Electronic supplementary information

Gas-Phase Synthesis of Morphology-Controlled Pt Nanoparticles and Their Impact on Cinnamaldehyde Hydrogenation

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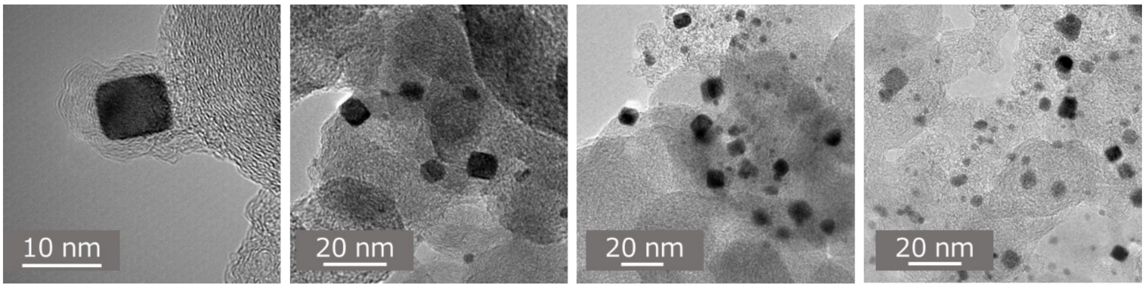

Figure S1. TEM images of Pt/C-CO catalysts.

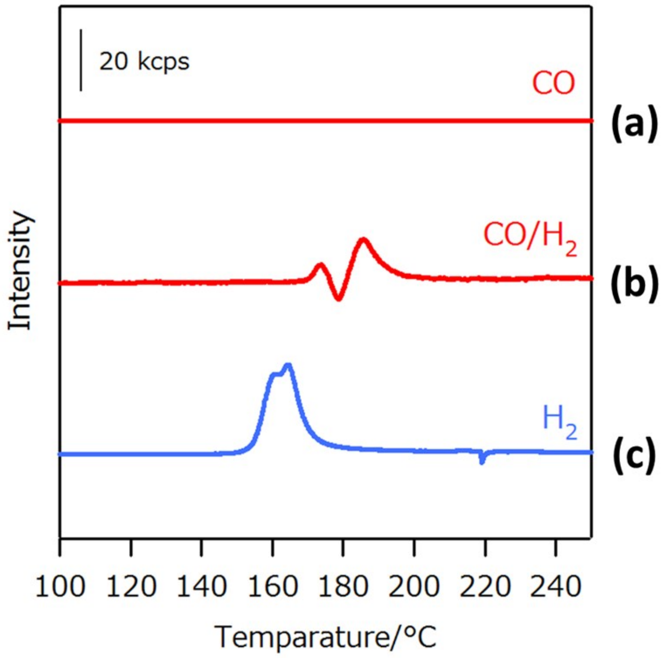

Figure S2. Temperature-programmed reduction (TPR) profiles of Pt/C under (a) CO, (b) CO/H_2, and (c) H_2 flow.

The TPR was carried out using a BEL-CAT-B instrument. Approximately 30 mg was placed in a sample tube. After the samples were pretreated at 50 °C in He, CO/H_2-TPR measurement was performed under a flow of mixed 5% CO/He and 1% H_2/Ar at rates of 5 and 50 mL/min; CO-TPR was performed under a flow of 5% CO/He, and H_2-TPR was performed under a 1% H_2/Ar flow at a rate of 40 mL/min. The sample temperature was ramped from 50 °C to 500 °C at 5 °C/min.

The CO/H_2-TPR (b) and H_2-TPR profiles (c) show peaks due to Pt precursor reduction below 200 °C. However, CO-TPR (a) showed no peaks from 50 °C to 500 °C. The results indicate that CO acts as a protective rather than a reducing agent.

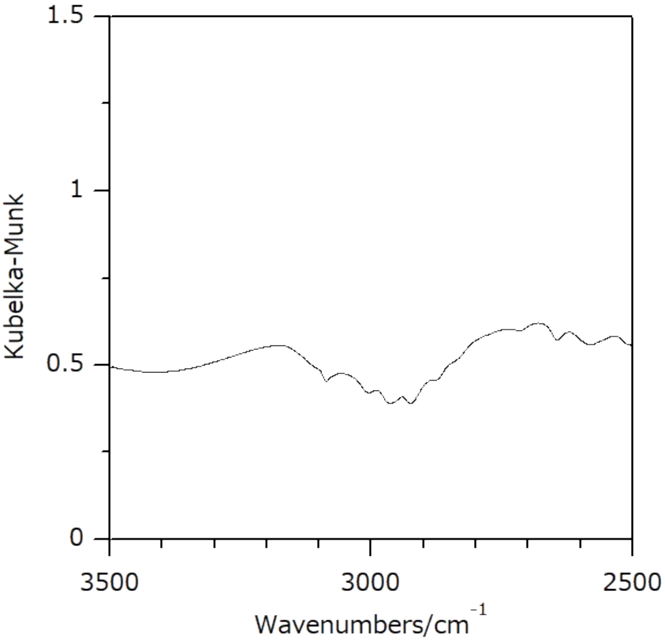

Fig. S3 In situ IR spectrum of C-H vibration region of 10wt% Pt/SiO_2-CO after treatment under 2.7% CO/33% H_2/Ar flow at 200 °C for 1 h. There was no significant peak due to C-H vibration; however, CO vibration was clearly observed as shown in Fig. 4. The result suggests that CO mainly contribute the structural variation of Pt nanoparticles.

Table S1. Pt particle size and CAL hydrogenation results[a] for Pt/C catalysts.

Catalyst	Particle size (nm)		XRD crystallite size (nm)	Reaction time (min)	Conversion (%)	Reaction Rate (10^{-5} mol/s/g)	Selectivity (%)			TOF (/s)		
	TEM	CO pulse[b]					COL	HCAL	HCOL	TEM	CO pulse	XRD
5 wt% Pt/C-CO	5.3 ± 3.9	9.3	8.0	20	36.2	2.0	62.4	30.9	6.7	0.39	0.66	0.60
10 wt% Pt/C-CO	6.6 ± 3.9	16	13	20	28.2	1.6 ± 0.33	68.7 ± 4.6	27.9	3.4	0.27 ± 0.06	0.63 ± 0.14	0.54 ± 0.12
20 wt% Pt/C-CO	9.9 ± 4.1	26	19	15	36.6	2.7	61.1	31.9	7.0	0.33	0.84	0.99
5 wt% Pt/C-H_2	2.2 ± 1.0	3.7	11	50	28.2	0.63	35.7	59.5	4.8	0.051	0.087	0.26
10 wt% Pt/C-H_2	3.9 ± 2.8	5.3	17	60	26.3	0.49 ± 0.17	32.5 ± 2.3	64.6	2.9	0.039 ± 0.01	0.051 ± 0.01	0.17 ± 0.01
20 wt% Pt/C-H_2	4.8 ± 2.8	7.0	19	60	35.6	0.66	34.5	59.7	5.8	0.030	0.042	0.15
50 wt% Pt/C-H_2	6.9 ± 3.4	13	16	20	24.1	1.3	28.9	58.0	13.1	0.033	0.069	0.078
10 wt% Pt/C-hCO	6.3 ± 3.3	9.9	9.4	15	34.1	2.5	55.0	35.6	9.4	0.30	0.48	0.45
10 wt% Pt/C-hCO-500	7.4 ± 3.2	17	9.9	13	32.7	2.8	63.0	31.6	5.4	0.51	1.1	0.66
10 wt% Pt/C-H_2-500	6.0 ± 3.7	14	18	60	26.5	0.49	38.4	57.2	4.4	0.054	0.12	0.16

[a] Reaction conditions: catalyst 10 mg : toluene : cinnamaldehyde : o-xylene = 10 : 1 : 1 (mol%), distilled water 0.5 mL, 120 ℃, and 1.0 MPa H_2 pressure.

[b] Calculated from Pt dispersion assuming spherical Pt particles.