Supporting information

N-doped Carbon Nanotube Encapsulated Cobalt for Efficient Oxidative Esterification of 5-Hydroxymethylfurfural

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Table S1 The Co leaching concentration detected by ICP-MS

Reycle No.	Cat.	Co leaching content (ppm)
1	Co/GCN-800	15.2
2	Co/GCN-800	4.3

Reaction conditions: 1 mmol HMF, 20 mL methanol, 1 MPa O_2, reaction time 16 h, temperature 130 °C.

Table S2 The previous reported for the oxidative esterification of HMF to FDMC

Entry	Cat.	HMF Conv. (%)	FDMC yield. (%)	Ref.
1	PdCoBi/C	99	96	[1]
2	Au-CeO_2	99	99	[2]
3	$C_{ox}O_y$-N@C+Ru@C	100	99	[3]
4	Au/TiO_2	>99	98	[4]
5	Co@C-N(800)	99	91	[5]
6	Co@CN	100	95	[6]

Table S3 The oxidative esterification of HMF in different solvent

Entry	Solvent	HMF Conv. (%)	Esterification product yield (%)
1	ethnaol	91.8	42.7
2	n-propanol	65.4	13.2

Reaction conditions: 1 mmol HMF, 0.05 g catalyst, 20 mL solvent, 1 MPa O_2, reaction time 16 h, temperature 130 °C.

Characterization

The FT-IR spectrums of catalysts was measured with IRAffinity-1S instrument. The CO_2 temperature-programmed desorption (CO_2-TPD) experiments were carried out on Tianjin Xianquan Chemisorption analyzer instrument. The NH_3-TPD was performed on a Micromeritics 2920 Autochem II Chemisorption Analyzer. The ICP-MS was carried out on Thermo fisher iCAP-7000 series instrument.

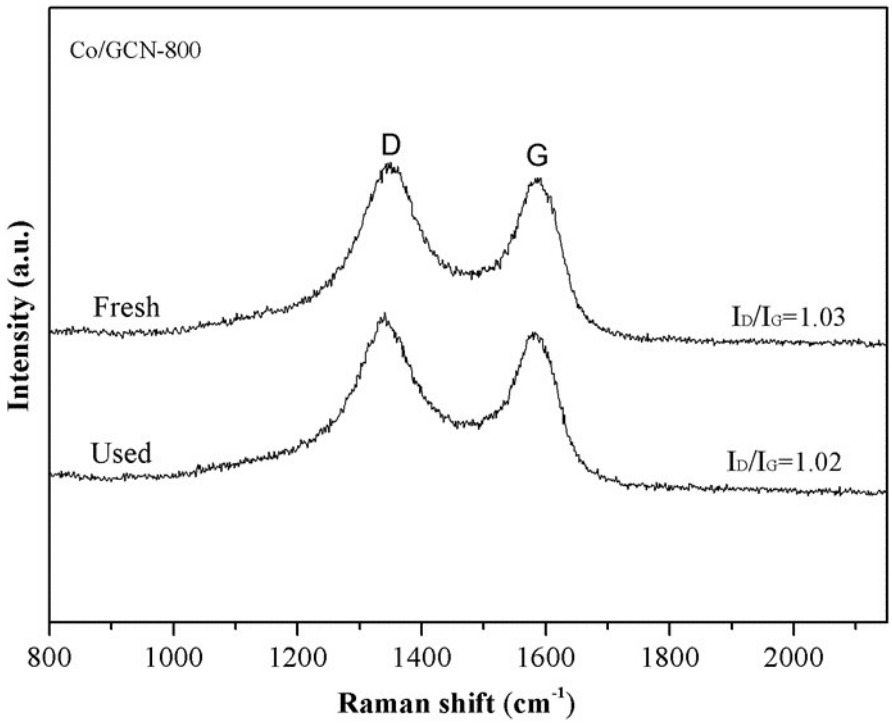

Fig. S1 Raman spectra of fresh and reused the Co/GCN-800 samples.

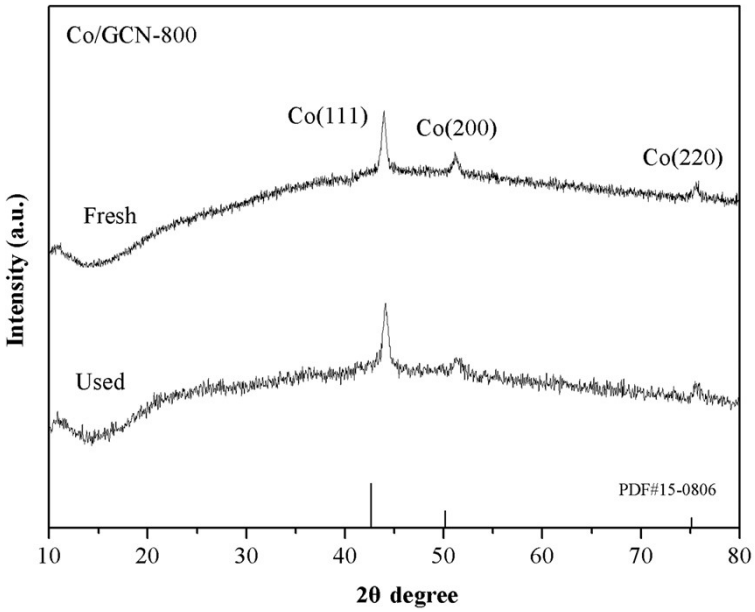

Fig. S2 XRD pattern of Co/GCN-800 before and after the reaction

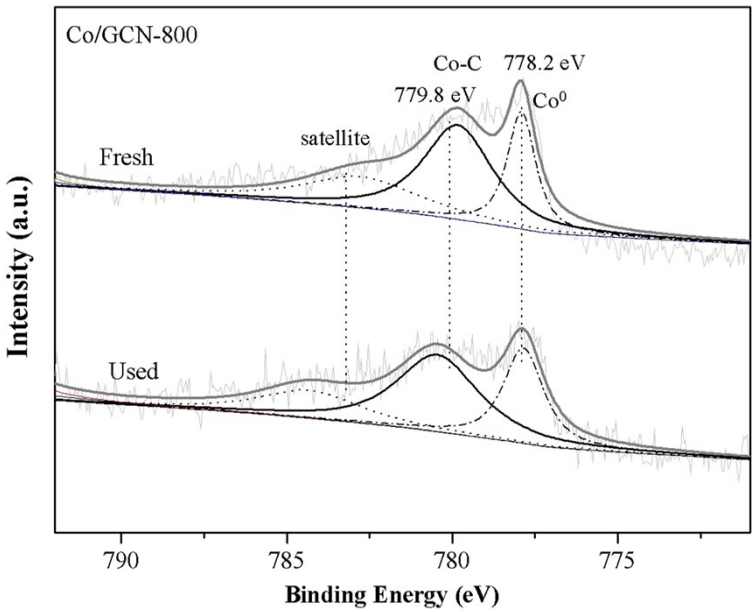

Fig. S3 Co $2p_{2/3}$ spectra of Co/GCN-800 before and after the reaction

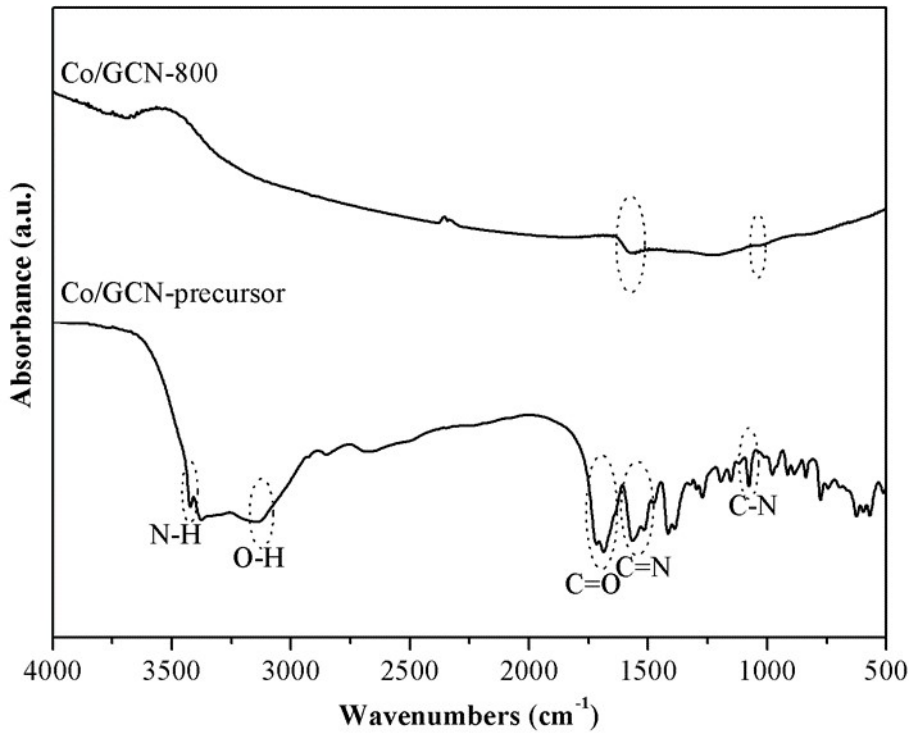

Fig. S4 FT-IR spectra of Co/GCN-800 and Co/GCN-precursor

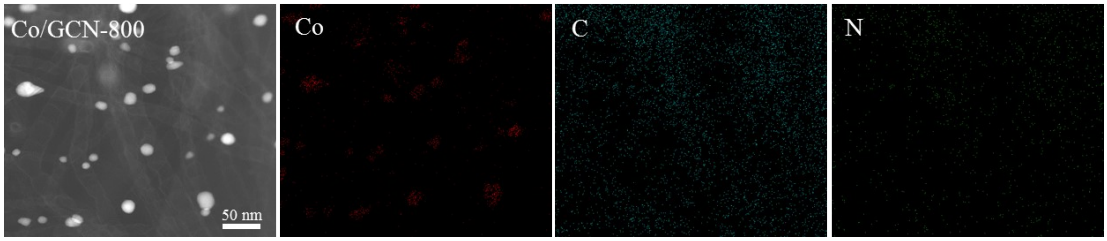

Fig. S5 The TEM mapping of Co/GCN-800

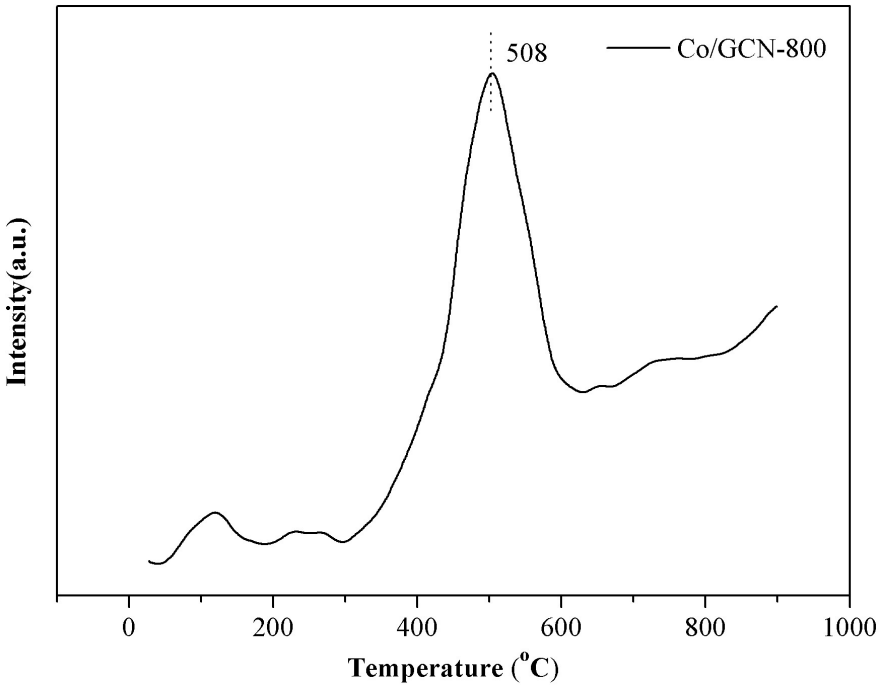

Fig. S6 CO_2-TPD of Co/GCN-800

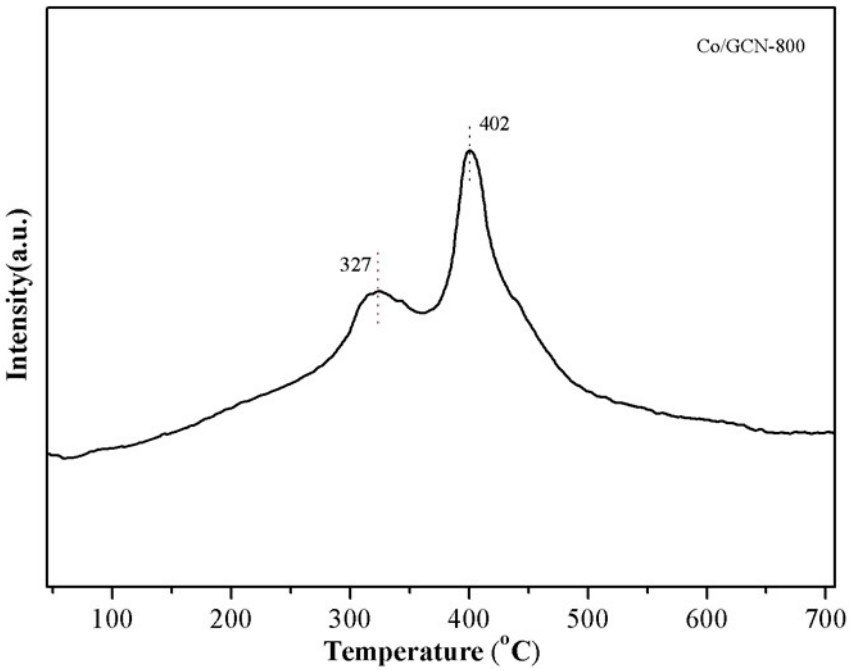

Fig. S7 NH_3-TPD of Co/GCN-800

Reference

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