

*Supporting information to*

**Low temperature hydrogenation of  $\alpha$ -angelica lactone on silica supported Pd-NiO catalysts with synergistic effect**

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**Captions**

Catalyst preparation.

Fig. S1 XRD patterns of Pd- $x$ Ni/SiO<sub>2</sub> catalysts.

Fig. S2 H<sub>2</sub>-TPR profile of Pd-SiO<sub>2</sub>.

Table S1 Catalytic activity of Pd-9.9NiO/SiO<sub>2</sub> in  $\alpha$ -AL hydrogenation.

Table S2 H<sub>2</sub> consumptions of supports and supported Pd catalysts.

## **Catalyst preparation**

**Preparation of  $x\text{Ni-SiO}_2$**  ( $x=0.26, 2, 9.9, 19, 29$  and  $40$  determined by ICP, wt.%).

For comparison, the metallic  $x\text{Ni-SiO}_2$  samples were also prepared by reducing the  $x\text{NiO-SiO}_2$  at  $400\text{ }^\circ\text{C}$  for 2 h.

**Preparation of  $\text{Pd-}x\text{Ni/SiO}_2$  catalysts** ( $\sim 0.2$  wt.%, determined by ICP) were prepared by deposition-precipitation-reduction method. The support (0.3 g) was dispersed in  $\text{H}_2\text{O}$  (60 mL) with stirring. A specified amount of  $\text{H}_2\text{PdCl}_4$  aqueous solution ( $21.512\text{ g}_{\text{Pd}}/\text{L}$ ) was added to the mixture and stirred for 3 h. The final pH value of the suspension was adjusted to 10 by adding NaOH solution (1 M). Then,  $\text{NaBH}_4$  aqueous solution ( $\text{NaBH}_4/\text{Pd} = 10$ , molar ratio) was added into the suspension and the mixture was stirred for another 30 min allowing for the full reduction of  $\text{Pd}^{2+}$  species. Thus obtained catalyst was dried at  $110\text{ }^\circ\text{C}$  overnight. The sample was denoted as  $\text{Pd-}x\text{Ni-SiO}_2$  ( $x$  stands for Ni loading).

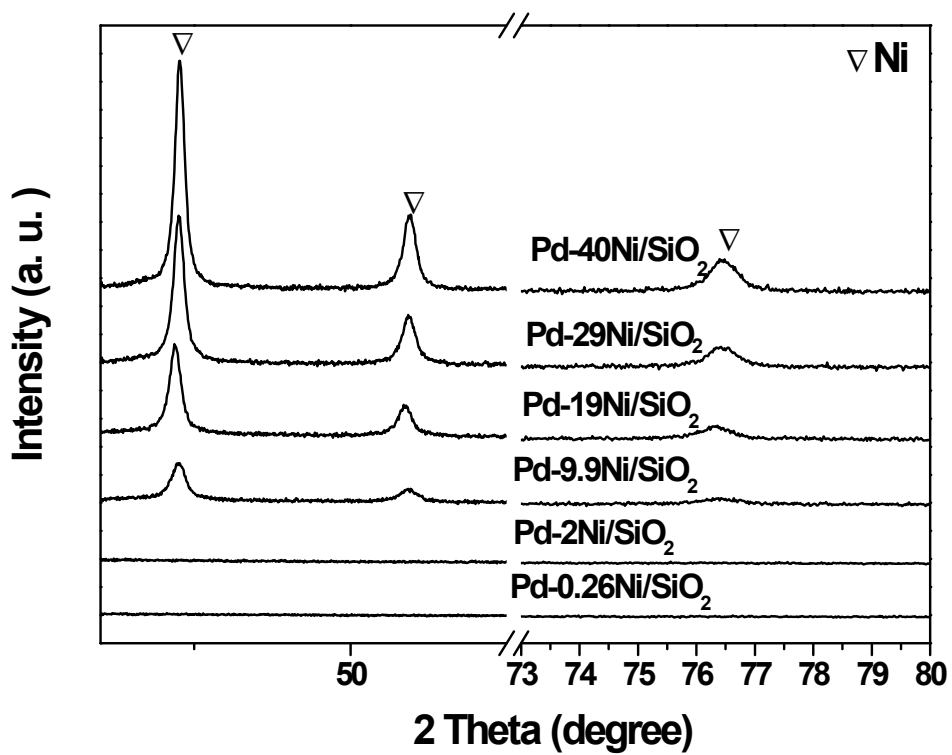


Fig. S1 XRD patterns of Pd-xNi/SiO<sub>2</sub> catalysts

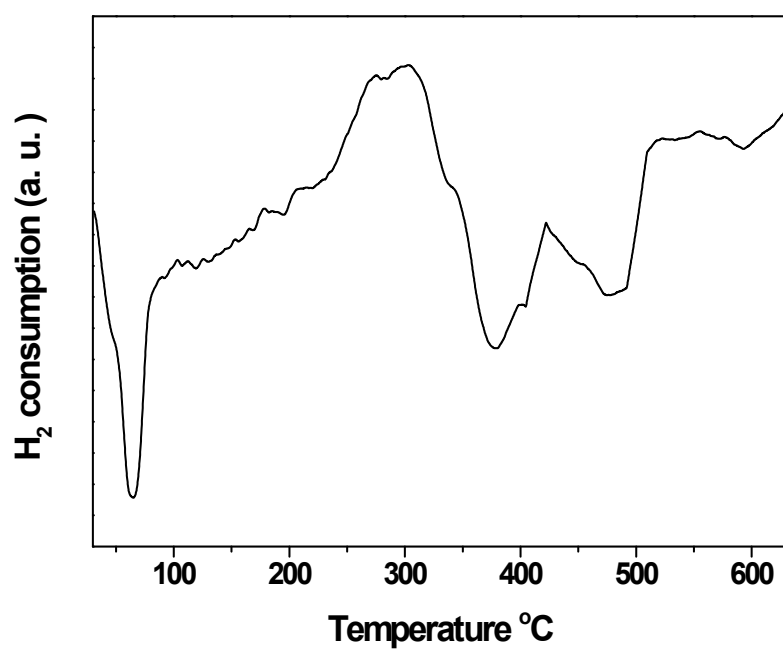


Fig. S2 H<sub>2</sub>-TPR profile of Pd-SiO<sub>2</sub>.

Table S1 Catalytic activity of Pd-9.9NiO/SiO<sub>2</sub> in  $\alpha$ -AL hydrogenation.

Entry	Catalysts	Time (min)	Conv. %		
			$\alpha$ -AL	GVL	$\beta$ -AL
1	<sup>a</sup> Pd-9.9NiO/SiO <sub>2</sub>	30	82	100	-
2	<sup>b</sup> Pd-9.9NiO/SiO <sub>2</sub>	15	99.8	100	
3	<sup>c</sup> Pd-9.9NiO/SiO <sub>2</sub>	30	44	98	2

Reaction conditions: catalyst (25 mg), H<sub>2</sub>O (9.8 mL), 30 °C

<sup>a</sup>  $\alpha$ -AL (0.2 mL), 0.3 MPa H<sub>2</sub>

<sup>b</sup>  $\alpha$ -AL (0.2 mL), 1 MPa H<sub>2</sub>

<sup>c</sup>  $\alpha$ -AL (0.4 mL), 0.3MPa H<sub>2</sub>

Table S2 H<sub>2</sub> consumptions of supports and supported Pd catalysts.

Catalyst	H <sub>2</sub> /Ni (mol ratio) <sup>a</sup>	Reduction T <sub>max</sub> (°C)
9.9NiO/SiO <sub>2</sub>	63%	350
Pd-9.9NiO/SiO <sub>2</sub>	60%	370

<sup>a</sup> Based on 10 wt.% CuO-SiO<sub>2</sub> catalyst.