

Supporting Information

The Acids roles of PtSn@Al₂O₃ in the Synthesis and Performance of Propane Dehydrogenation

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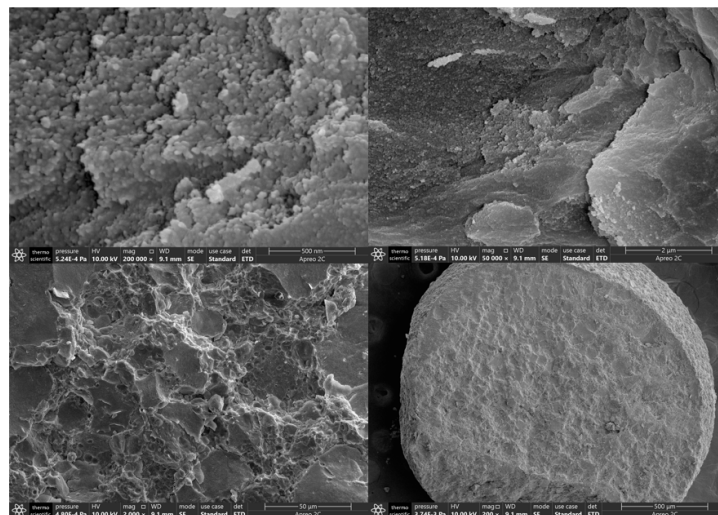


Figure S1 SEM images of γ -Al₂O₃ support

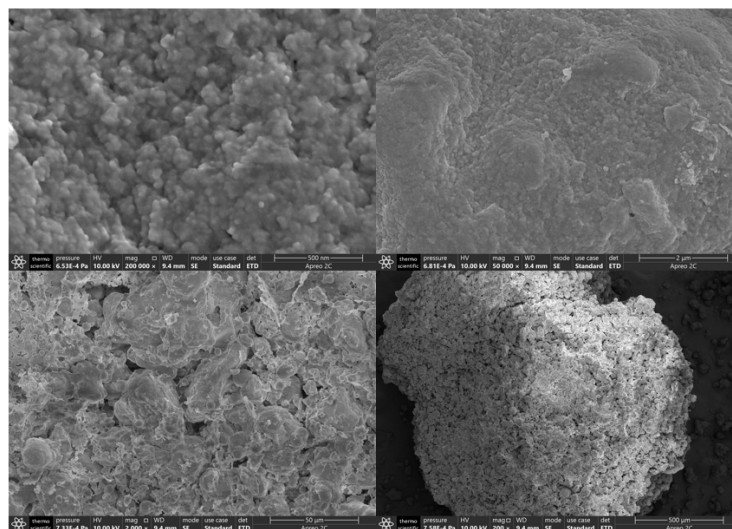


Figure S2 SEM images of PtSn/Al₂O₃ catalyst

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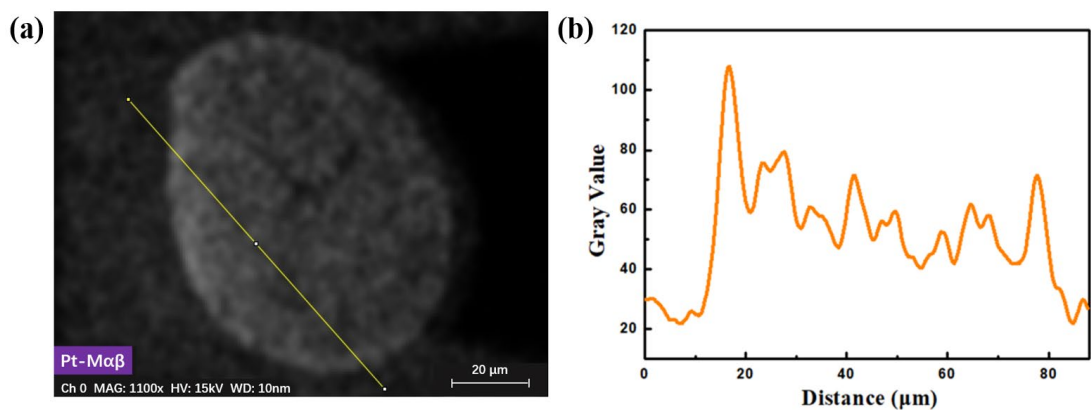


Figure S3 EDS of PtSn/Al₂O₃ catalyst (a) Pt element scanning; (b) gray value of line from EDS

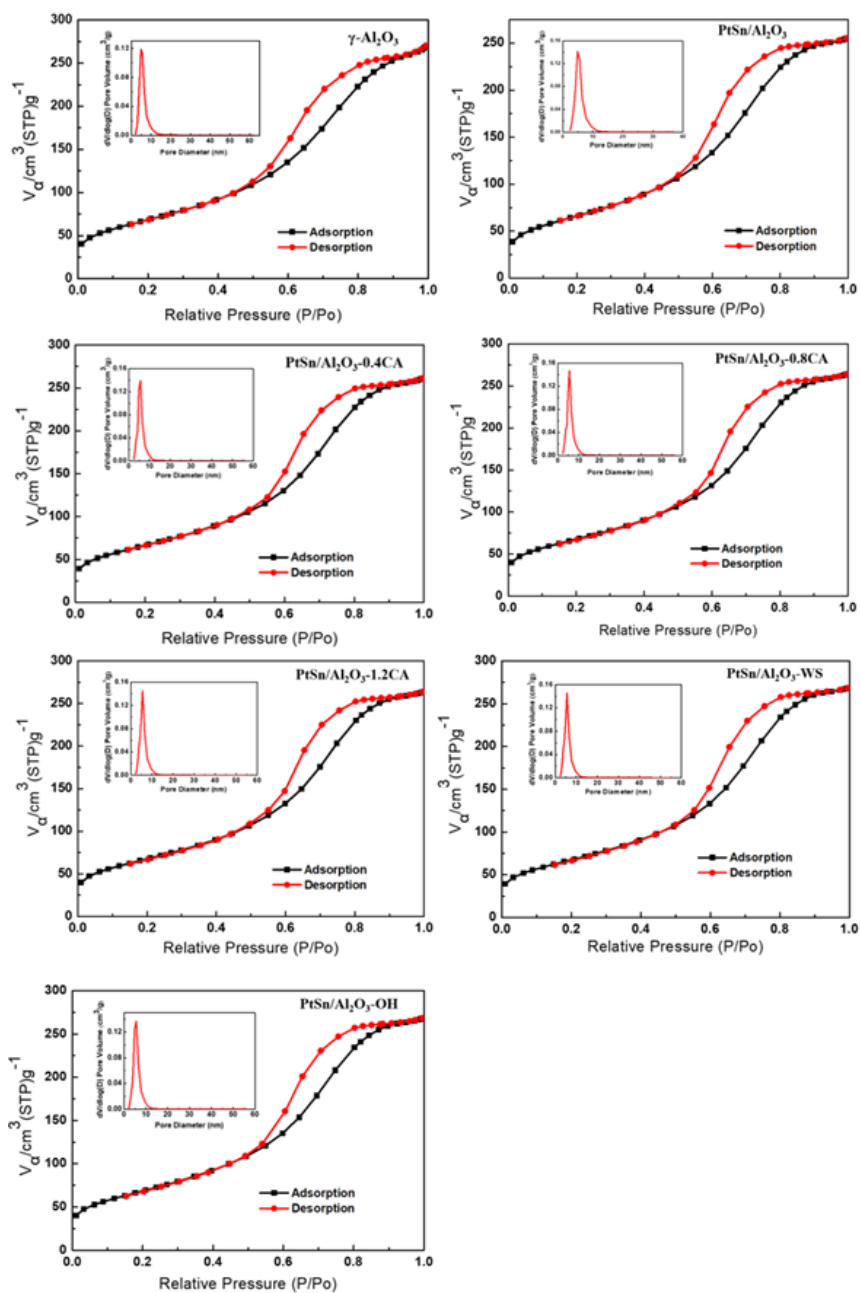


Figure S4 N₂ adsorption isotherms and pore size distribution of PtSn bimetallic catalyst
Table S1 BET specific surface area, pore volume, and average pore size of PtSn bimetallic

catalysts and supports

Sample	BET area (m ² g ⁻¹)	Pore volume (cm ³ g ⁻¹)	Pore size (nm)
γ -Al ₂ O ₃	250	0.44	5.6
PtSn/Al ₂ O ₃	241	0.42	5.4
PtSn/Al ₂ O ₃ -0.4CA	241	0.43	5.6
PtSn/Al ₂ O ₃ -0.8CA	245	0.43	5.6
PtSn/Al ₂ O ₃ -1.2CA	245	0.43	5.6
PtSn/Al ₂ O ₃ -WS	245	0.44	5.6
PtSn/Al ₂ O ₃ -OH	250	0.44	5.5

Table S2 SEM line scan elemental analysis of PtSn/Al₂O₃ catalyst

Sample	element	Line Type	apparent concentration	k ratio	wt%	wt% Sigma	Atomic percentage
PtSn/Al ₂ O ₃	Pt	M	0.23	0.00230	3.81	0.34	0.41
PtSn/Al ₂ O ₃ -0.4CA	Pt	M	0.30	0.00303	3.85	0.33	0.42
PtSn/Al ₂ O ₃ -0.8CA	Pt	M	0.26	0.00259	3.68	0.39	0.40
PtSn/Al ₂ O ₃ -1.2CA	Pt	M	0.25	0.00247	3.38	0.27	0.36

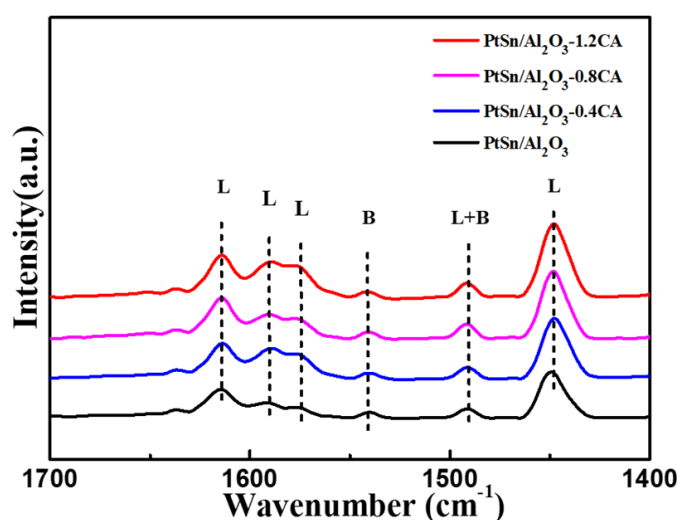


Figure S5 Infrared spectra of pyridine at 200°C before and after adding citric acid

Table S3 Pyridine infrared quantitative results (unit: μ mol/g)

Sample	150°C		200°C		350°C	
	B	L	B	L	B	L
PtSn/Al ₂ O ₃	17.55	211.06	16.04	161.27	13.19	78.77
PtSn/Al ₂ O ₃ -0.4CA	20.02	307.71	18.19	213.34	17.55	101.69
PtSn/Al ₂ O ₃ -0.8CA	19.86	311.37	18.67	227.86	17.79	111.77
PtSn/Al ₂ O ₃ -1.2CA	18.43	349.05	16.28	258.58	14.38	119.51
PtSn/Al ₂ O ₃ -WS	18.27	289.42	16.60	213.16	15.41	91.07
PtSn/Al ₂ O ₃ -OH	20.89	255.76	19.14	189.52	17.47	92.15

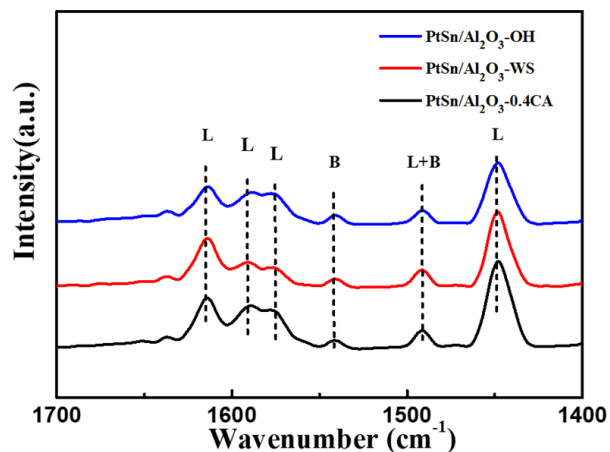


Figure S6 Pyridine infrared spectra of catalysts treated with alkali neutralization and water washing at 200°C

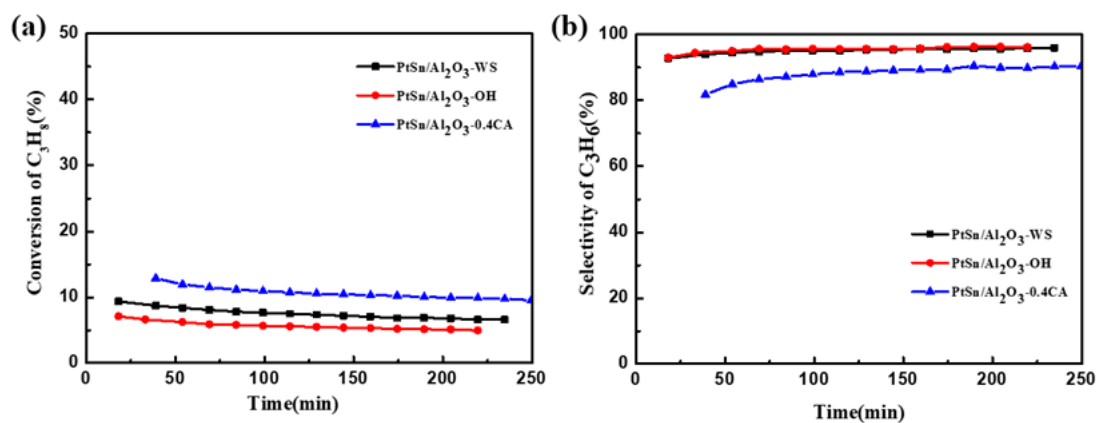


Figure S7 The catalytic performance of PtSn/Al₂O₃ catalyst treated with alkali neutralization and water washing (a) Conversion; (b) Selectivity

Table S4 The catalytic performance of PtSn/Al₂O₃ catalyst for propane dehydrogenation reaction

Sample	Conversion (%)		Selectivity (%)		K_d^a (h ⁻¹)
	Initial	Final	Initial	Final	
PtSn/Al ₂ O ₃ -0.4CA	12.9	9.4	81.8	91.0	0.0011
PtSn/Al ₂ O ₃ -WS	9.4	6.6	92.8	96.0	0.0016
PtSn/Al ₂ O ₃ -OH	7.1	5.0	93.0	96.2	0.0017

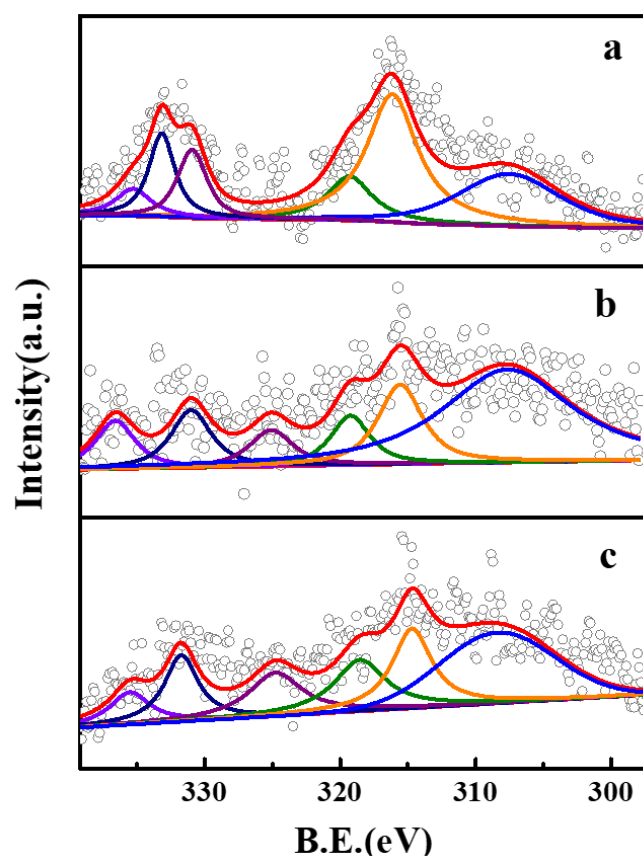


Figure S8 XPS spectra of PtSn/Al₂O₃ catalyst (a) PtSn/Al₂O₃ (b) PtSn/Al₂O₃-WS (c) PtSn/Al₂O₃-OH

Table S5 Peak centers of the Pt species of the PtSn/Al₂O₃ catalysts

Sample	Binding energy(eV)						Pt ⁰ /Pt ^{δ+} (%)
	Pt 4d _{5/2}			Pt 4d _{3/2}			
	Pt ⁰	Pt ²⁺	Pt ⁴⁺	Pt ⁰	Pt ²⁺	Pt ⁴⁺	
PtSn/Al ₂ O ₃	309.5	316.9	320.1	332.0	334.2	336.4	37.5%
PtSn/Al ₂ O ₃ -WS	307.3	315.0	318.6	324.3	330.0	335.5	58.3%
PtSn/Al ₂ O ₃ -OH	308.4	314.7	318.5	324.8	331.7	355.5	45.2%