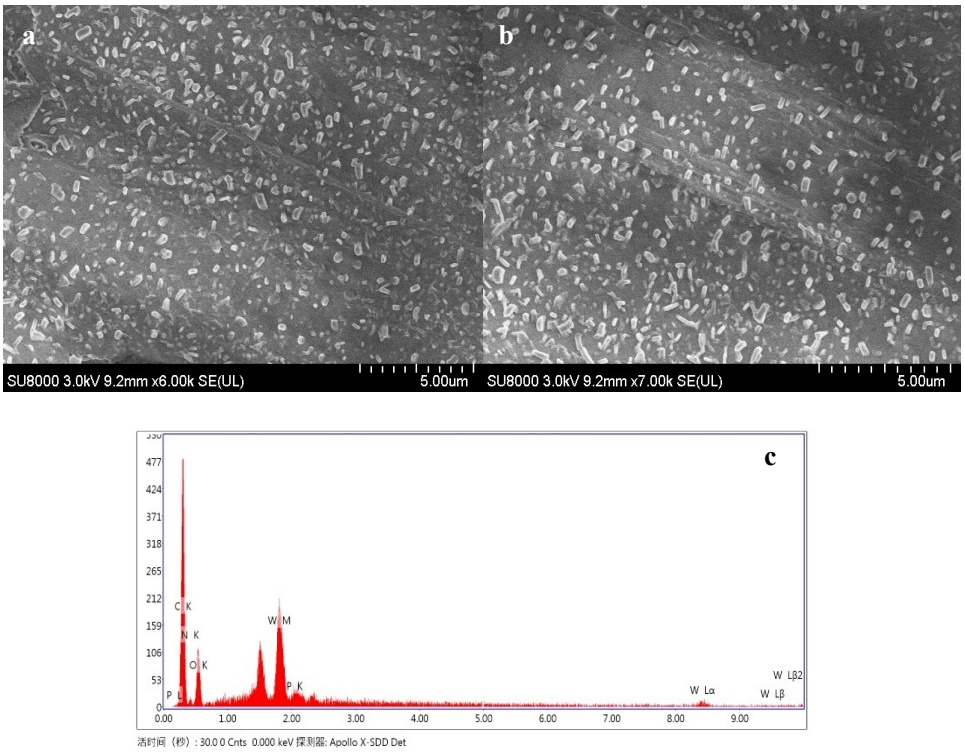


Fig. S6 The SEM images of (a) fresh $C_{16}PW(O_2)_2$/PNIPAM, (b) $C_{16}PW(O_2)_2$/PNIPAM after the reaction, and (c) the EDAX spectrum of fresh $C_{16}PW(O_2)_2$/PNIPAM.

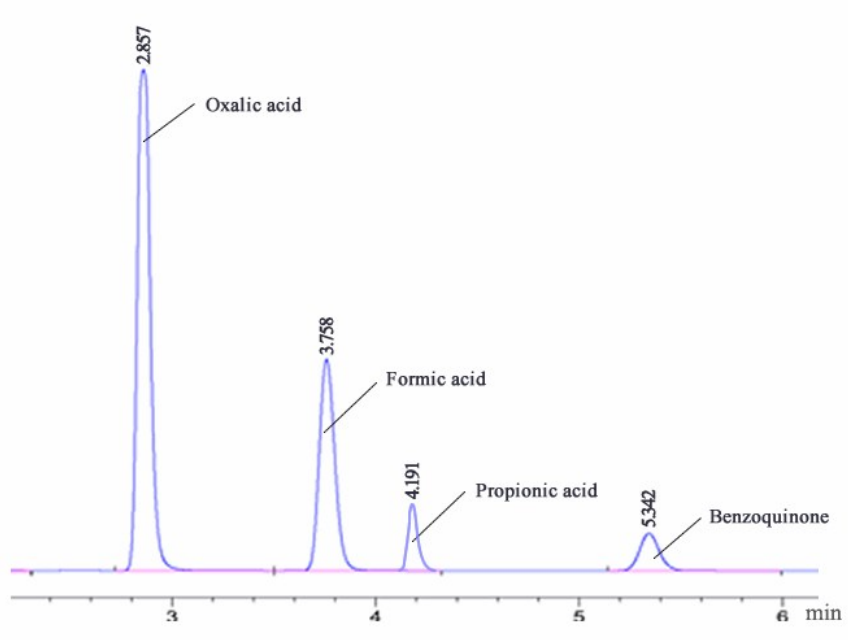


Fig. S7 The high performance liquid chromatography (HPLC) of intermediate products

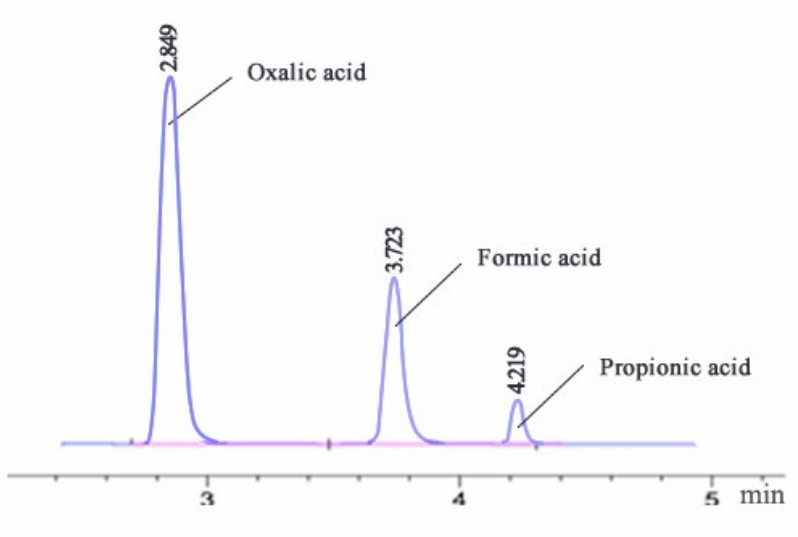


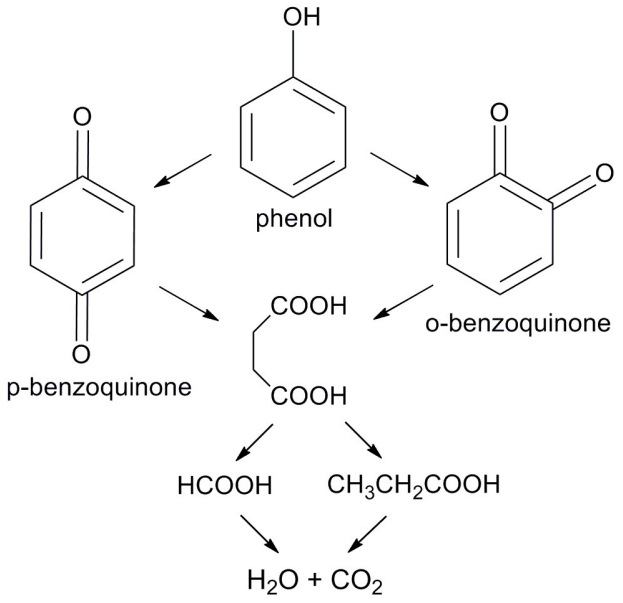
Fig. S8 The high performance liquid chromatography (HPLC) of oxalic acid degradation under the same reaction conditions.

Table S1 The different performance for CWPO of phenol.

Catalyst	Phenol/Catal/H_2O_2 (ppm/ppm/ppm)	Temperature/Irradiation	Time	pH	Degradation efficiency (%)	TOC removal (%)	Ref.
TiO_2-CdS-gCNNSs	10 / 5000 / -	UV light	5 h	-	80	-	1
n(Fe)/n(Mn)-MOFs	1000 / 64 / 249.9	35 °C	3 h	6.2	90	-	2
CuCo@γ-Al_2O_3	4700 / 500 / 3400	45 °C	1 h	-	90	40.2	3
Nano-metallic particles	20 / 250 / 3400	Ultrasound power (500 W)	2 h	6.9	100	-	4
Fe_3O_4 NPs	100 / 500 / 79.9	30 °C	4 h	2.0	89.52	-	5
rGO-Fe/MCM-41	100 / 100 / 340	25 °C	100 min	3.0	91	-	6
Zero-valent iron-assisted Fenton reaction	100 / 1000 / 1700	25 °C	10 min	2.5	100	80	7
$CuWO_4/WO_3$	6.063 / 1000 / 340	Visible light	4 h	7.0	80	-	8
Co:Ni LDHs	100 / 4030 / 340	-	77.8 min	-	94	-	9
FeCu-ZSM-5 coating/PSSF	1000 / - / 4760	80 °C	7 h	2.0	99	62	10
$Fe_3O_4/FeAl_2O_4$	35 / 3000 / 204	30 °C	10min	6.0	100	-	11
$LaCuO_3$	940 / 5000 / 23800	30 °C	2 h	3.0	90	86	12
Sch-Mo	100 / 1000 / 499.8	25 °C	2 h	3.0	100	-	13
G/FePc	50 / 200 / 2451.4	Visible light	3 h	5.5	96	77.1	14
α-Fe_2O_3-Bi_2WO_6	50 / 1000 / 102	UV light	2 h	5.5	95	70	15
$[C_{16}H_{33}(CH_3)_3N]_4H_2SiV_2W_{10}O_{40}$	50 / 3000 / 7820	25 °C	90 min	2.8	91.6	85.5	16

Table S2 Elemental composition of $C_{16}PW(O_2)_2$/PNIPAM with the loading amount of 16.0 wt% $C_{16}PW(O_2)_2$

Number theoretical content (%)					Actual content (%)					Formula
C	N	P	W	H	C	N	P	W	H	
5.27	0.34	0.25	5.97	1.02	5.21	0.38	0.29	5.92	1.03	$C_{16}PW(O_2)_2$/PNIPAM (before)
					5.18	0.31	0.25	5.81	0.98	$C_{16}PW(O_2)_2$/PNIPAM (after)



Scheme S1 The possible degradation of phenol in CWPO process using $C_{16}PW(O_2)_2$/PNIPAM as catalyst

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