Supplementary Information

Deactivation and regeneration of carbon supported Pt and Ru catalysts in aqueous phase hydrogenation of 2-pentanone

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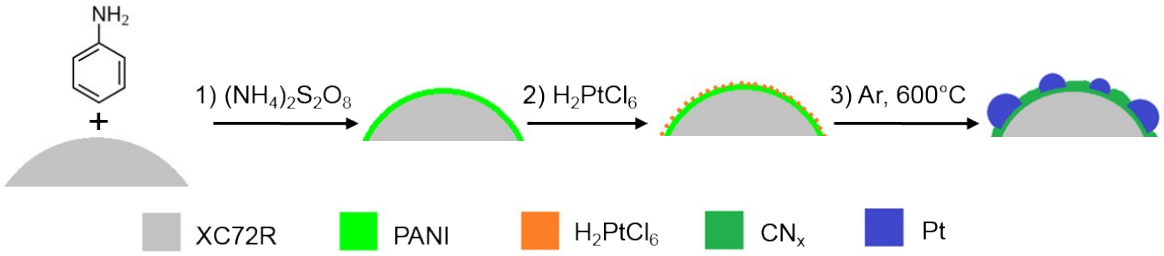

Figure S1. Synthesis procedure of Pt PANI XC72R including 1) polymerization, 2) incipient wetness impregnation of H_2PtCl_6, and 3) carbonization at 600 °C in argon for 1h.

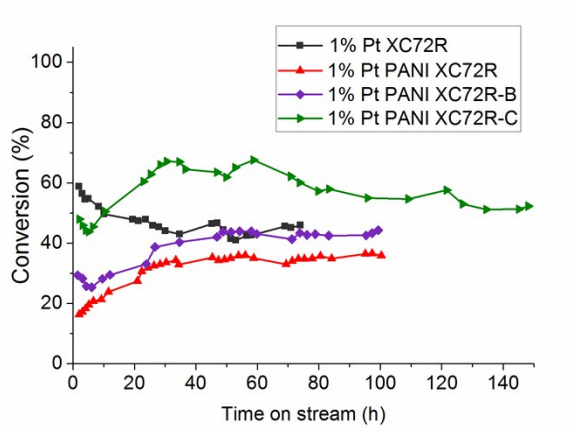

Figure S2. Catalytic conversion of aqueous phase hydrogenation of 2-pentanone at 180 °C, 40 mg of catalyst, and 0.08 mL/min 2-pentanone solution on carbon material with different PANI loadings. The XC72R and PANI coating weight ratio is 1% PANI XC72R (XC72R:PANI=4:1), 1% PANI XC72R-B (XC72R:PANI=8:1), 1% PANI XC72R-C (XC72R:PANI=16:1). Higher activity was observed when decreasing the PANI loading.

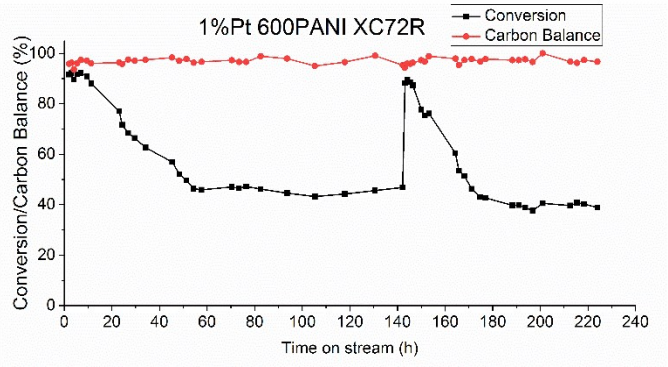

Figure S3. Catalytic conversion of aqueous phase hydrogenation of 2-pentanone at 180 °C, 40 mg of catalyst, and 0.08 mL/min 2-pentanone solution on 1% Pt 600PANI XC72R. 1% Pt PANI XC72R was synthesized by carbonization of PANI XC72R first at 600 °C followed by incipient wetness impregnation of H_2PtCl_6 and H_2 reduction at 300 °C.

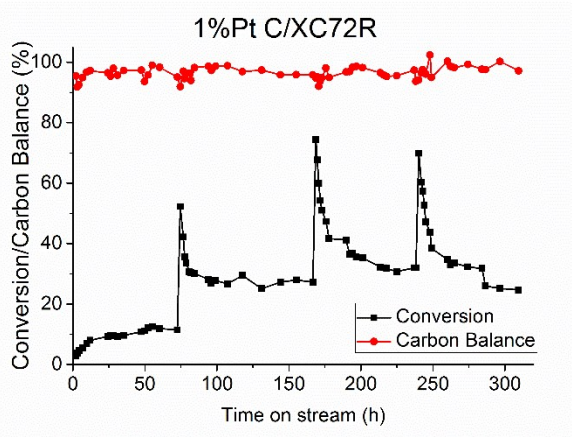

Figure S4. Catalytic conversion of aqueous phase hydrogenation of 2-pentanone at 180 °C, 40 mg of catalyst, and 0.08 mL/min 2-pentanone solution on 1% Pt C/XC72R, which was synthesized from glucose as a carbon source.

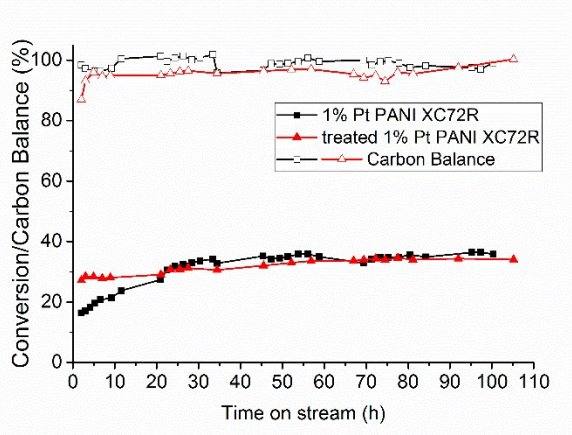

Figure S5. Catalytic conversion of aqueous phase hydrogenation of 2-pentanone to 2-pentanol at 180 °C, 40 mg of catalyst, and 0.08 mL/min 2-pentanone solution on 1% Pt PANI XC72R with and without in-situ water treatment at 180 °C for 24 h.

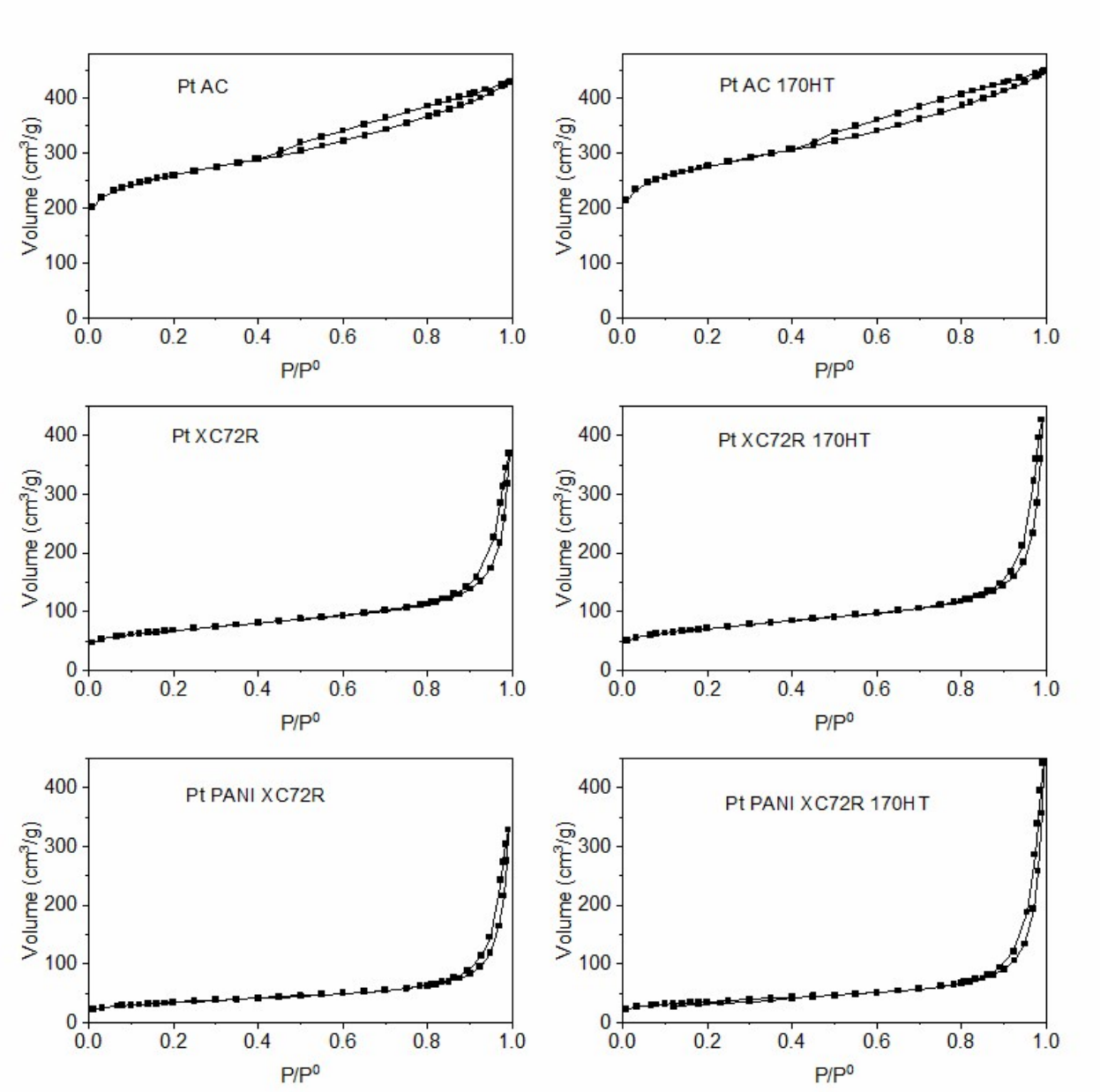

Figure S6. Nitrogen physisorption isotherms of Pt AC, Pt XC72R, and Pt PANI XC72R before and after hydrothermal treatment. Hydrothermal treatment (HT) was performed in pressurized water at 170 °C for 48 h.

Table S1. BET surface area, pore volume and pore diameter of Pt AC, Pt XC72R, and Pt PANI XC72R before and after hydrothermal treatment. Hydrothermal treatment (HT) was performed in pressurized water at 170 °C for 48 h.

Sample name		BET surface area (m^2/g)	Total pore volume (cm^3/g)	t-Plot micropore volume (cm^3/g)	Mesopore volume (cm^3/g)	BJH adsorption avg pore diameter (nm)
Pt XC72R	fresh	239	0.335	0.034	0.301	14.1
	48h HT	251	0.362	0.034	0.328	15.7
Pt PANI/XC72R	fresh	122	0.254	0.011	0.243	21.7
	48h HT	125	0.299	0.015	0.284	28.1
Pt AC	fresh	891	0.650	0.228	0.422	4.9
	48h HT	947	0.680	0.245	0.435	4.8

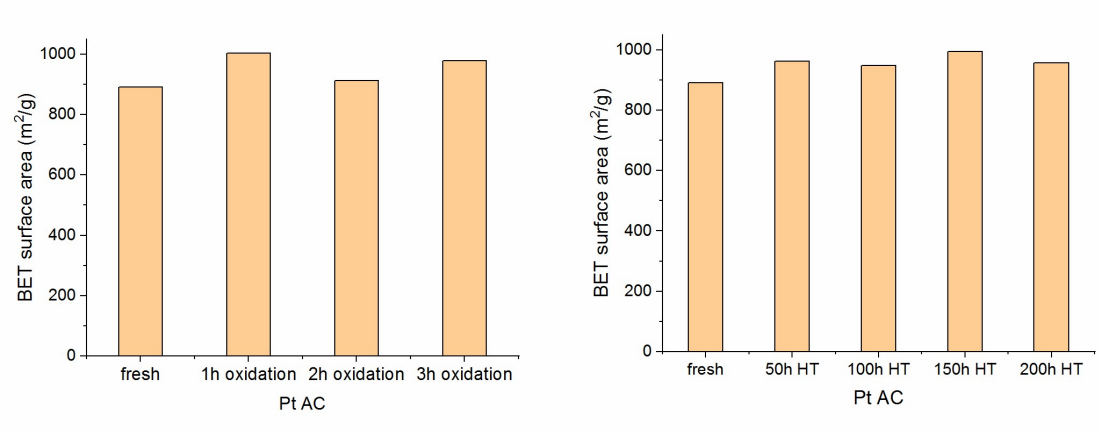

Figure S7. BET surface areas of 1% Pt AC after ex-situ oxidation in air at 200 °C for 1 , 2 , and 3 h (left); and after hydrothermal treatment at 200 °C for 50 , 100 , 150 , and 200 h (right).

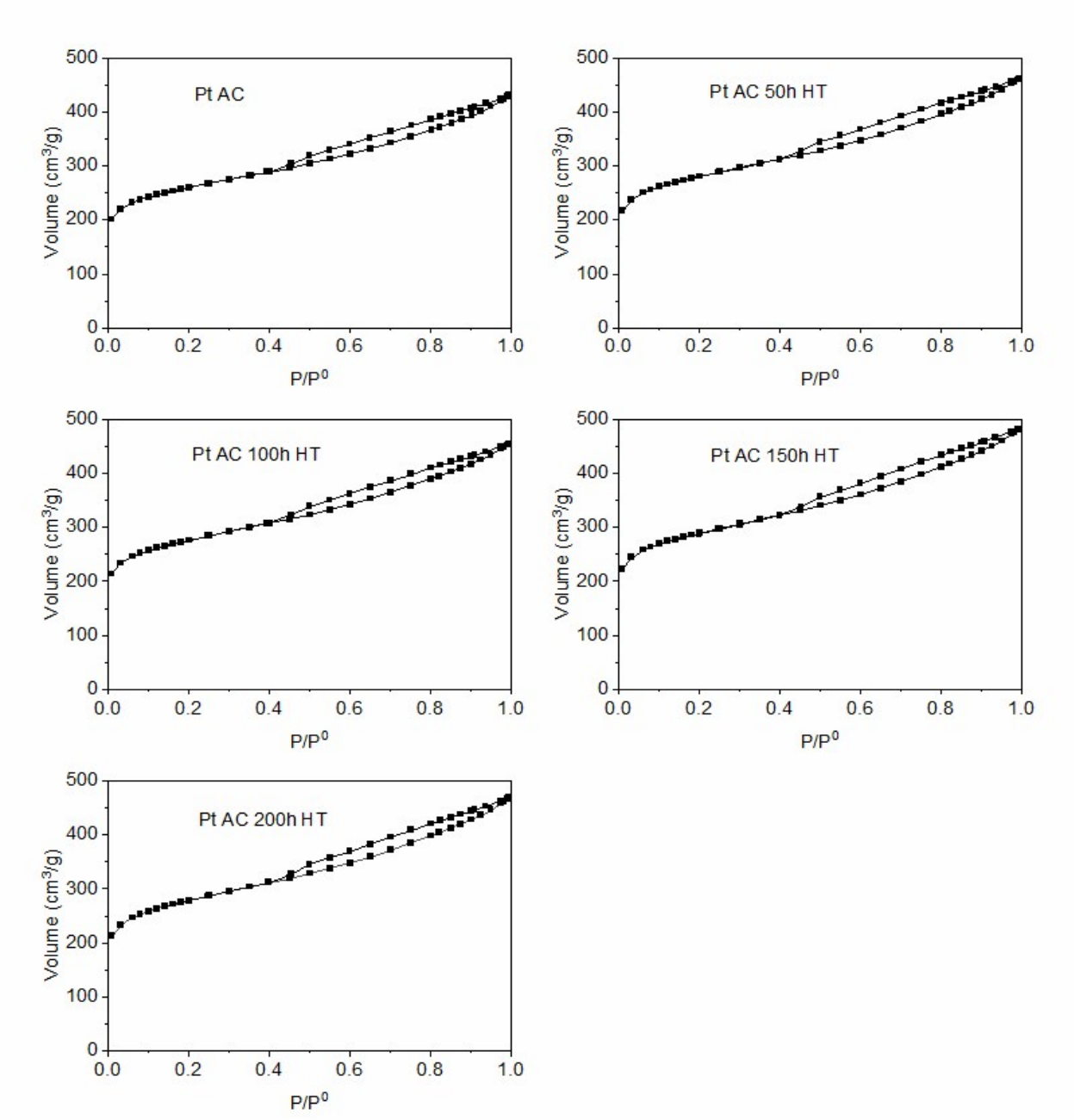

Figure S8. Nitrogen physisorption isotherms of Pt AC after 50, 100, 150, and 200 h of hydrothermal treatment at 200 °C.

Table S2. BET surface area, pore volume and pore diameter of 1% Pt AC after hydrothermal treatment (HT) at 200 °C for 50 , 100 , 150 , and 200 h.

Pt AC	BET surface area (m^2/g)	Total pore volume (cm^3/g)	t-Plot micropore volume (cm^3/g)	Mesopore volume (cm^3/g)	BJH adsorption avg pore diameter (nm)
fresh	891	0.650	0.228	0.422	4.9
50h HT	962	0.699	0.246	0.453	4.9
100h HT	948	0.689	0.241	0.448	4.8
150h HT	994	0.730	0.250	0.480	4.9
200h HT	957	0.709	0.234	0.475	4.8

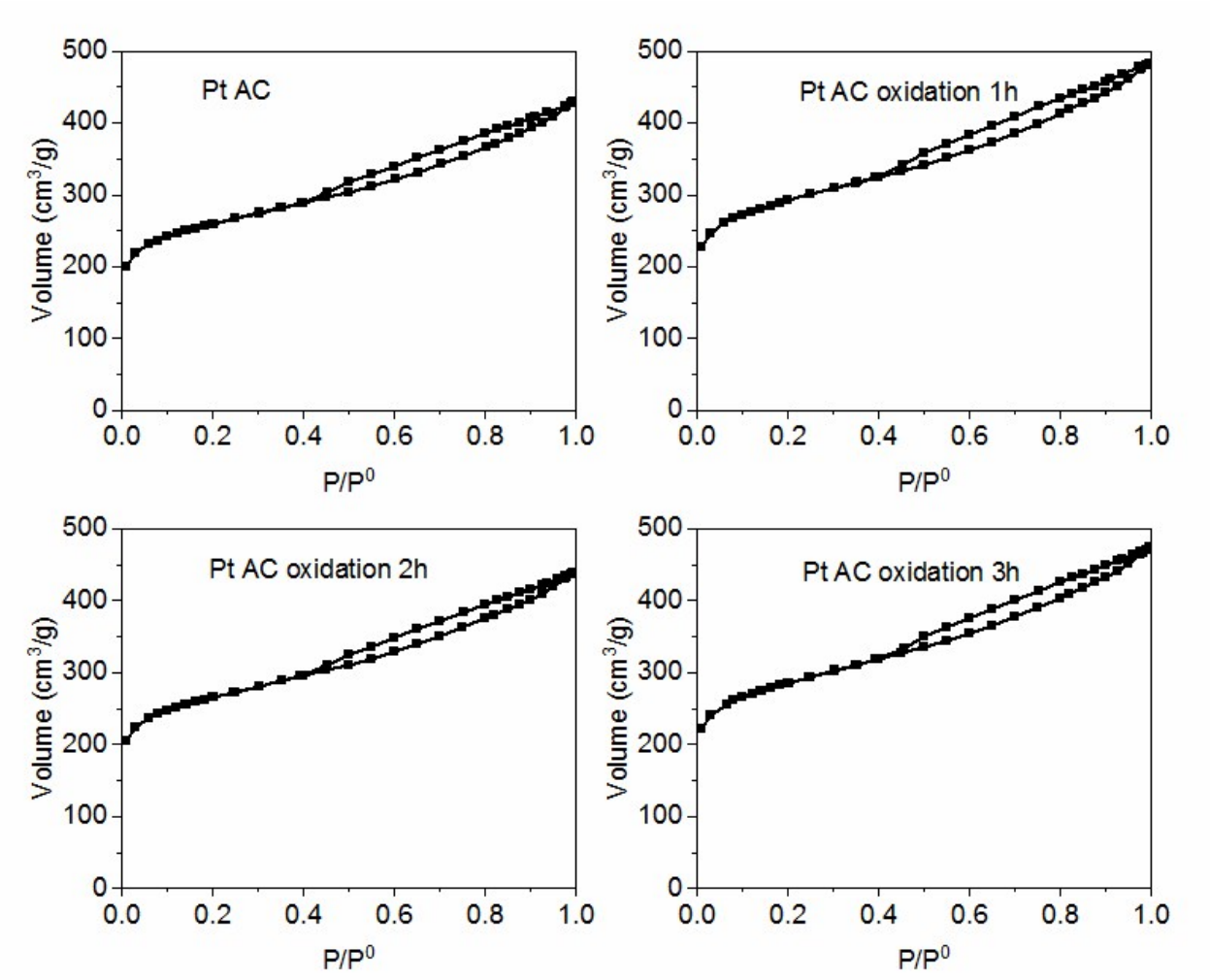

Figure S9. Nitrogen physisorption isotherms of Pt AC after 1, 2, and 3 h of air oxidation at 200 °C.

Table S3. BET surface area, pore volume and pore diameter of Pt AC after 1h, 2h, and 3h of oxidation in air at 200 °C.

Pt AC	BET surface area (m^2/g)	Total pore volume (cm^3/g)	t-Plot micropore volume (cm^3/g)	Mesopore volume (cm^3/g)	BJH adsorption avg pore diameter (nm)
fresh	891	0.650	0.228	0.422	4.9
1h oxidation	1003	0.732	0.256	0.476	4.9
2h oxidation	912	0.665	0.234	0.431	4.9
3h oxidation	979	0.716	0.251	0.465	4.9

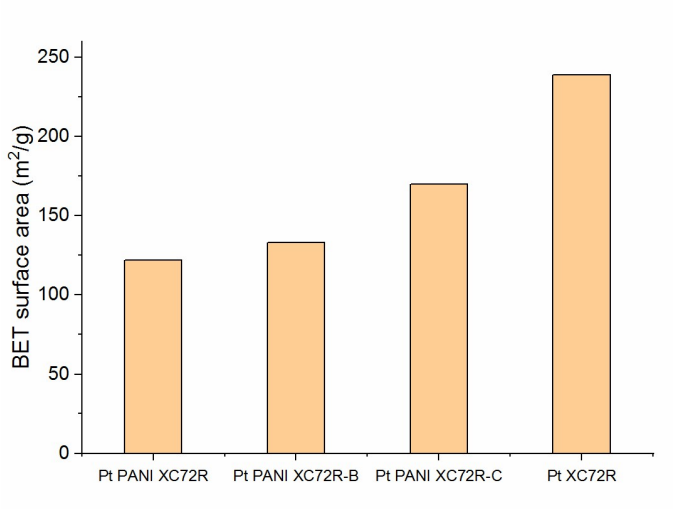

Figure S10. BET surface area of Pt PANI XC72R materials with different PANI coating amount. The XC72R and PANI coating weight ratio is 1% Pt PANI XC72R (XC72R:PANI=4:1), 1% Pt PANI XC72R-B (XC72R:PANI=8:1), 1% Pt PANI XC72R-C (XC72R:PANI=16:1).

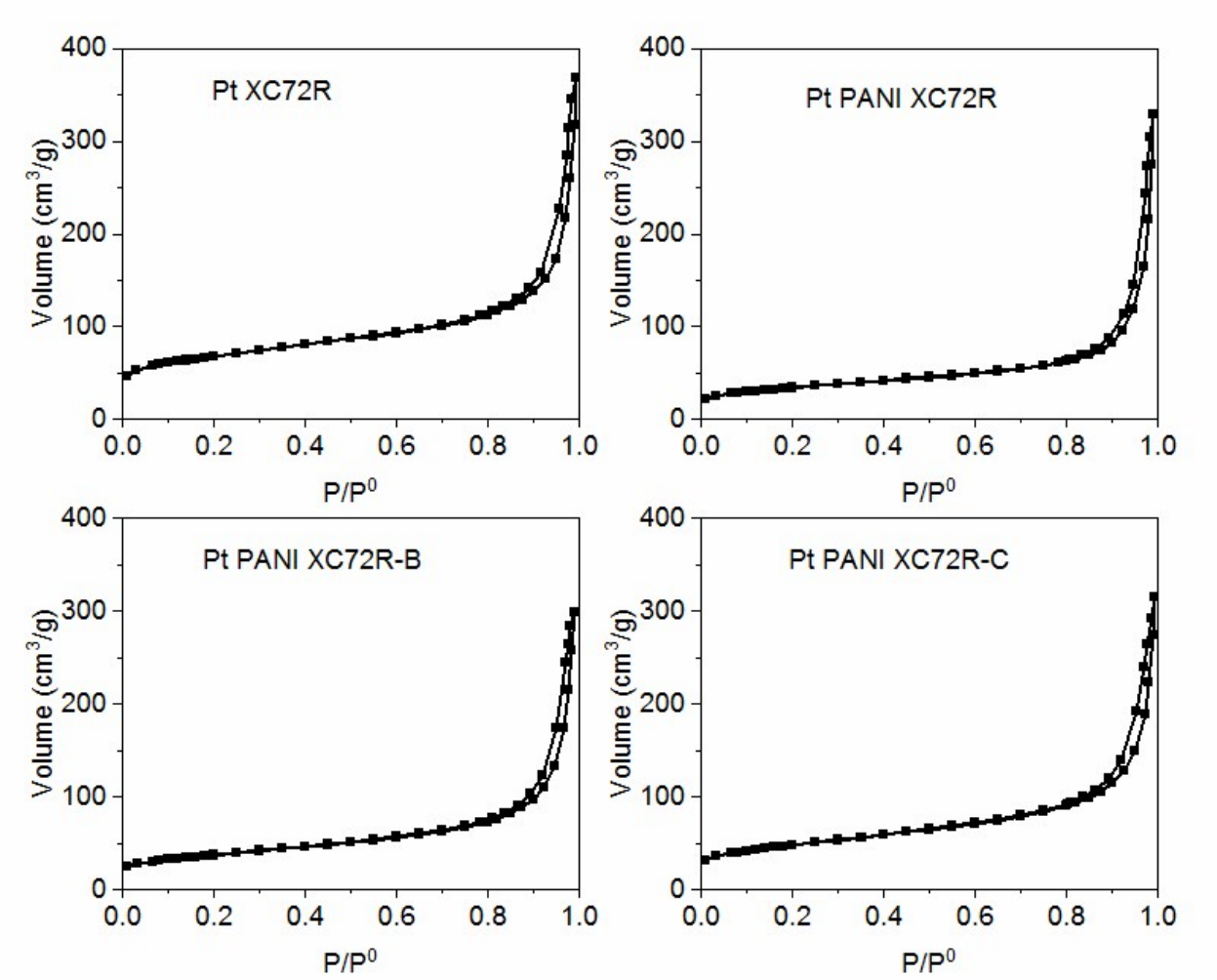

Figure S11. Nitrogen physisorption isotherms of Pt XC72R and Pt PANI XC72R with different PANI loading. 1% Pt PANI XC72R (PANI:XC72R=1:4); 1% Pt PANI XC72R-B (PANI:XC72R=1:8); 1% Pt PANI XC72R-C (PANI:XC72R=1:16).

Table S4. BET surface area, pore volume and pore diameter of Pt XC72R and Pt PANI XC72R with different PANI loading. 1% Pt PANI XC72R (PANI:XC72R=1:4); 1% Pt PANI XC72R-B (PANI:XC72R=1:8); 1% Pt PANI XC72R-C (PANI:XC72R=1:16).

	BET surface area (m^2/g)	Total pore volume (cm^3/g)	t-Plot micropore volume (cm^3/g)	Mesopore volume (cm^3/g)	BJH adsorption avg pore diameter (nm)
Pt XC72R	239	0.335	0.034	0.301	14.1
Pt PANI XC72R	122	0.254	0.011	0.243	21.7
Pt PANI XC72R-B	133	0.269	0.011	0.258	16.6
Pt PANI XC72R-C	170	0.292	0.014	0.278	14.2

Table S5. CO chemisorption data of fresh and hydrothermally treated 1% Pt AC at 200 °C after 50, 100, 150, and 200 h. HT refers to hydrothermal treatment.

Sample name	CO uptake μmol/g	Dispersion /%	Particle size[a]/nm
Pt AC	22.4	44	2.6
Pt AC 50 h HT	15.6	31	3.7
Pt AC 100 h HT	13.0	25	4.5
Pt AC 150 h HT	12.9	25	4.5
Pt AC 200 h HT	10.2	20	5.7
Pt AC 200 h HT 1st oxidation	13.6	26	4.3
Pt AC 200 h HT 2nd oxidation	14.3	28	4.1
Pt AC 200 h HT 3rd oxidation	14.0	27	4.2

[a] Particle size =1.13/Dispersion. The Micromeritics ASAP software built-in value of density of Pt (21.45 g/cm^3), cross sectional area of Pt (0.08 nm^2) was used for the calculation.[1]

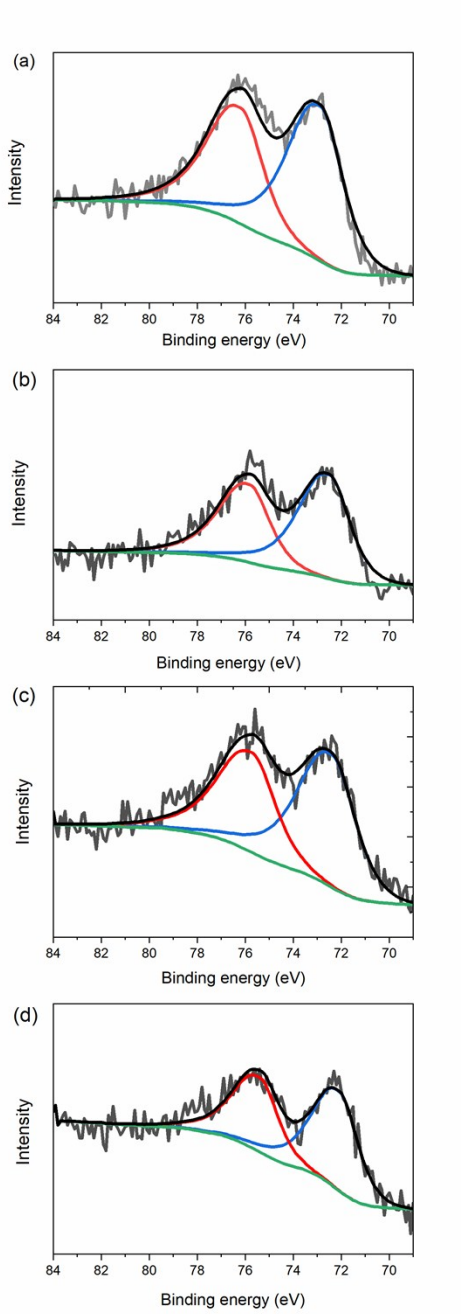

Figure S12. XPS spectra of Pt 4f on (a) fresh 1% Pt AC, (b) spent 1% Pt AC, (c) spent 1% Pt AC after oxidation, (d) spent 1% Pt AC after oxidation and reduction.

Reference

[1]. *Micromeritics AutoChem 2920 Automated Catalyst Characterization System Operator's Manual*, V4.00 edn., 2009.