Significantly Enhanced Catalytic Performance of Pd Nanocatalyst on AlOOH Featuring Abundant Solid Surface Frustrated Lewis Pair for Improved Hydrogen Activation

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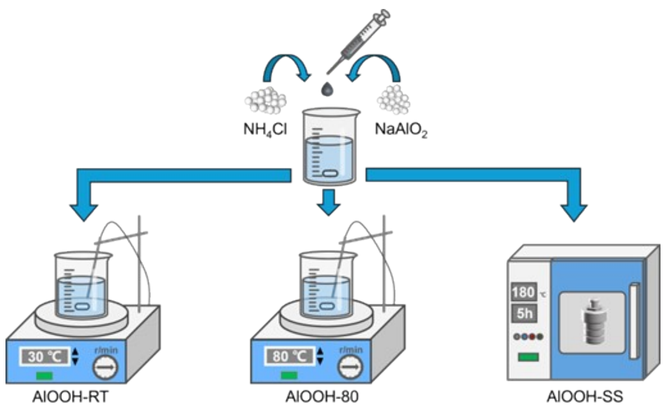

Figure S1. Schematic of the synthesis of AlOOH with different crystallinities.

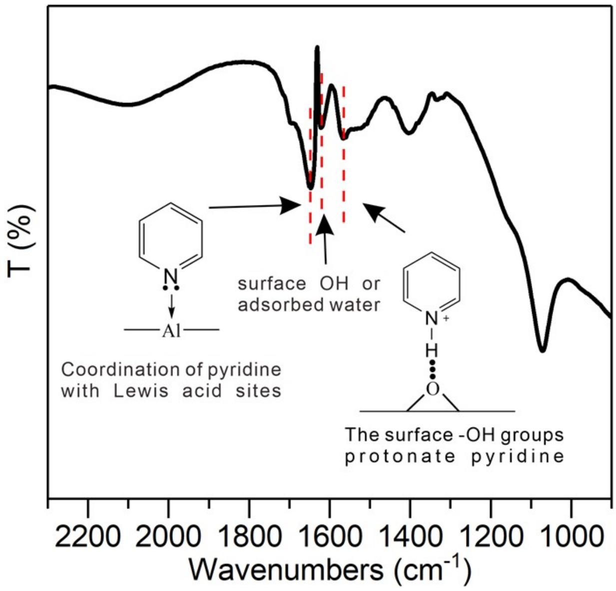

Figure S2. FT-IR spectra of pyridine adsorption on AlOOH-80. The absorption peak at 1647 cm^{-1} corresponded to the coordination of pyridine molecules with unsaturated Al sites (Lewis acid sites) exposed on the surface. The absorption peak at 1615 cm^{-1} was attributed to surface hydroxyl groups or adsorbed water, while at 1567 cm^{-1}, protonation of pyridine by the surface -OH groups was indicated.

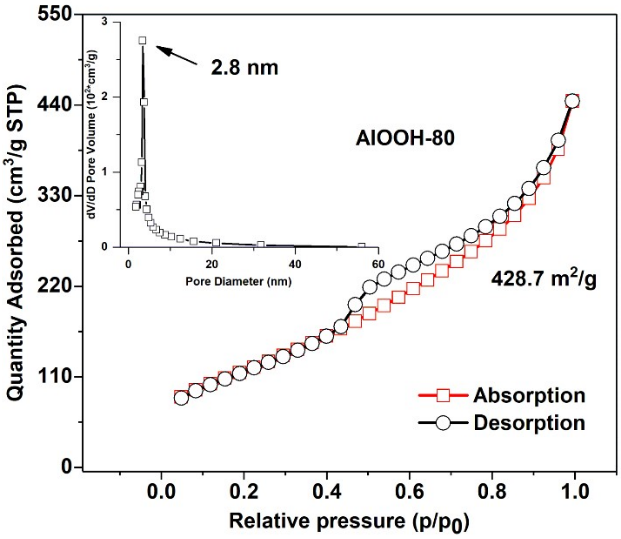

Figure S3. N_2 adsorption-desorption isotherms and pore diameter distribution curve of AlOOH-80.

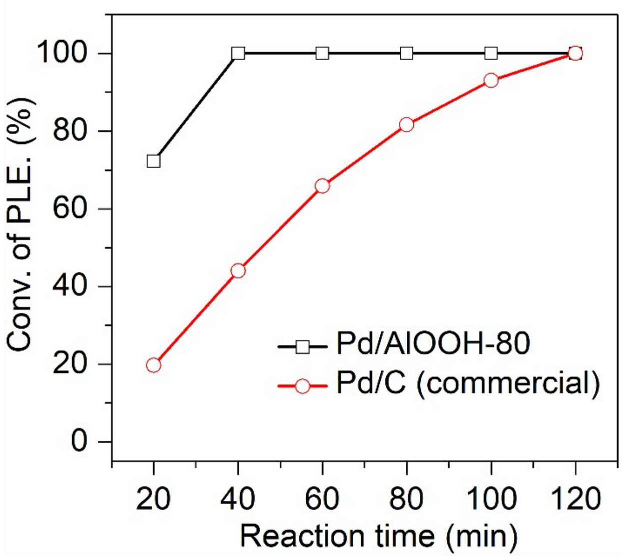

Figure S4. Pd/AlOOH-80 compared with commercial palladium on C (Pd/C) for catalytic performance.

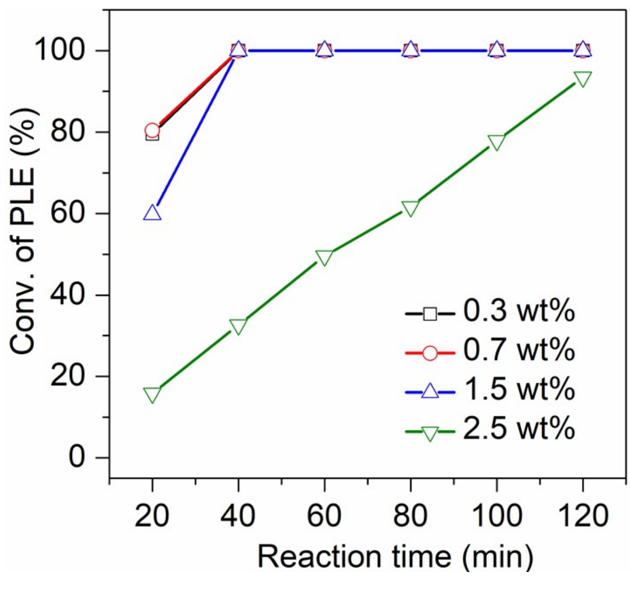

Figure S5. Catalytic performance of hydrogenation of phenylacetylene on Pd/AlOOH-80 with different Pd loadings.

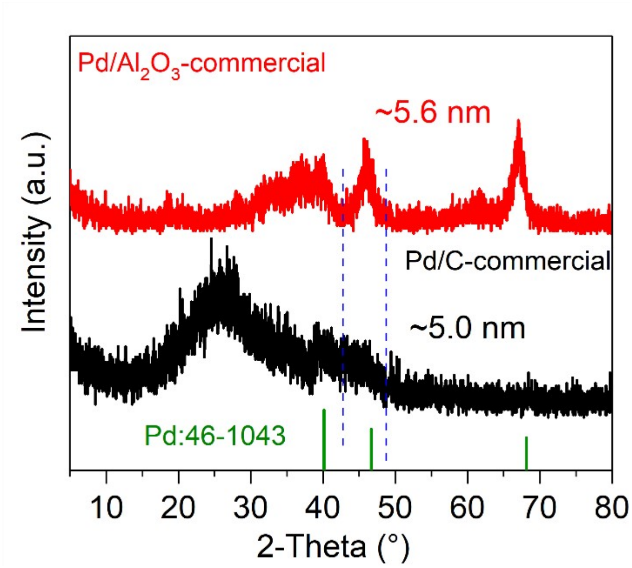

Figure S6. XRD patterns of commercial Pd/Al_2O_3 and commercial Pd/C. The average size of nanoparticles was calculated using the Scherrer equation based on the half-width of peaks.

Table S1. Results of XPS analysis of O1s of the AlOOH catalysts

Entry	Catalyst	O_{adH2O}/O_{Total} (%)
1	AlOOH-80	8.7
2	AlOOH-RT	17.2
3	AlOOH-SS	22.5

Table S2. The Pd content in Pd/AlOOH-80 catalyst was measured by ICP-AES.

Entry	Catalyst	Theoretical load (wt%)	Actual load (wt%)
1	AlOOH-80	0.3	0.4
2	AlOOH-80	0.7	0.7
3	AlOOH-80	1.5	1.7
4	AlOOH-80	2.5	2.2

Table S3. Catalytic performance comparison between Pd/AlOOH-80 and previously reported catalysts of the hydrogenation of phenylacetylene.

Entry	Catalyst	T (^oC)	Hydrogen source	Time	Con. (%)	Reaction rate (h^{-1})	Ref.
1	Pd_2Cu_2@α-Al_2O_3	30	0.1 MPa H_2	70 min	>99.9	146.2	1
2	Pd_1/NC-PHF	60	0.5 MPa H_2	2 h	93.1	88.5	2
3	Pd_1/BP	80	2 bar H_2	4 h	95	133.0	3
4	$Pd_{4.5}$Se NCs/C	110	0.1 MPa H_2	1.5 h	100	358.6	4
5	$PdCu_2$@MF-H	30	0.1 MPa H_2	4 h	100	125.9	5
6	PdCu@Cu_2O	30	0.1 MPa H_2	80 min	>99	1500.0	6
7	Pd_1/Cu_2O	30	0.1 MPa H_2	60 min	100	500.0	7
8	Pd/AlOOH-80	30	0.1 MPa H_2	40 min	100	4500.0	This work

$$\text{Reaction rate} = \frac{\text{moles of } phenylacetylene}{\text{moles of Pd} \times \text{reaction time (h)}}$$

References

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