Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

A reusable citric acid modified V/AC catalyst prepared by dielectric barrier discharge for hydroxylation of benzene to phenol

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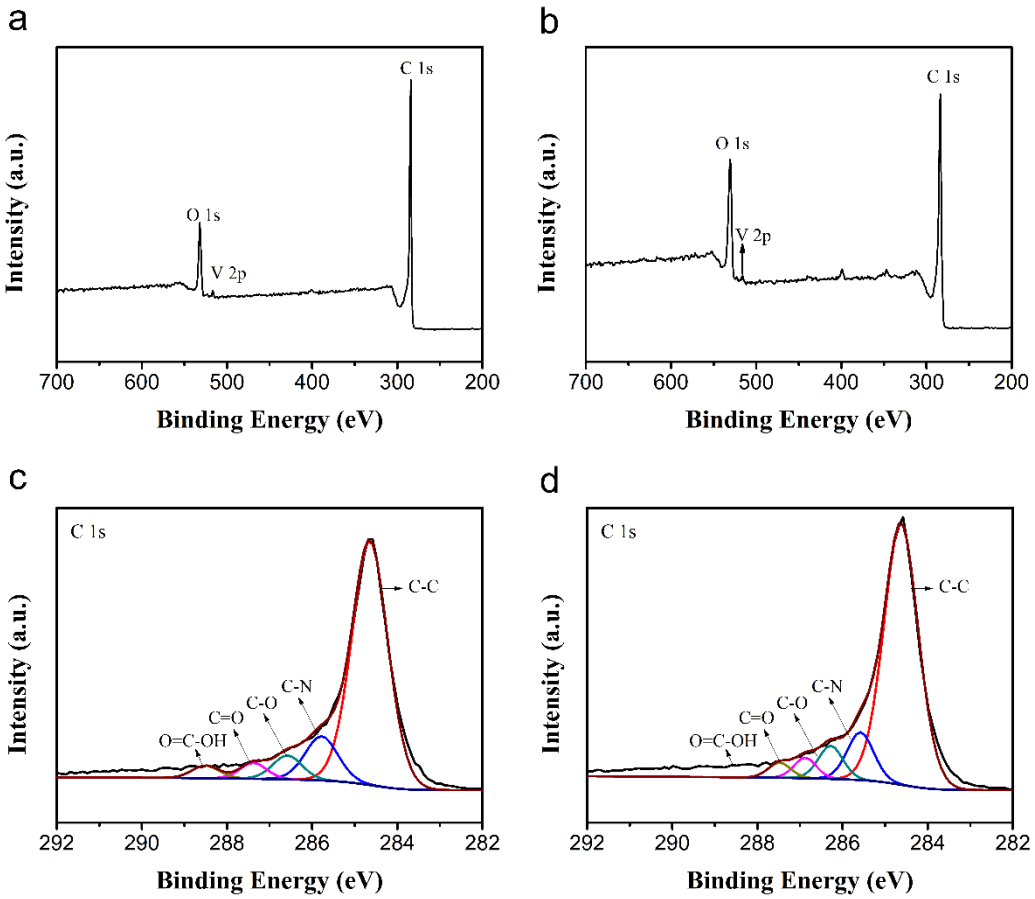

Figure S1 (a), (b) Full XPS and (c), (d) C 1s spectra of V_xO_y/AC-DBD and V_xO_y/AC(cit)-DBD.

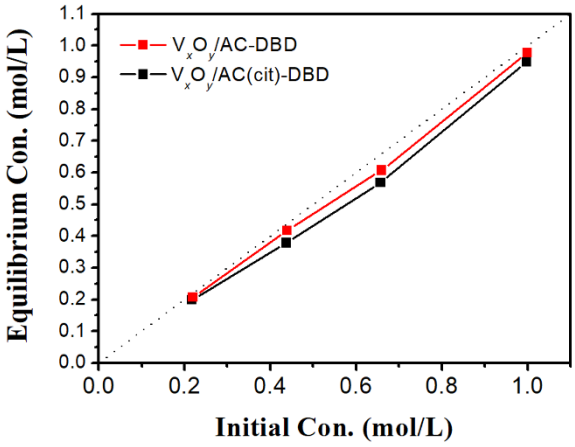

Figure S2 The relationship between initial and equilibrium concentrations of benzene on V_xO_y/AC-DBD and V_xO_y/AC(cit)-DBD.

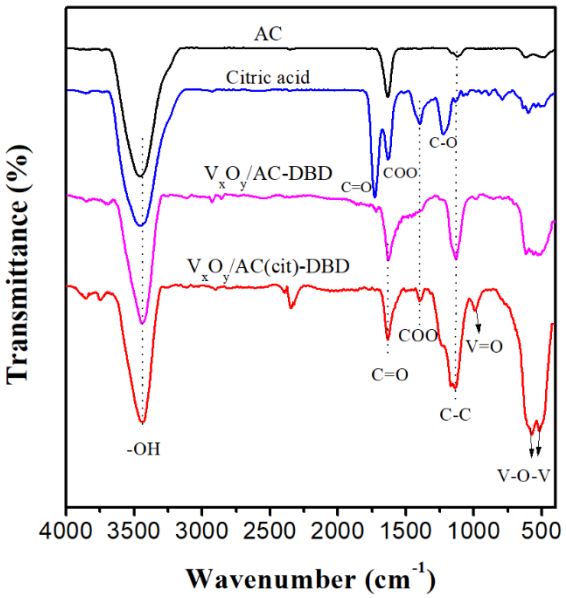

Figure S3 FTIR Spectra of activated carbon, citric acid, V_xO_y/AC-DBD and V_xO_y/AC(cit)-DBD.

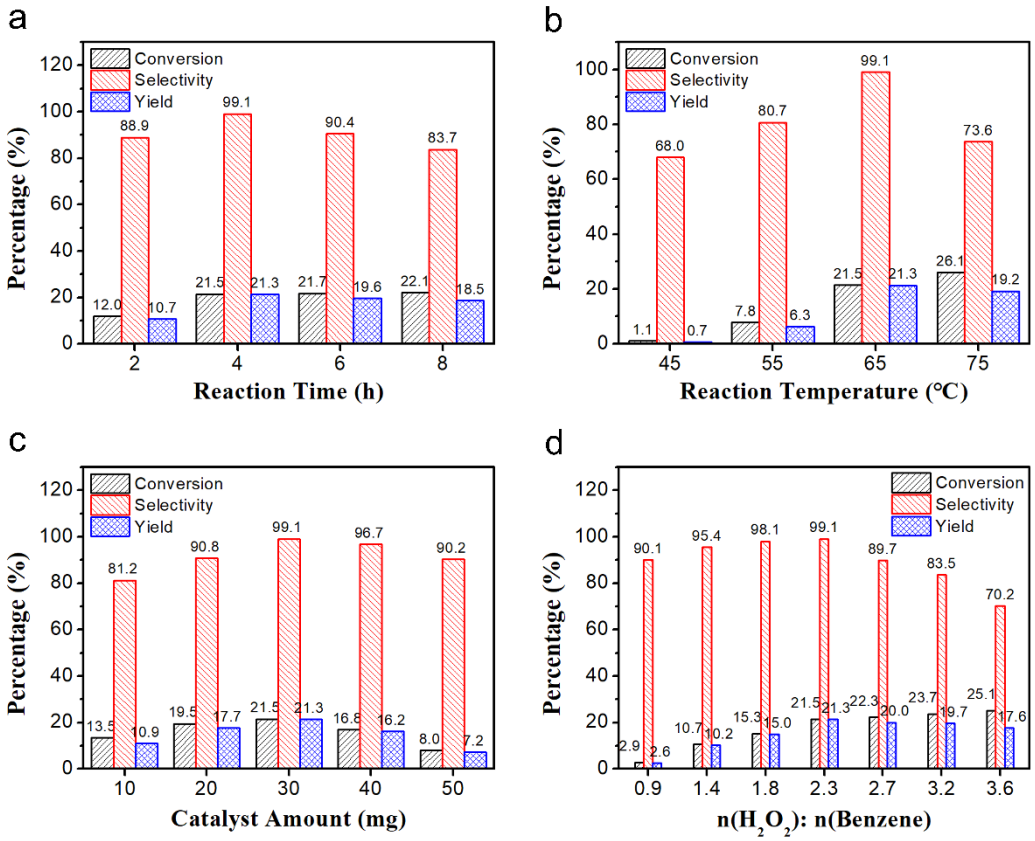

Figure S4 Effects of (a) reaction time, (b) reaction temperature, (c) catalyst amount, and (d) molar ratio of H_2O_2 to benzene on catalytic activities of V_xO_y/AC(cit)-DBD.

Table S1 Structural parameters of V_xO_y/AC-DBD and V_xO_y/AC(cit)-DBD.

Sample	BET surface area (m^2/g)	Pore volume (cm^3/g)	Pore diameter (DFT) (nm)
V_xO_y/AC-DBD	1227.93	2.65	0.55
V_xO_y/AC(cit)-DBD	1154.46	2.08	0.52

Table S2 XPS fitting parameters of the C 1s, V 2p and O 1s peaks of V_xO_y/AC-DBD and V_xO_y/AC(cit)-DBD.

Sample	Name	BE (eV)	Atomic (%)	Mass (%)	C/O ratio	V $2p_{3/2}$ peak area (%)		V Content[a] (wt%)
						V^{4+}	V^{5+}	
V_xO_y/AC-DBD	C 1s	284.7	85.7	92.4	6.26	22.6	77.4	3.8
	V 2p	517.1	0.6	0.5				
	O 1s	532.3	13.7	7.1				
V_xO_y/AC(cit)-DBD	C 1s	284.8	89.2	94.5	8.92	83.4	16.6	3.6
	V 2p	517.2	0.8	1.2				
	O 1s	532.3	10.0	4.3				

a: ICP analysis

Table S3 Catalytic performance of the precursor and V_xO_y/AC(cit)-T in benzene hydroxylation.

Entry	Catalyst	Cycle	Benzene conversion (%)	Phenol selectivity (%)
1	precursor	1st	7.01	96.52
		2nd	3.09	95.38

2	V_xO_y/AC(cit)-300	1st	4.51	95.78
		2nd	2.75	95.54
3	V_xO_y/AC(cit)-400	1st	3.40	96.47
		2nd	2.01	96.64
4	V_xO_y/AC(cit)-500	1st	4.09	91.05
		2nd	2.29	95.11
5	V_xO_y/AC(cit)-600	1st	5.40	94.12
		2nd	1.27	96.07