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

Enhanced CO Oxidation in Porous Metal-oxide Nanoparticles Derived from MOFs

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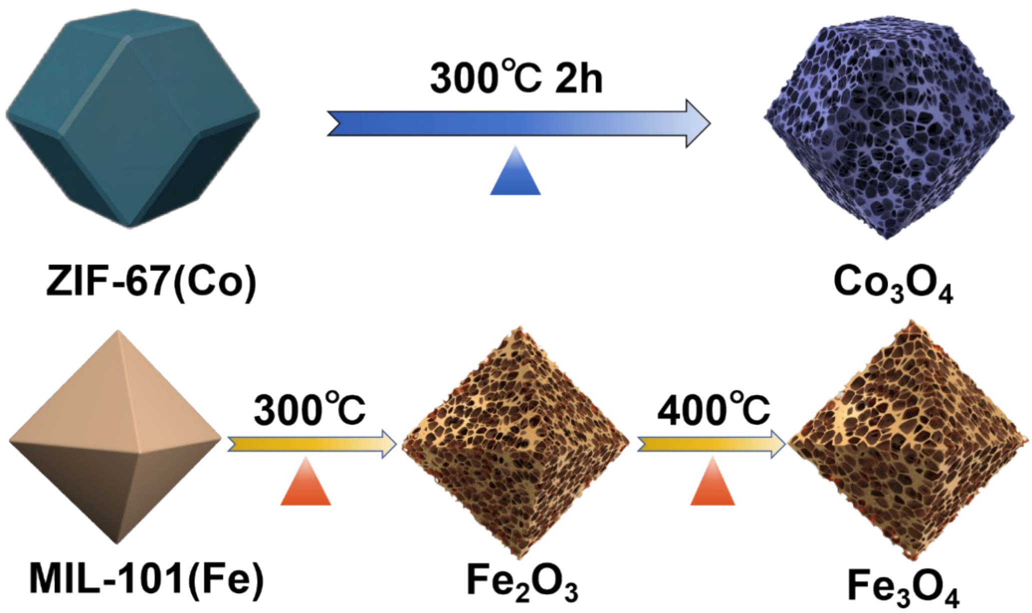

Fig. S1 Flow preparation chart of Co_3O_4, Fe_2O_3 and Fe_3O_4.

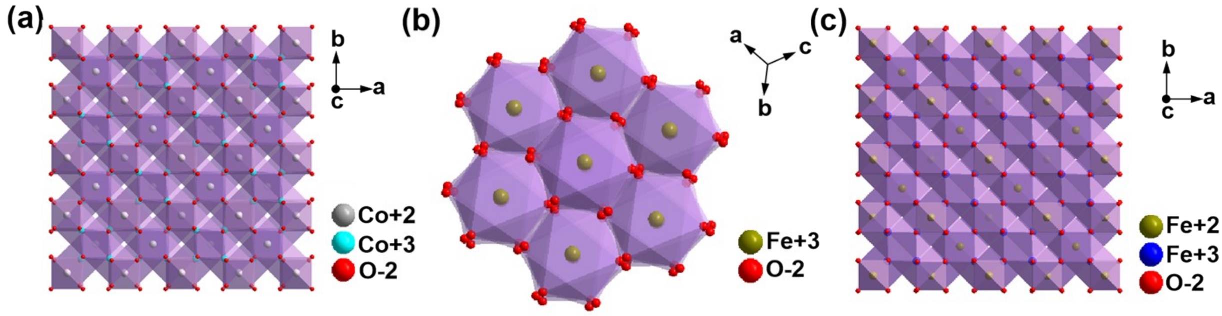

Fig. S2 The unit cell structure of (a) Co_3O_4, (b) Fe_2O_3, (c) Fe_3O_4.

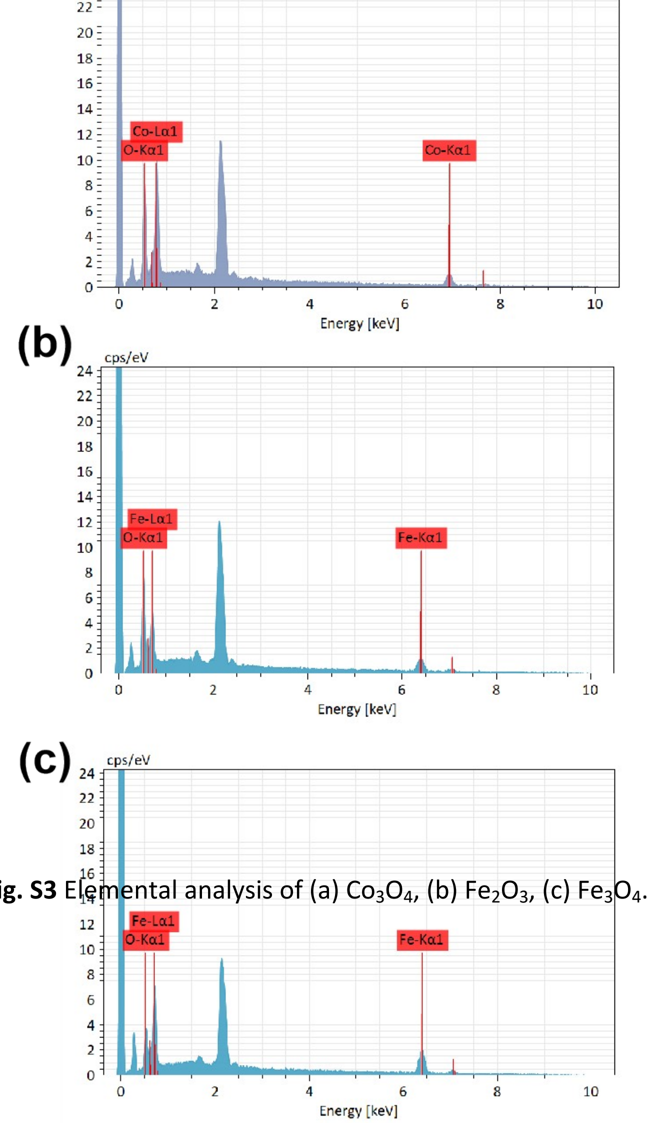

Fig. S3 Elemental analysis of (a) Co_3O_4, (b) Fe_2O_3, (c) Fe_3O_4.

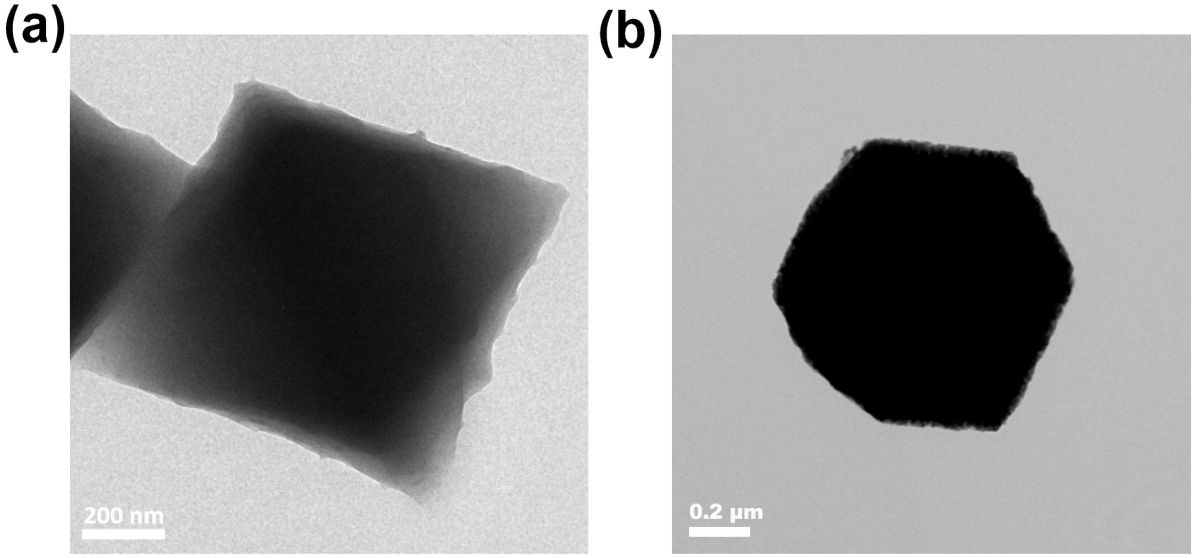

Fig. S4 TEM images of (a) MIL-101(Fe) and (b) ZIF-67(Co).

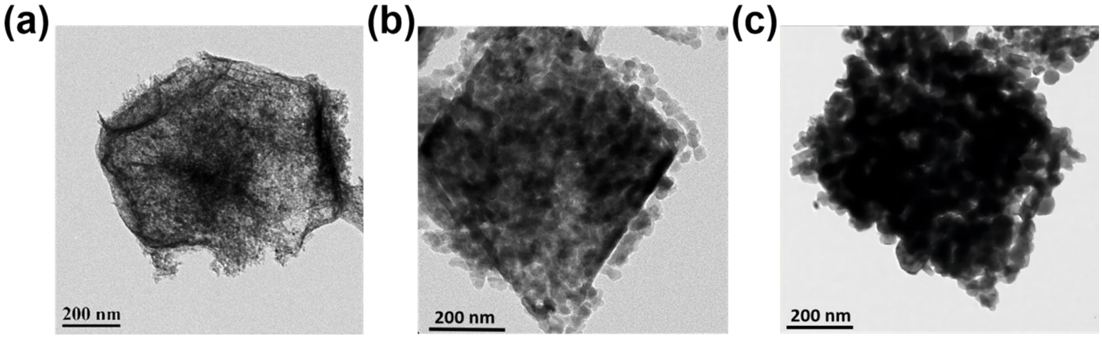

Fig. S5 HRTEM images of (a) Co_3O_4, (b) Fe_2O_3, (c) Fe_3O_4.

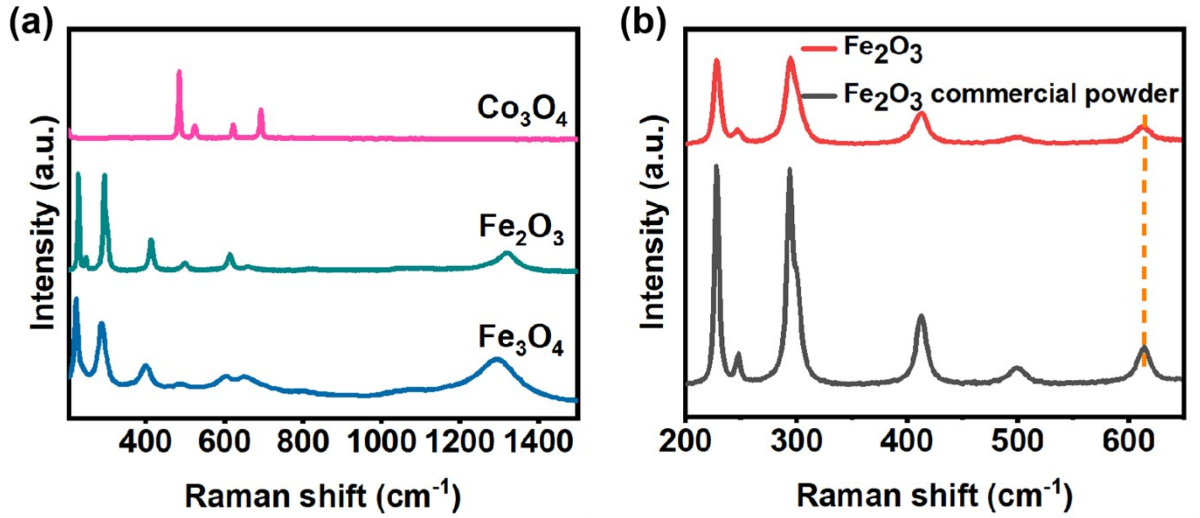

Fig. S6 Raman spectra of (a) commercial powders Co_3O_4, Fe_2O_3 and Fe_3O_4. (b) Fe_2O_3 and Fe_2O_3 commercial powders

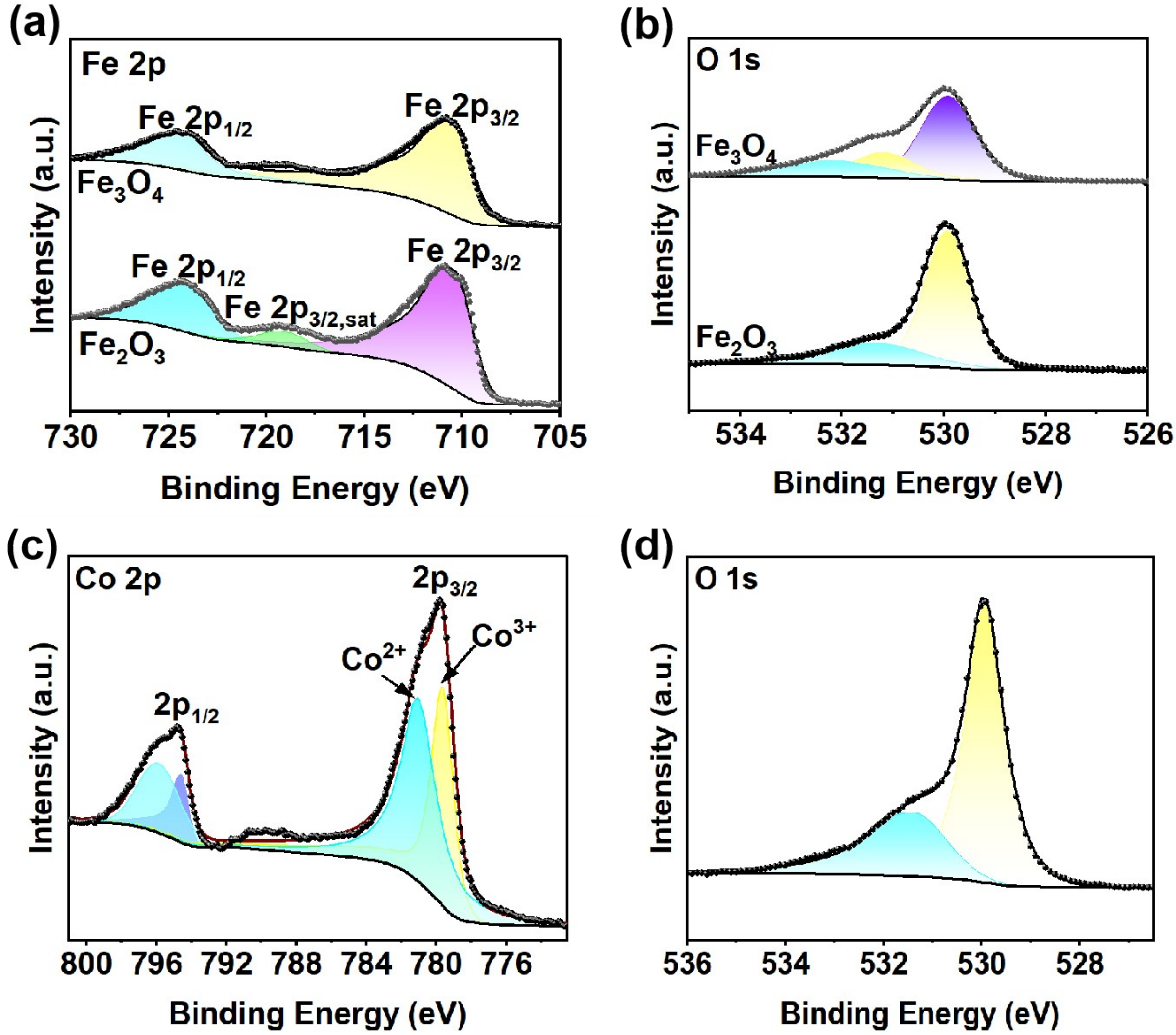

Fig. S7 XPS spectra of the porous nanoparticles after the reaction of (a) Fe 2p peaks of Fe_2O_3 and Fe_3O_4, (b) O 1s peaks of Fe_2O_3 and Fe_3O_4, (c) Co 2p peaks of Co_3O_4, and (d) O 1s peaks of Co_3O_4.

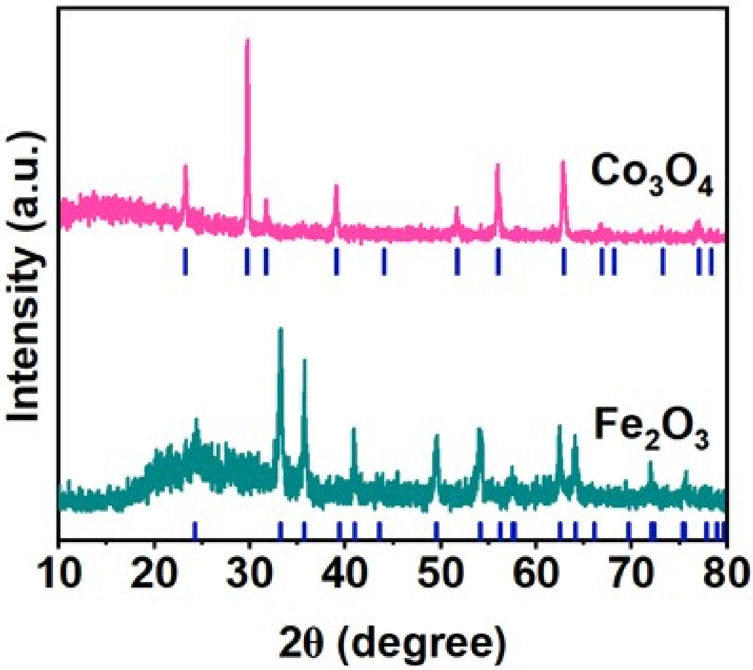

Fig. S8 XRD of porous Co_3O_4 and Fe_2O_3 nanoparticles after 48 h long period of CO oxidation.

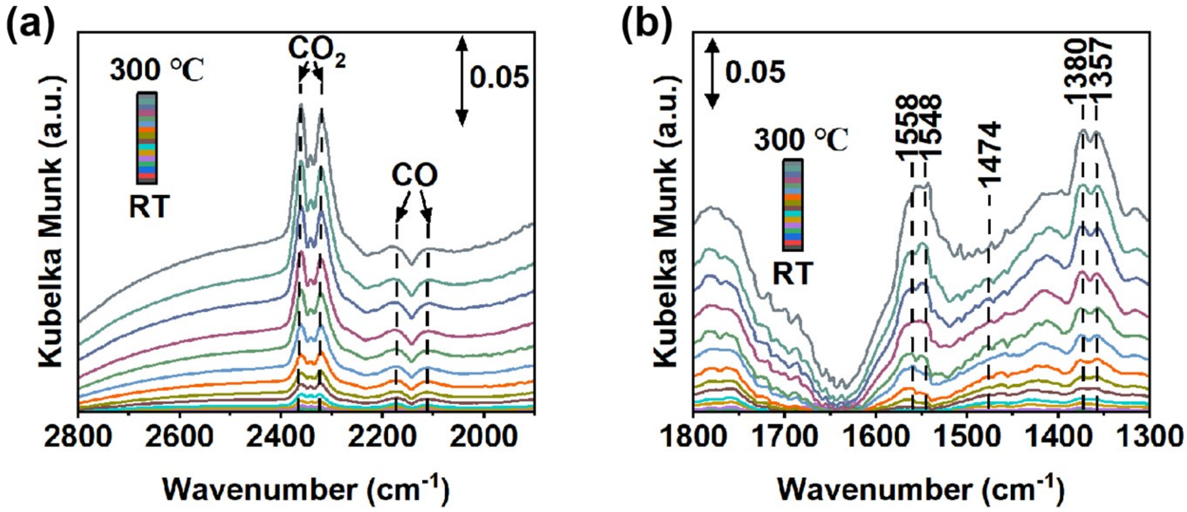

Fig. S9 *In situ* DRIFTS of porous Fe_2O_3 nanoparticle under 1 vol% CO, 21 vol% O_2 and 78 vol% N_2 condition.

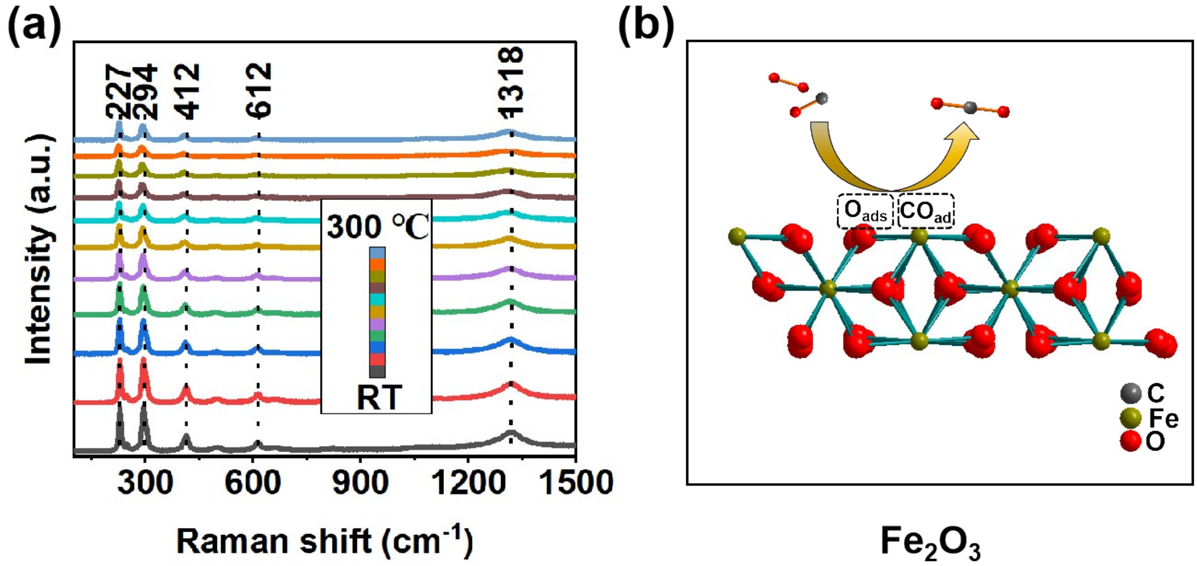

Fig. S10 (a) Raman spectra of Fe_2O_3 at different temperatures, (b) Schematic diagram of carbon monoxide oxidation on Fe_2O_3 surface

Table. S1 Elemental analysis of N and C species in porous Co_3O_4, Fe_2O_3 and Fe_3O_4 nanoparticles.

	Element C content (wt%)	Element N content (wt%)
Co_3O_4	≤0.3	≤0.3
Fe_2O_3	≤0.3	≤0.3
Fe_3O_4	≤0.3	≤0.3

Table. S2 Ratio of O species in porous Co_3O_4, Fe_2O_3 and Fe_3O_4 nanoparticles.

	Before Reduction	
	$O_{latt}/(O_{latt}+O_{ads})$	$O_{ads}/(O_{latt}+O_{ads})$
Co_3O_4	62.33%	37.67%
Fe_2O_3	70.77%	29.23%
Fe_3O_4	76.08%	23.92%

Table. S3 Comparison of CO oxidation performances of different cobalt and iron oxides.

Catalyst	Load content	Reaction gas	Flow Rate (mL min^{-1})	Amount of catalyst used	Reaction temperature	Ref.
Co_3O_4	Ag	$CO/O_2/N_2$ =1.6/21.4/77.0	25	50mg	T100=120 °C	[1]
Co_3O_4	Ce_2O	$CO/O_2/N_2$ = 0.6:0.6:99.8	66.66	50mg	T99 = 192 °C	[2]
Co_3O_4	SiO_2	$CO/O_2/N_2$ = 0.4:8:91.6	150	50mg	T50 = 158 °C	[3]
Co_3O_4		CO/O_2/He = 5:10:85	50	20mg	T100 = 175°C	[4]
Co_3O_4	Pt	CO/O_2/He = 2:5:43	50	10mg	T100 = ~140°C	[5]
Fe_2O_3		$CO/O_2/(He+N_2)$ = 1:10:5	150	150mg	T50 = 300°C	[6]
Fe_2O_3	pt	$CO/O_2/N_2$ = 2.4:2.4:95.2	100	200mg	T100 < 200°C	[7]
Fe_3O_4					T20 < 300°C	
Co_3O_4		$CO/O_2/N_2$=1:21:78	50	50mg	T90 = 127°C	This work
Fe_2O_3		$CO/O_2/N_2$=1:21:78	50	50mg	T90 = 267°C	This work
Fe_3O_4		$CO/O_2/N_2$=1:21:78	50	50mg	T20=275°C	This work

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