

Supplementary Information

Palladium Nanoparticles on Chitin-derived Nitrogen-doped Carbon Materials for Carbon Dioxide Hydrogenation into Formic Acid

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Table S1 Relative content of C and N species on chitin-derived N-doped carbon materials.

Sample	C 1s					N 1s				
	sp ² C	C-N	C-O	C=O	C(O)OH	Pyridinic N	C-NH ₂	Pyrrolic N	Graphitric N	N oxide
C-HC	60.22	18.87	5.81	8.97	6.13	37.04	2.22	47.91	9	3.82
C-600	53.82	18.99	10.2	7.97	8.38	31.75	5.67	47.88	11	3.71
C-TC	52.6	19.04	10.49	11.6 ₈	6.19	29.14	5.17	48.55	12.35	4.79

Table S2 ICP-MS test results of Pd catalysts.

Catalyst	Pd (wt%)
Pd/C-HC	3.3
Pd/C-600	5.1
Pd/C-TC	5.2

Table S3 Relative content of N and Pd species on Pd catalyst surface.

Catalyst	N specie					Pd specie			
	Pyridinic N	C-NH ₂	Pyrrolic N	Graphitic N	N oxide	Pd ⁰ 3d _{5/2}	Pd ²⁺ 3d _{5/2}	Pd ⁰ 3d _{3/2}	Pd ²⁺ 3d _{3/2}
Pd/C-HC	16.6	14.36	34.0	26.4	8.7	28.5	14.6	20.0	36.9
Pd/C-600	23.0	13.1	33.6	21.7	8.6	31.5	15.0	20.5	33.0
Pd/C-TC	24.9	12.8	32.7	22.3	7.3	26.1	13.0	17.4	43.5

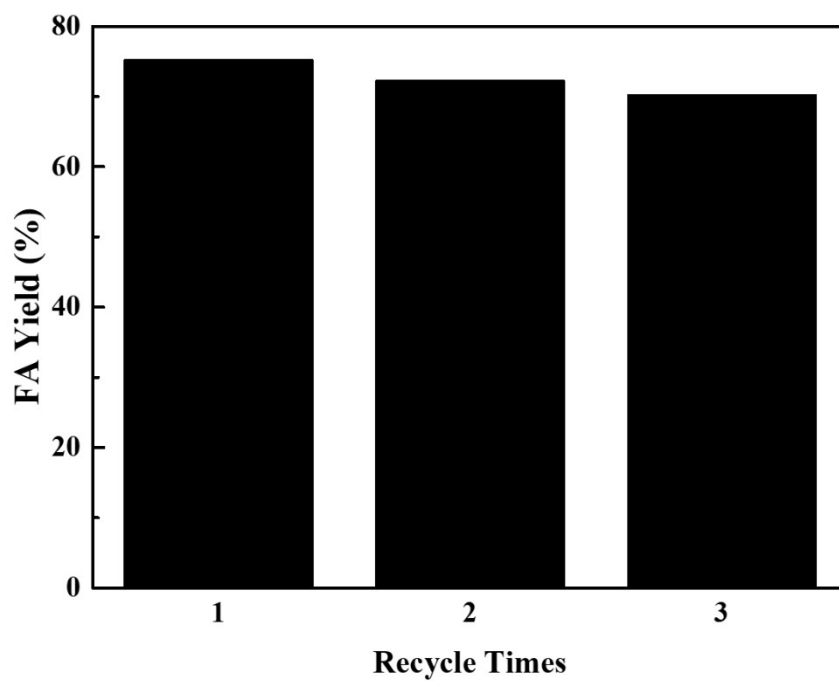


Fig. S1 The recycling test of Pd/C-TC on bicarbonate hydrogenation into FA. Reaction conditions: 5 mmol KHCO_3 , 5 mL water, 3 MPa H_2 , 100 °C, 3 h, Pd/C-TC (6 wt%), n (substrate)/n (Pd) = 400:1.

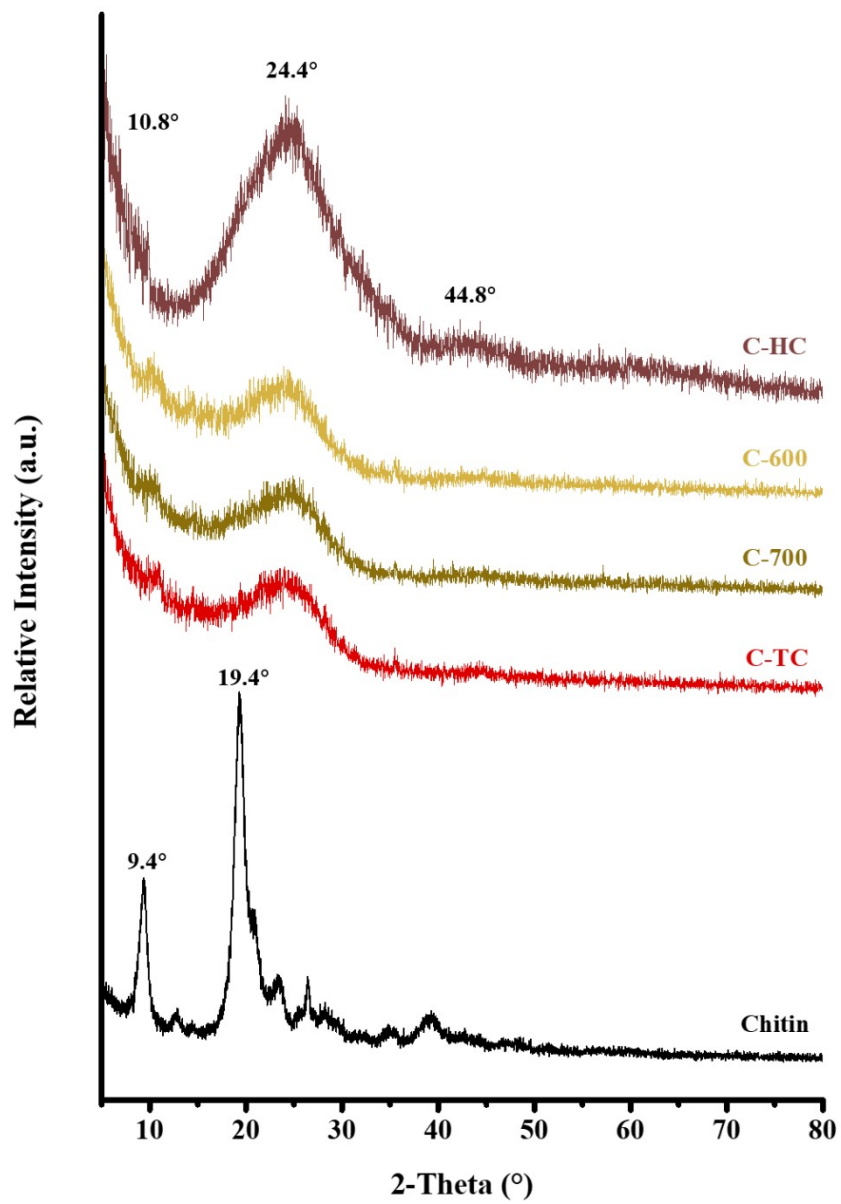


Fig. S2 XRD patterns of chitin and four N-doped carbon materials.

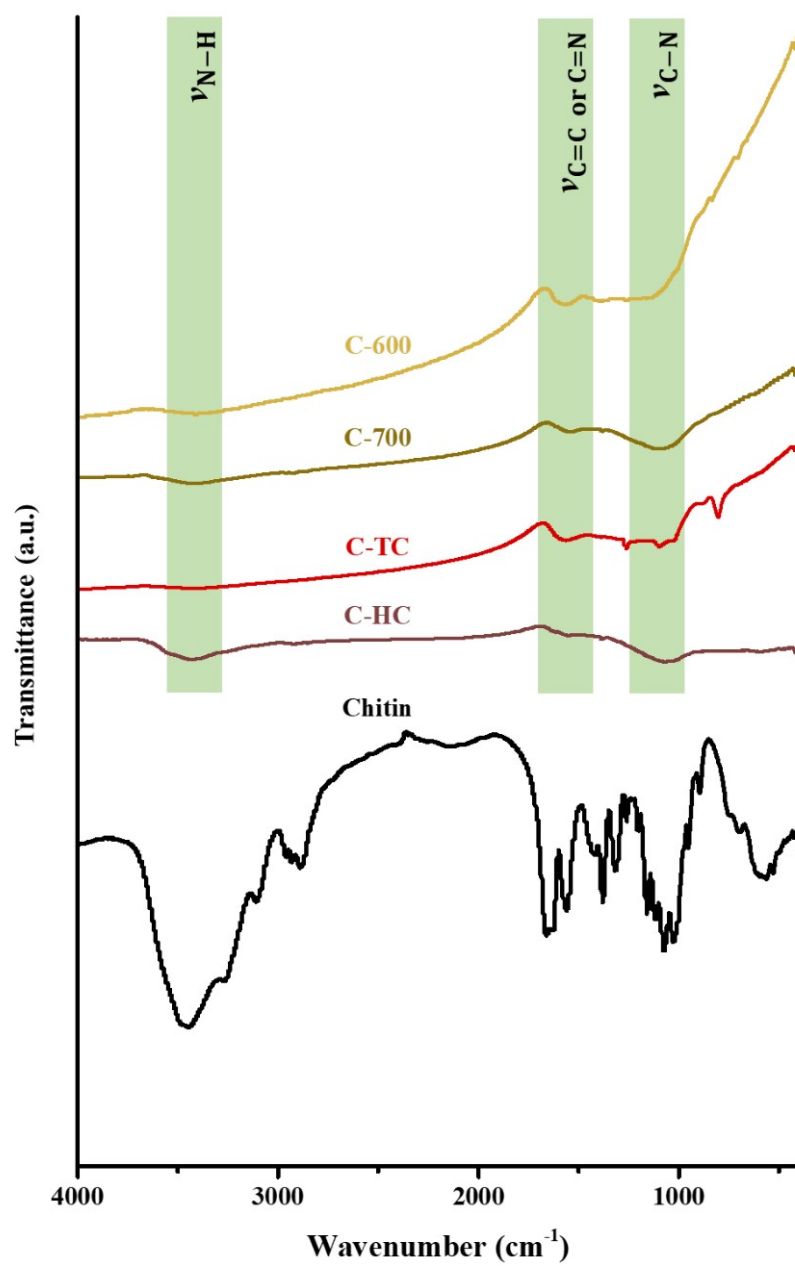


Fig. S3 FTIR spectra of chitin and four N-doped carbon materials.

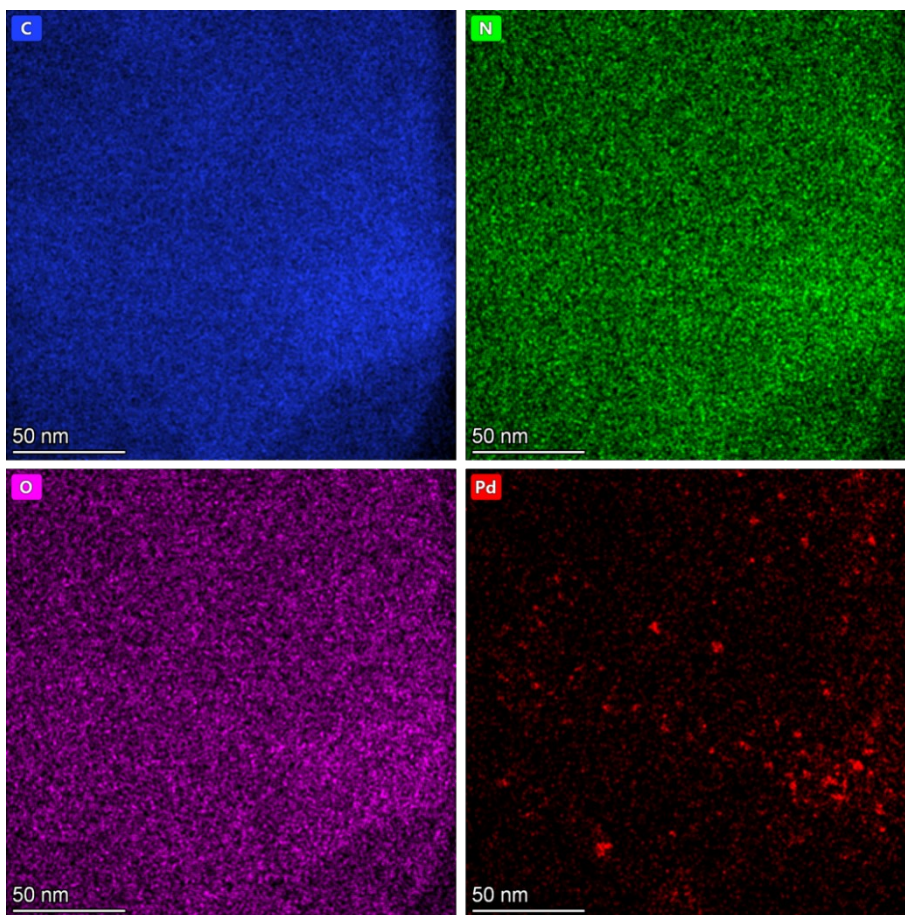


Fig. S4 EDS mapping diagram of catalyst Pd/C-TC.

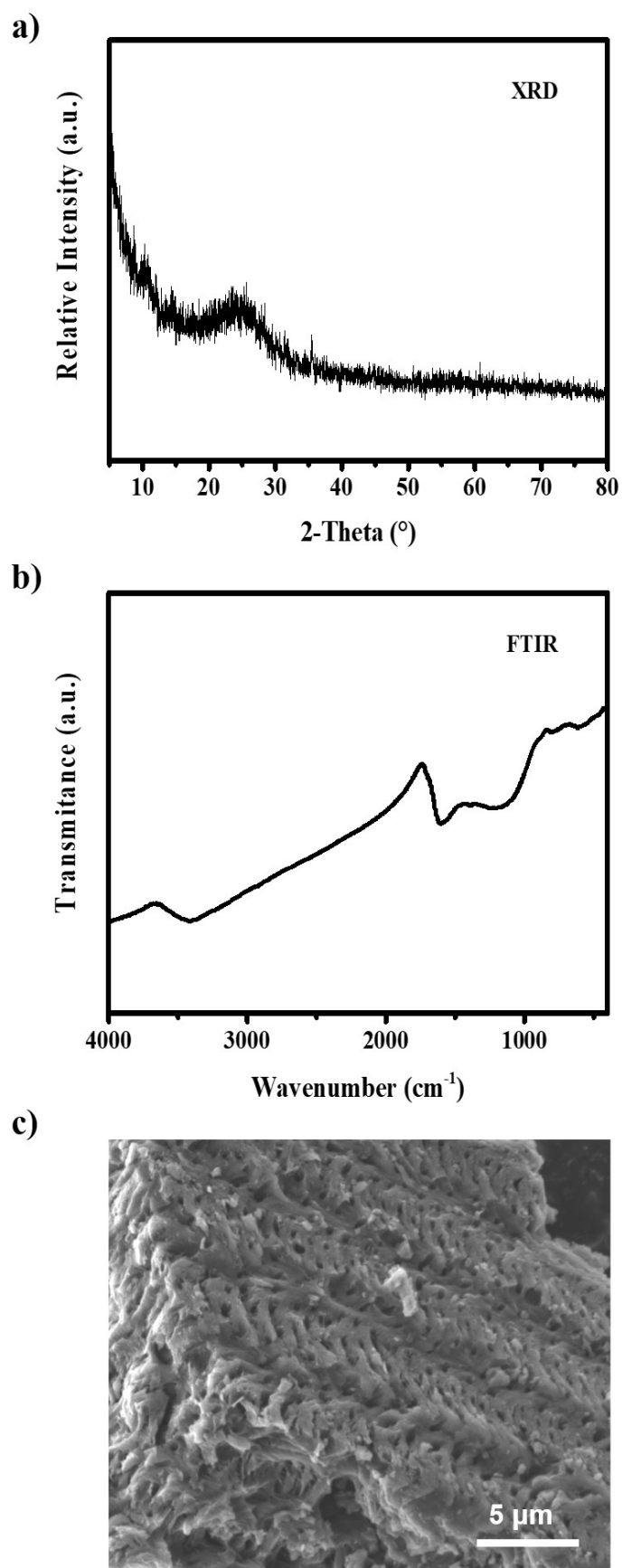


Fig. S5 The XRD pattern (a), FTIR pattern (b), and SEM image (c) of S-TC.