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ELECTRONIC SUPPORTING INFORMATION (ESI)

Nitrogen-riched porous carbon supported Pd-nanoparticles as an efficient catalyst for the transfer hydrogenation of alkenes

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1.1 Chemicals and materials

Urea (A.R.), glucose (A.R.), palladium chloride ($PdCl_2$, A.R.), formic acid (FA, A.R.), sodium formate (SF, HCOONa, A.R.), sodium borohydride ($NaBH_4$, A.R.), and ammonium formate (A.R.), ethanol (C_2H_5OH, A.R.) were purchased from Huaxin Co., Ltd (Baoding, China). All materials were used as received without further purification.

1.2 Characterizations

The size and morphology of the samples were observed using transmission electron microscopy (TEM) using a JEOL model JEM-2011IJHR) at 200 kV. The X-ray diffraction (XRD) patterns of the samples were recorded with a Rigaku D/max 2500 X-ray diffractometer using Cu Kα radiation (40 kV, 150 mA) in the range 2θ = 5o-80o. The surface area, total pore volume and pore size distribution of the samples were measured at 77 K using nitrogen adsorption with V-Sorb 2800P volumetric adsorption equipment (Jinaipu, China). X-ray photoelectron spectroscopy (XPS) was performed with a PHI 1600 spectroscope using a Mg Kα X-ray source for excitation. The Pd loading in the materials was analyzed by a T. J. A.ICP-9000 type inductively coupled plasma atomic emission spectroscopy (ICP-AES) instrument. Fourier transform infrared (FTIR) spectra were recorded with a Bruker VERTEX 700 spectrometer between 4000 and 500 cm^{-1}. GC analyses were carried out on a Shimadzu GC-2014-C series gas chromatograph (Shimadzu, Janpan) equipped with a flame ionization detector (FID) and a split/splitless injector. All the separations were performed on a HP-5 capillary column (30 m × 0.25mm i.d. × 0.25 μm film thickness) (WondaCap5) was employed to identify all reaction products.

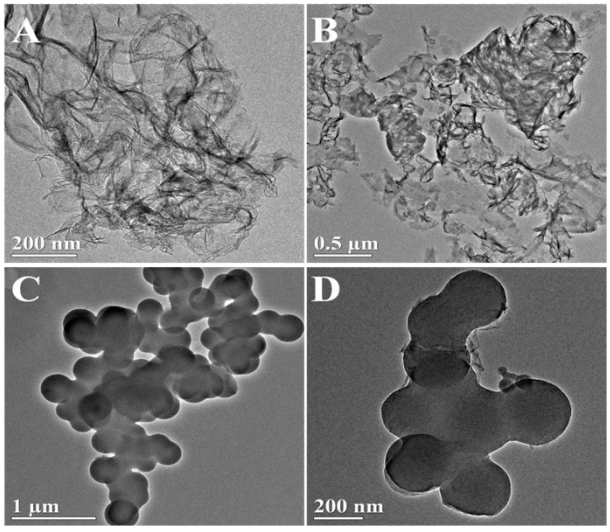

Fig. S1 The TEM pictures of NPC (A), g-C_3N_4 (B), Glu (C) and g-C_3N_4-Glu (D)

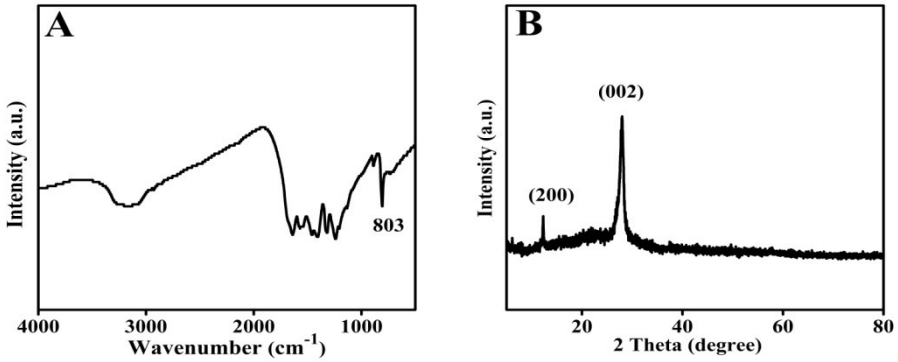

Fig S2. The FTIR spectra of g-C_3N_4 (A) and XRD patterns of g-C_3N_4 (B).

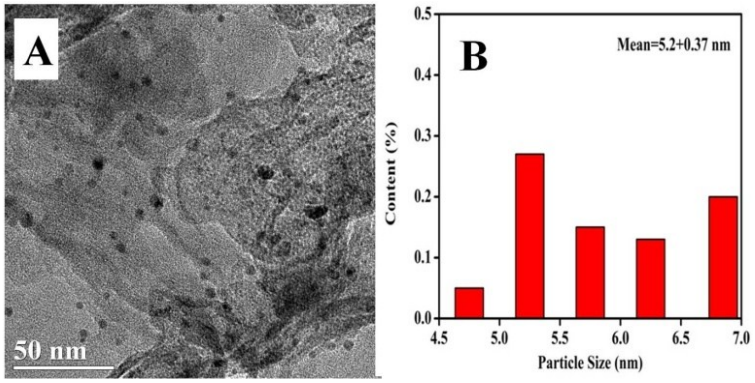

Fig S3. The TEM images of used Pd@NPC (A), and Pd particle-size distribution in the used Pd@NPC catalyst (B)

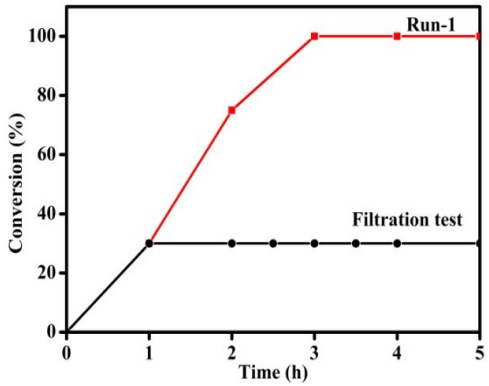

Fig. S4 Thermal filtration experiment of the Pd@NPC.

Table S1. Various reported catalyst tested for hydrogenation of alkenes.

Entry	Catalyst	Hydrogen source	Solvent	Tem (^oC)	Time (h)	TOF (h^{-1})	Reference
1	cobalt catalyst	i-PrOH	THF	100	24	0.005-0.02	[1]
2	Pd/CN	HCOOH	H_2O	25	0.25-3	4-53	[2]
3	Pd@POP	HCOOH:Et_3N	EtOH	25	4-15	4-57	[3]
4	$Al_2(BDC)_3$[b]	$N_2H_4 \cdot H_2O$	MeCN	25	24	0.07	[4]
5	$Cu_3(BTC)_2$[a]	$N_2H_4 \cdot H_2O$	MeCN	25	24	0.04	[4]
6	MIL-53 (Al)	$N_2H_4 \cdot H_2O$	MeCN	25	24	0.74	[5]
7	Cu(0)@UiO-66-NH_2	$N_2H_4 \cdot H_2O$	EtOH	25	0.25	100	[6]
8	HKUST-1[c]	$N_2H_4 \cdot H_2O$	MeCN	25	24	1.1	[5]
9	Fe_3O_4@GO	$N_2H_4 \cdot H_2O$	EtOH	80	4-20	0.7-3	[7]
10	Pd-g-C_3N_4 NS/rGO_{20}	HCOOH:$HCOONH_4$	EtOH	30	0.25-4	9-266	[8]
11	Pd/KCC-1-NH_2	HCOOH	MeOH-H_2O	100	12	0.3-1.28	[9]
12	Pd@NPC	HCOOH:$HCOONH_4$	EtOH	50	0.5-9.5	6-132	This work

[a] BTC=1,3,5-benzenetricarboxylate

[b] BDC= *p*-benzenedicarboxylate

[c] HKUST-1=MOF-199

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