Electronic Supporting Information

Selective synthesis of 1,3-propanediol from glycidol over carbon film encapsulated Co catalyst

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Table S1 Loading amount and particle size of active metals.

Entry	Catalyst	Active metal loading (wt. %)[a]	Particle size (nm)	
			XRD[b]	TEM[c]
1	Co@NC	58.90	23.1	25.6
2	Co/AC	15.85	10.2	11.0
3	Co@NG-ZIF	41.40	12.1	13.3
4	Co/H-BEA	14.74	–	–
5	Co/MCM-41	13.71	–	–
6	Co/ZnO	14.88	–	–
7	Co/MgO	13.29	–	–
8	Co/Al_2O_3	13.49	–	–
9	Co/MWCNTs	14.90	–	–
10	Ni/MWCNTs	14.92	–	–
11	Cu/MWCNTs	14.89	–	–
12	Pt/ MWCNTs	3.57	–	–
13	Pd/MWCNTs	3.78	–	–
14	Ru/MWCNTs	3.80	–	–

[a] Metal contents were estimated by ICP-AES.

[b] Calculated according to the Scherrer formula.

[c] Derived from the TEM images.

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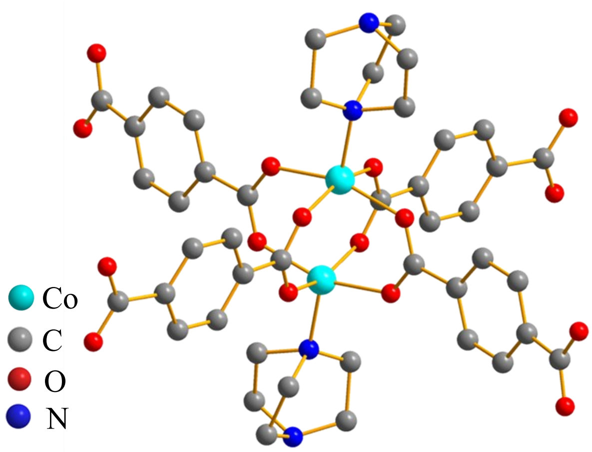


Fig. S1 Coordination environment of $Co_2(bdc)_2(ted)$ [1].

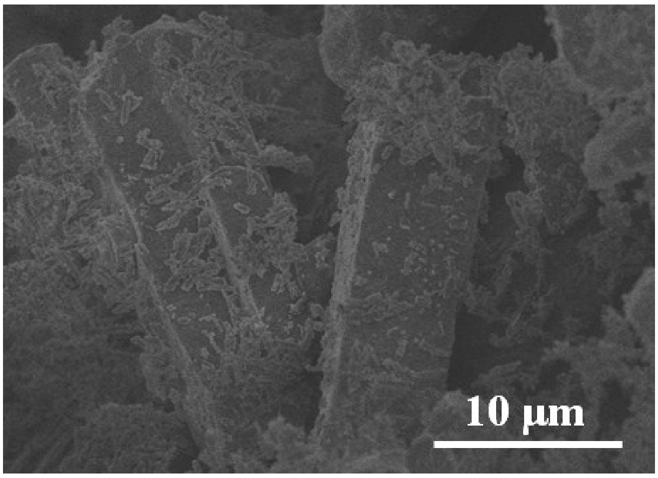


Fig. S2 SEM image of $Co_2(bdc)_2(ted)$.

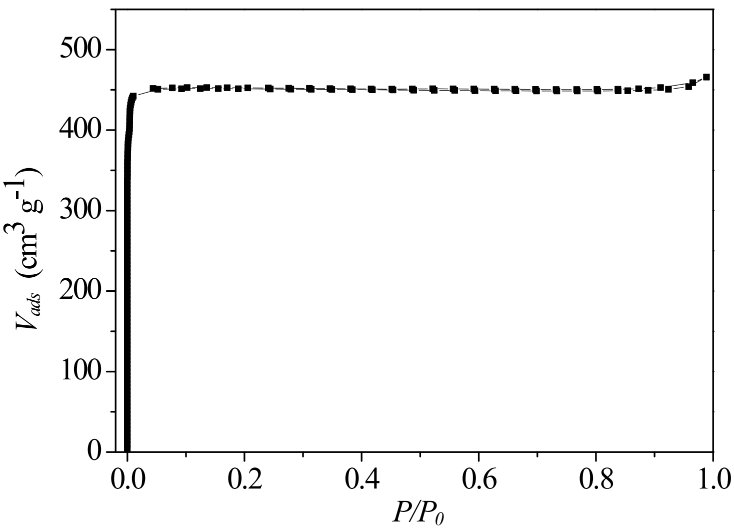


Fig. S3 N_2 adsorption-desorption isotherm of $Co_2(bdc)_2(ted)$.

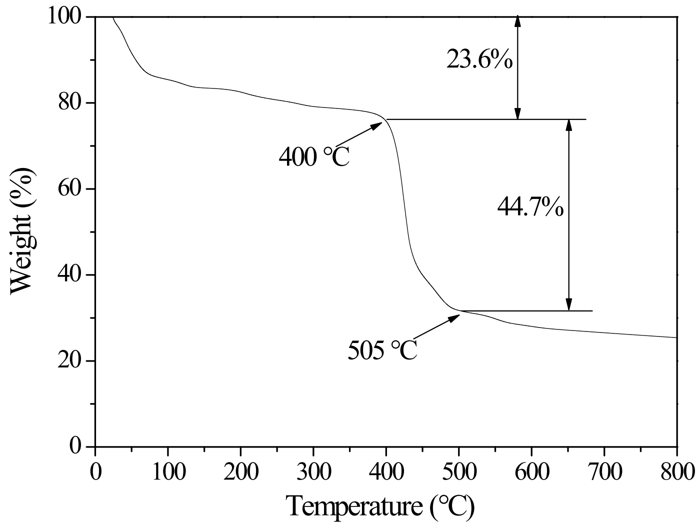


Fig. S4 TG curve of $Co_2(bdc)_2(ted)$.

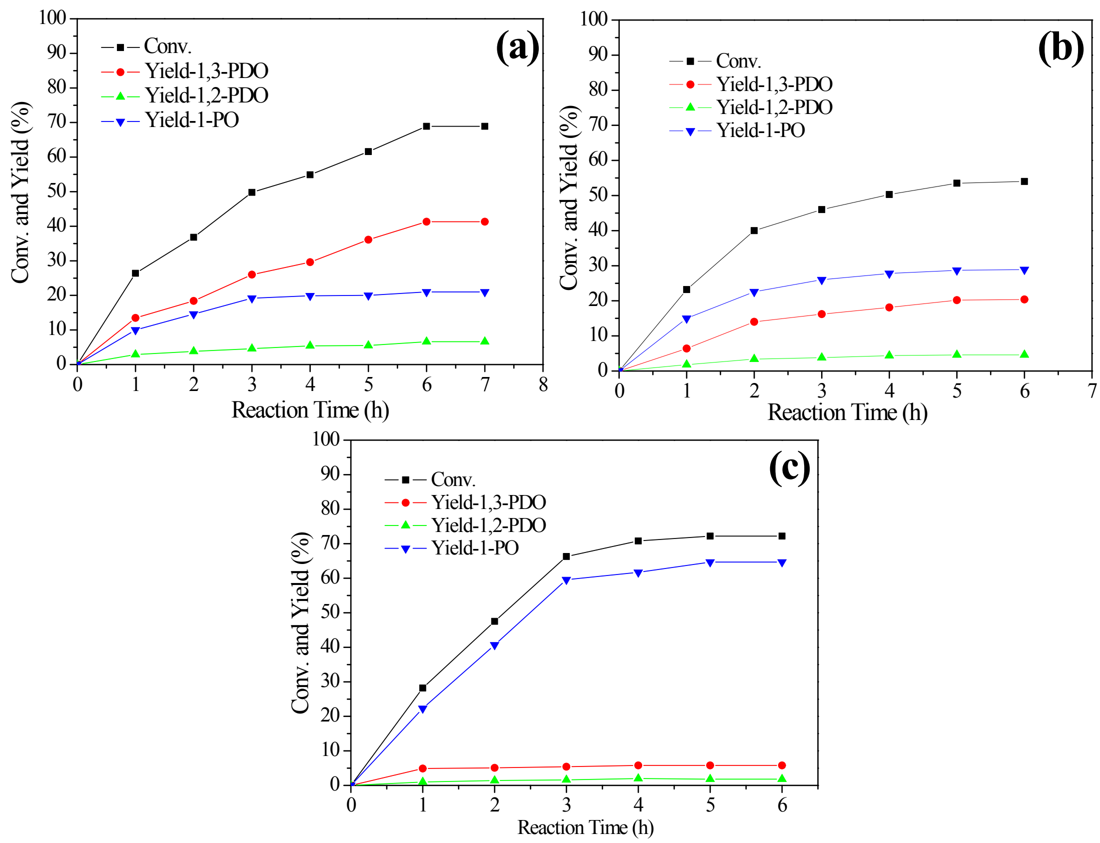


Fig. S5 Time courses of glycidol hydrogenation over (a) Co@NC, (b) Co/AC at 120 °C, and (c) Co@NG-ZIF at 100 °C.

Reaction conditions: 0.3 g glycidol in 10.0 mL ethanol, Co 9.8 wt.%, 2.0 MPa H_2.

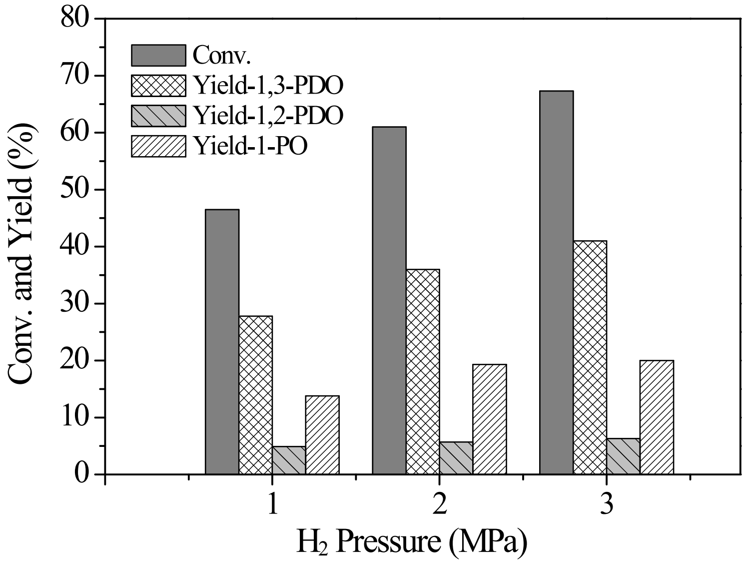


Fig. S6 Hydrogenation of glycidol under varied H_2 pressure.

Reaction conditions: 0.3 g glycidol in 10.0 mL ethanol with 9.8 wt.% of Co (Co@NC catalyst), 120 °C, 5 h.

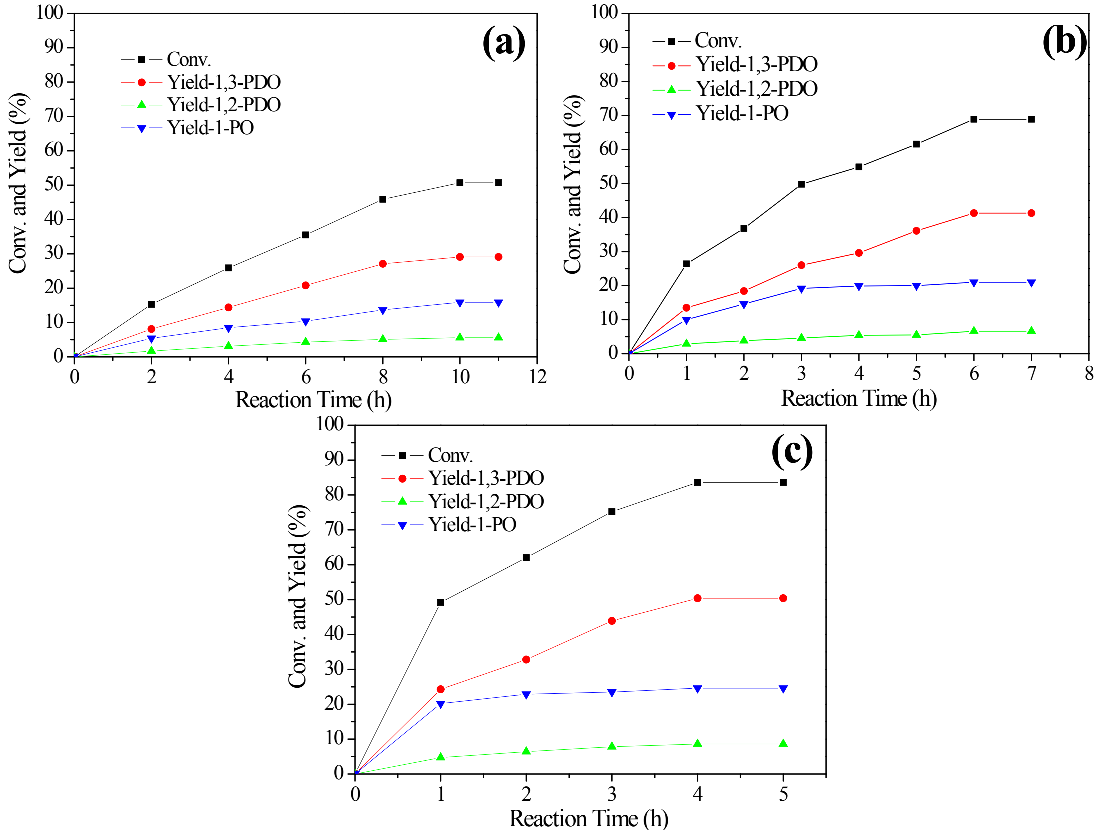


Fig. S7 Hydrogenation of glycidol over Co@NC at (a) 100 °C, (b)120 °C and (c) 140 °C.

Reaction conditions: 0.3 g glycidol in 10.0 mL ethanol with 9.8 wt.% of Co, 2.0 MPa H_2.

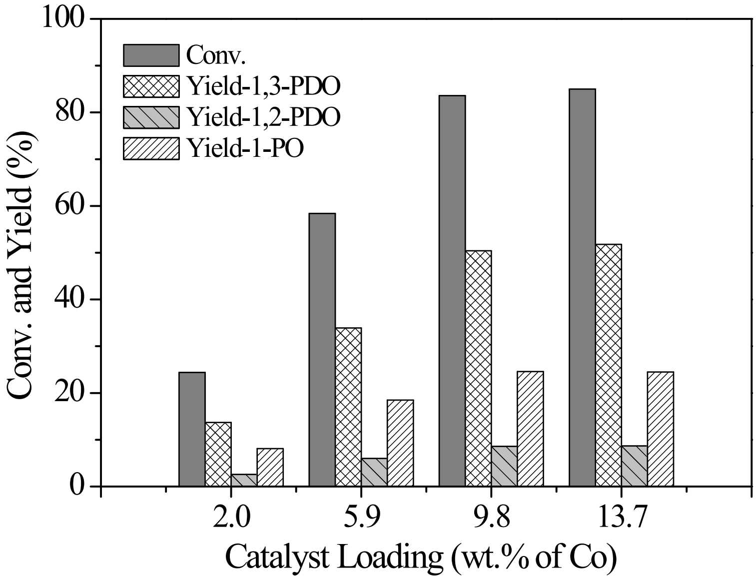


Fig. S8 Hydrogenation of glycidol with varied dosage of catalyst.

Reaction conditions: 0.3 g glycidol in 10.0 mL ethanol with different amount of Co@NC catalyst, 2.0 MPa H_2, 140 °C, 4 h.

Table S2 Results of glycidol hydrogenation in those pioneering works and this work.

Catalyst	Conv. (%)	Selectivity (%) 1,3-PDO	1,2-PDO	1-PO	Others [a]	1,3-PDO Yield (%)	Ref.
Pd/C	96.1	<1	93.1	-	6.7	<0.96	[2]
Pd/C+A15	100±8	-	>99	-	-	>99	[3]
Ni(40)/Sap	100	26	53	-	21	26	[4]
NiRe(7)/MS	98	47	38	7	6	46.1	[5]
Co@NC	83.6	60.3	10.3	29.4	-	50.4	This work [b]

[a] Oligomers of glycidol.

[b] Data was obtained at 140 °C and 4 h (Fig. S7 (c)).

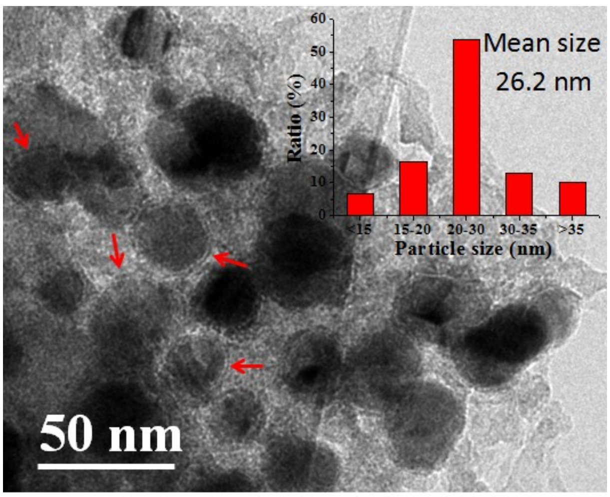


Fig. S9 TEM image of recycled Co@NC.

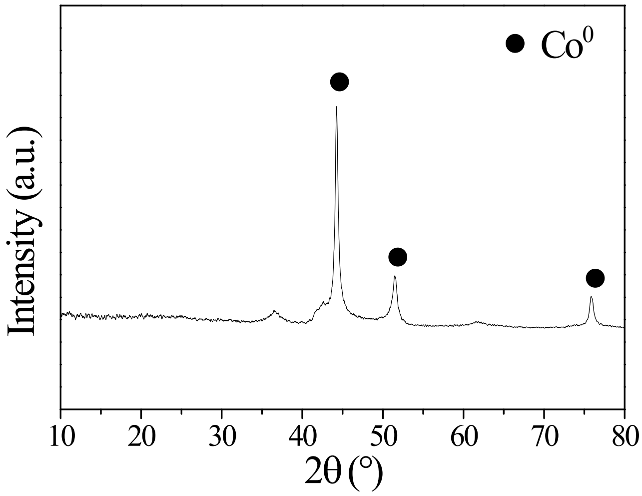
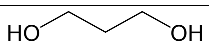
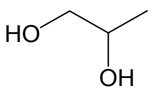
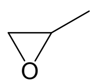


Fig. S10 XRD pattern of recycled Co@NC.

Table S3 Hydrogenation of PDOs and propylene oxide over three Co catalysts [a].

Entry	Substrate	Catalyst	Conversion (%)	Product selectivity	
				Compound	(%)
1		Co@NC	NR[b]	–	–
2		Co/AC	NR	–	–
3		Co@NG-ZIF	NR	–	–
4		Co@NC	NR	–	–
5		Co/AC	NR	–	–
6		Co@NG-ZIF	NR	–	–
7		Co@NC	93.8	1-propanol	86.8
				propane	13.2
8		Co@NG-ZIF	95.0	1-propanol	13.0
				propane	87.0

[a] Reaction conditions: 0.3 g substrate in 10.0 mL ethanol with 9.8 wt.% of Co, 2.0 MPa H_2, 140 °C, 4 h. [b] NR: no reaction.

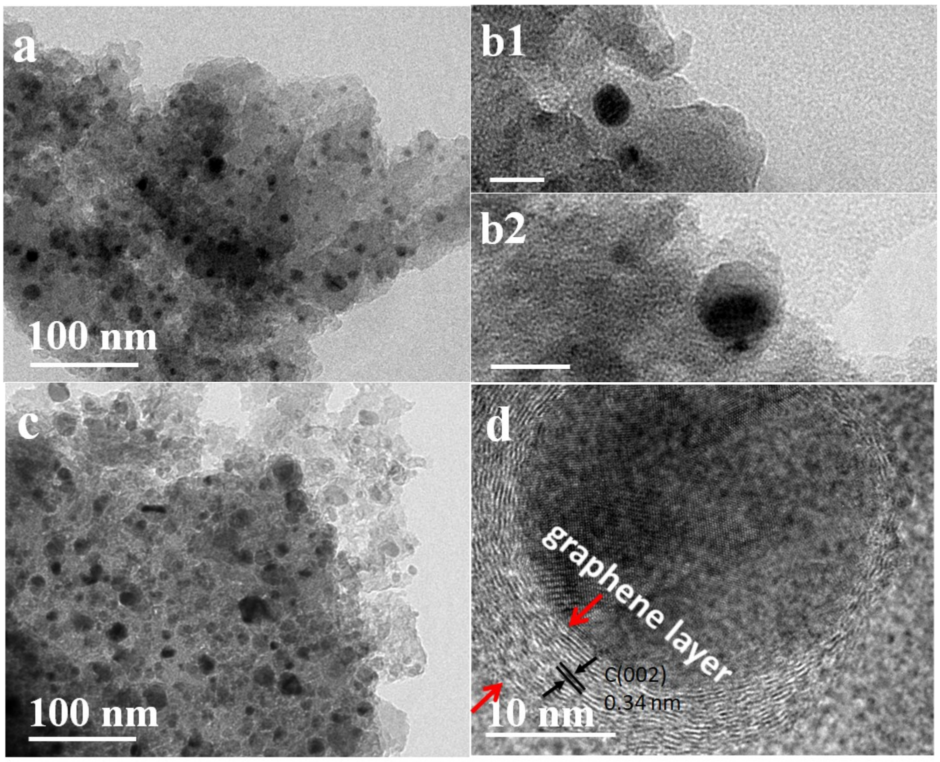


Fig. S11 TEM images of (a, b) Co/AC, and (c, d) Co@NG-ZIF (the scale bar in Fig. b was 20 nm).

Table S4 Surface elemental composition of different Co-based catalysts.

Entry	Catalyst	Surface atom composition (%)[a]			
		C	O	N	Co
1	Co@NC	80.2	14.1	1.1	4.6
2	Co@NG-ZIF	79.6	12.4	5.8	2.2

[a] Surface composition determined from XPS.

References

1. D. N. Dybtsev, H. Chun, and K. Kim, Angew. Chem., 2004, 116, 5143−5146.
2. R. Cucciniello, C. Pironti, C. Capacchione, A. Proto and M. Di Serio, *Catal. Commun.*, 2016, **77**, 98−102.
3. M. Ricciardi, D. Cespi, M. Celentano, A. Genga, C. Malitesta, A. Proto, C. Capacchione and R. Cucciniello, *Sustainable Chem. Pharm.*, 2017, **6**, 10−13.
4. F. B. Gebretsadik, J. Ruiz-Martinez, P. Salagre and Y. Cesteros, *Appl. Catal. A: Gen.*, 2017, **538**, 91−98.
5. F. B. Gebretsadik, J. Llorca, P. Salagre and Y. Cesteros, *ChemCatChem*, 2017, **9**, 3670−3680.