catalysts

MDPI

Supporting Information

One-Pot Synthesis of Ultra-Small Pt Dispersed on Hierarchical Zeolite Nanosheet Surfaces for Mild Hydrodeoxygenation of 4-Propylphenol

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List of Supporting Materials

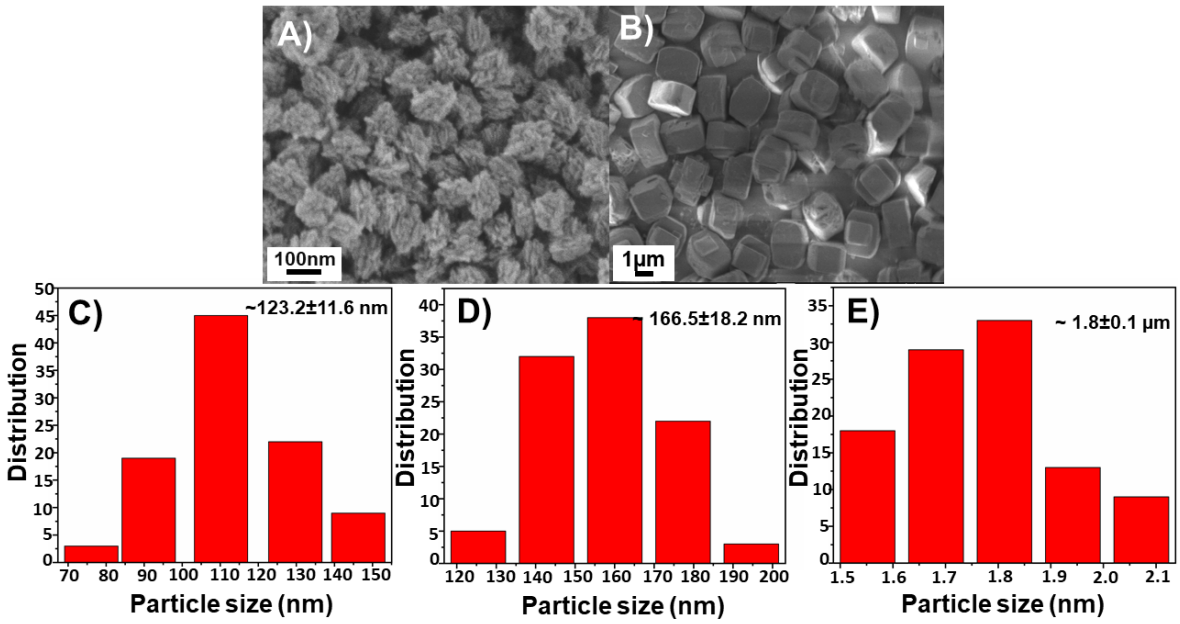

Figure S1. SEM images of (**A**) Pt/SiNS(imp) and (**B**) Pt/SiCON(imp), and particle size distribution of (**C**) Pt@SiNS(one), (**D**) Pt/SiNS(imp), and (**E**) Pt/SiCON(imp).

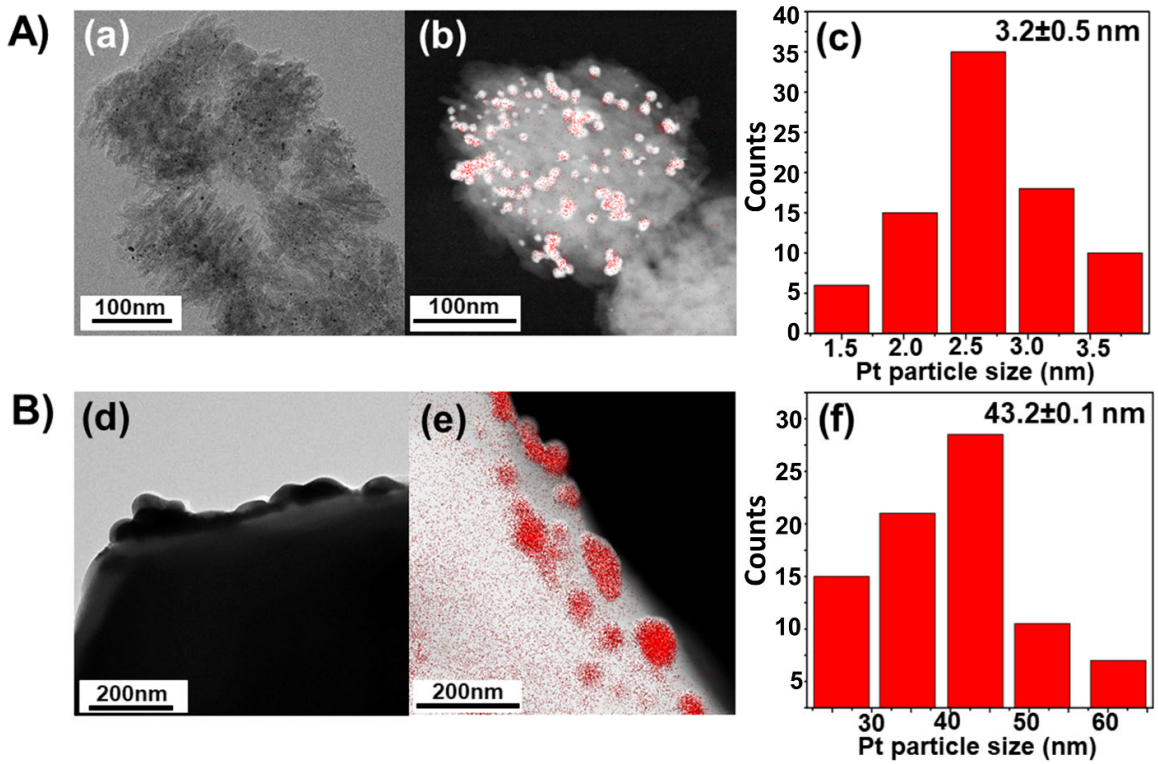

Figure S2. TEM images (**a**, **d**), EDS elemental mapping for Pt (red spots) on STEM images (**b**, **e**), and Pt particle size distribution (**c**, **f**) of (**A**) Pt/SiNS(imp) and (**B**) Pt/SiCON(imp).

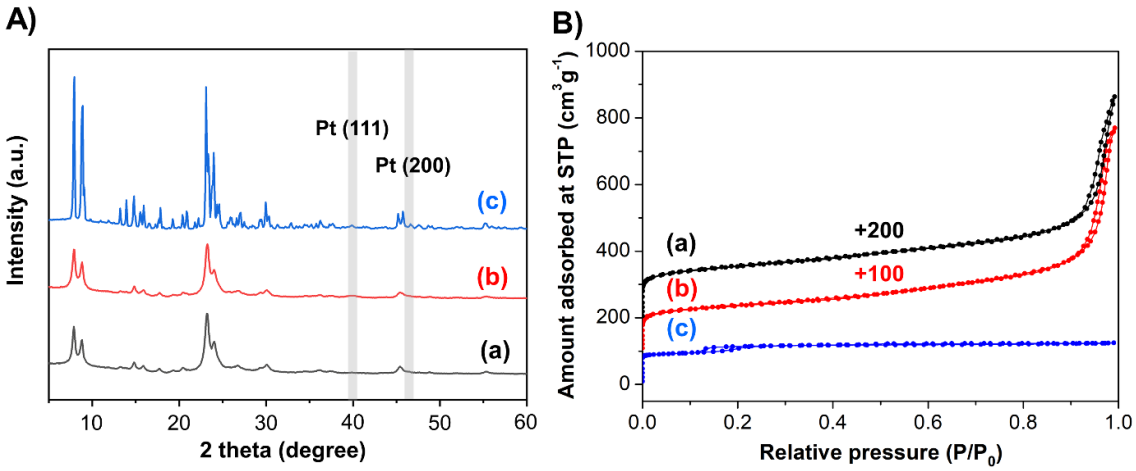

Figure S3. (**A**) XRD patterns and (**B**) N_2 adsorption-desorption isotherms of (**a**) Pt@HZSM-5NS(one), (**b**) Pt@HZSM-5NS(imp), and (**c**) Pt@HZSM-5CON(imp).

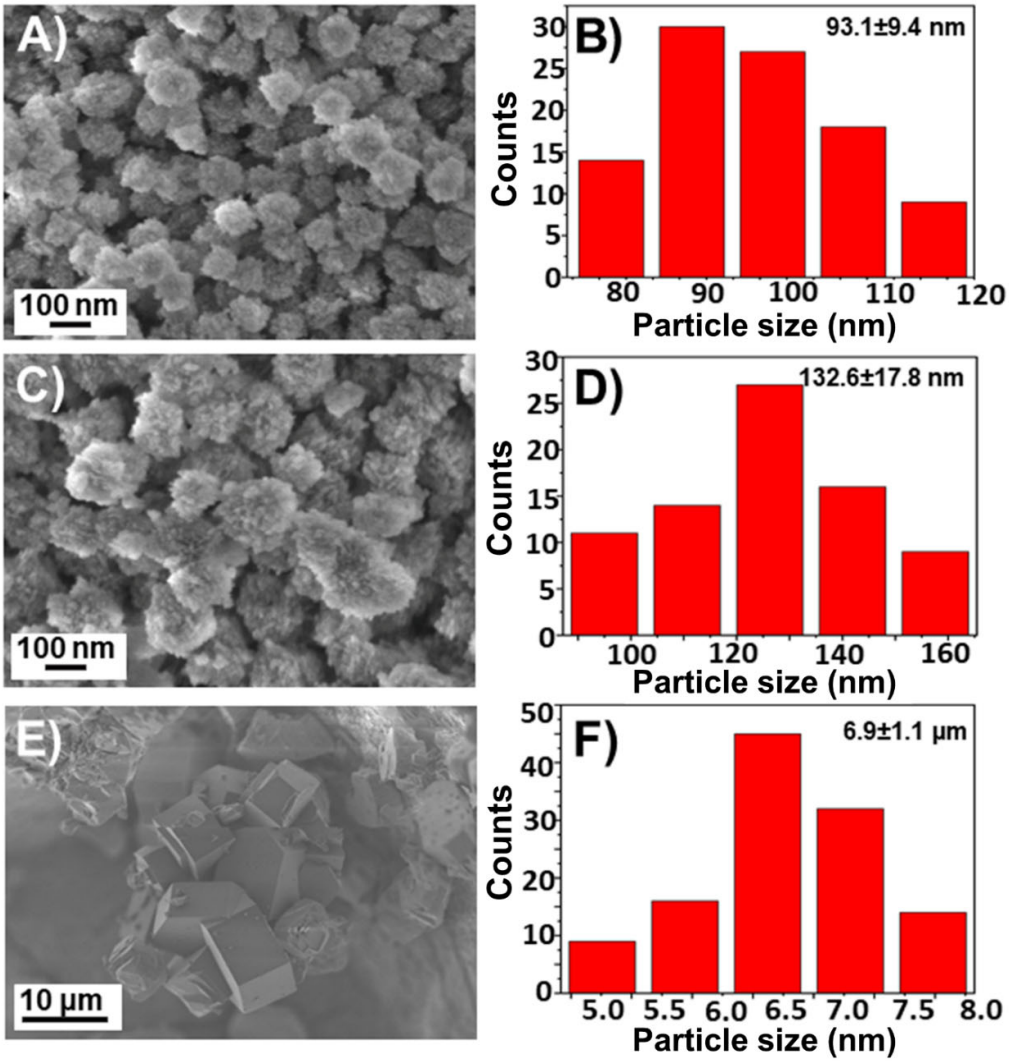

Figure S4. SEM images (**A**, **C**, **E**) and particle size distribution (**B**, **D**, **F**) of Pt@HZSM-5-NS(one) (**A**, **B**), Pt/HZSM-5-NS(imp) (**C**, **D**), and Pt/HZSM-5-CON(imp) (**E**, **F**).

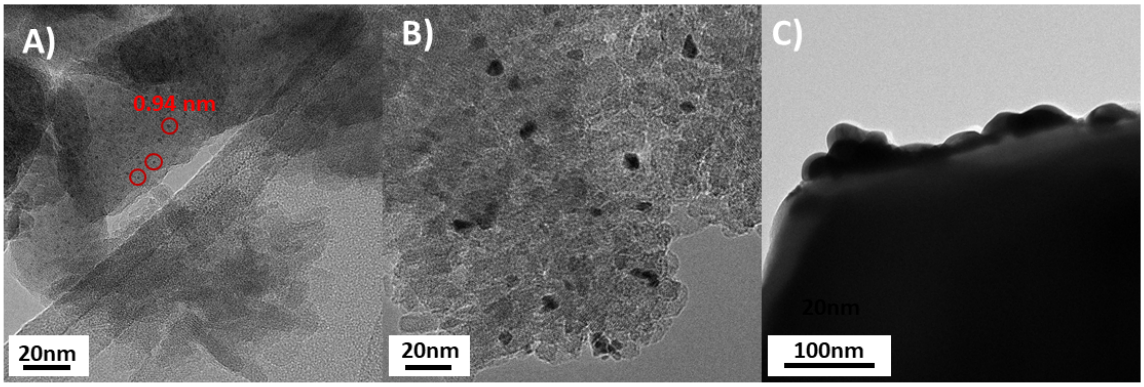

Figure S5. TEM images of (**A**) Pt@HZSM-5-NS(one), (**B**) Pt/HZSM-5-NS(imp), (**C**) Pt/HZSM-5-CON(imp).

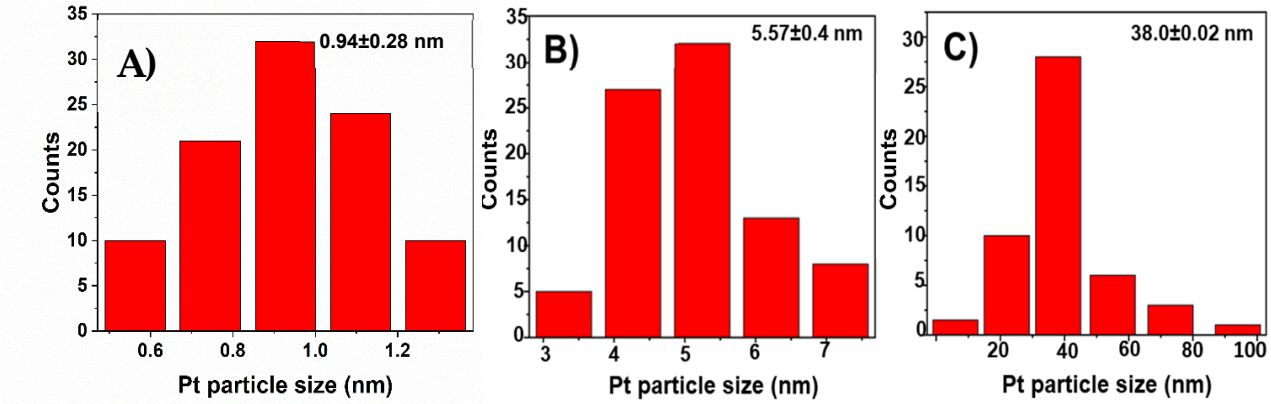

Figure S6. Pt particle size distribution of (**A**) Pt@HZSM-5-NS(one), (**B**) Pt@HZSM-5NS(imp), and (**C**) Pt@HZSM-5CON(imp).

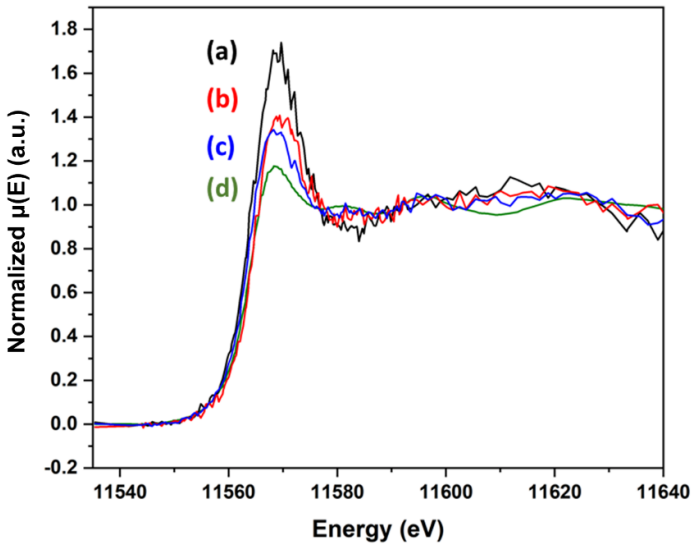

Figure S7. Pt L_3 edge XANES spectra of (**a**) Pt@HZSM-5-NS(one), (**b**) Pt/HZSM-5-NS(imp), (**c**) Pt/HZSM-5-CON(imp), and (**d**) standard Pt foil.

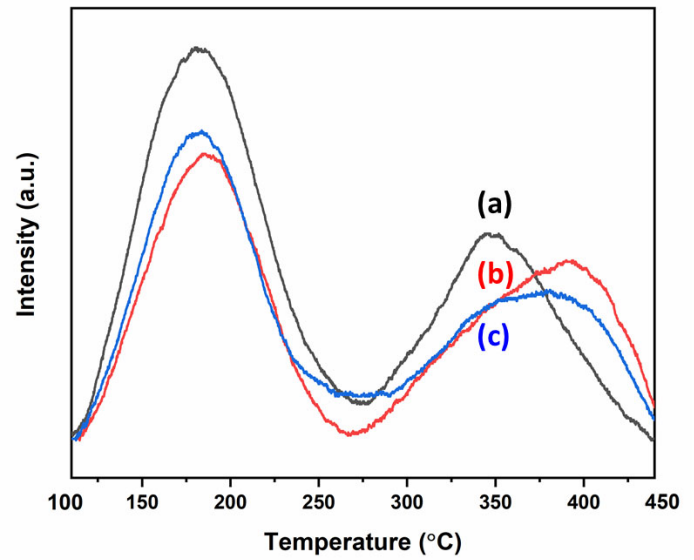

Figure S8. NH_3-TPD profiles of (**a**) Pt@HZSM-5-NS(one), (**b**) Pt/HZSM-5-NS(imp), (**c**) Pt/HZSM-5-CON(imp).

Table S1. Pt content (wt.%) in the synthesized samples.

Sample	Pt content[a] (wt.%)
Pt@SiNS(one)	0.67
Pt/SiNS(imp)	0.63
Pt/SiCON(imp)	0.65
Pt@HZSM-5-NS(one)	0.41
Pt/HZSM-5-NS(imp)	0.42
Pt/HZSM-5-CON(one)	0.42

[a]determined by XRF technique.

Table S2. Textural properties of the synthesized bifunctional Pt supported on HZSM-5 samples.

Sample	S_{BET}[a]	S_{micro}[b]	S_{ext}[c]	V_{total}[d]	V_{micro}[e]	V_{ext}[f]	V_{ext}/V_{total}[g]
Pt@HZSM-5-NS(one)	558	343	215	1.01	0.17	0.84	0.83
Pt/HZSM-5-NS(imp)	497	286	211	1.02	0.14	0.88	0.86
Pt/HZSM-5-CON(imp)	379	363	16	0.19	0.17	0.02	0.11

[a]BET specific surface area, [b]microporous surface area, [c]external surface area, [d]total pore volume, [e]micropore volume, [f]external volume = $V_{total} - V_{micro}$, and [g]Fraction of external volume.#All surface areas and pore volumes are in the unit of $m^2.g^{-1}$ and $cm^3.g^{-1}$, respectively.

Table S3. Acid properties of different bifunctional catalysts.

Sample	Acid amount[a] (mmol/g)		Total
	Weak (150–200 °C)	Strong (300–400 °C)	
Pt@HZSM-5-NS(one)	0.107	0.063	0.17
Pt/HZSM-5-NS(imp)	0.088	0.102	0.19
Pt/HZSM-5-CON(imp)	0.073	0.106	0.18

[a]determined by gaussian deconvolution of NH_3-TPD profiles.

Table S4. Catalytic performance of Pt@HZSM-5-NS(one) in terms of reactant conversion (%) and product selectivity (%) in the HDO of 4-propylphenol under reaction condition of 110 °C and H_2 atmospheric pressure as a function of time.

Reaction Time (min)	4-propylphenol conversion (%)	Selectivity (%)			
		Propyl cyclohexane	Propyl benzene	Propyl cyclohexanol	Propyl cyclohexanone
5	12.2	13.0	25.6	27.4	34.0
10	24.5	29.7	11.4	24.8	34.0
30	28.6	41.0	12.2	12.8	33.8
60	47.6	53.3	13.0	8.3	25.4
120	76.6	66.0	11.9	6.5	15.6
150	99.1	78.9	9.2	4.3	7.5
300	99.9	99.6	0.3	0.0	0.0
450	99.9	99.8	0.1	0.0	0.0
600	100.0	100.0	0.0	0.0	0.0

Table S5. Catalytic performance in the HDO of 4-propylphenol over different catalysts under reaction condition of 110 °C and H_2 atmospheric pressure taken from the reaction time of 10 h.

Sample	conversion (%)	Selectivity (%)			
		Propyl cyclohexane	Propyl benzene	Propyl cyclohexanol	Propyl cyclohexanone
Pt@NaZSM-5-NS(one)	33.4	1.0	0.7	46.9	51.4
Pt@HZSM-5-NS(one)	100.0	100.0	0.0	0.0	0.0
Pt/HZSM-5-NS(imp)	41.0	45.2	15.4	5.1	34.3
Pt/HZSM-5-CON(imp)	17.3	22.2	15.2	42.5	20.1