



## **Supplementary Information**

# Investigation of Various Pd species in Pd/BEA for Cold Start Application

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#### 20 Detailed information of 1-Pd-80

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Table S1. Detailed information of 1-Pd-80\*

catalyst	Si/Al(XRF)	ICP Pd (wt %)
1-Pd-80	82.8	0.97

\*1-Pd-80 was prepared through the same method as 1-Pd did whereas H-BEA zeolite with the Si/Al ratio of 80
 was used.

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#### 25 CO in situ FTIR spectra of 1-Pd-80



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Figure S1. CO in situ FTIR spectra of 1-Pd-80 (Temperature: 80 °C; Flow: 1000ppm CO, balanced with N<sub>2</sub>, 500 ml/min)



#### 29 NO<sub>x</sub> adsorption profiles of 1-Pd and 1-Pd-80

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Figure S2. NOx trapping profiles of 1-Pd and 1-Pd-80 (Temperature: 80 °C; Flow: NOx, CO, H2O, O2,
 CO2, balanced with N2, 1L/min)

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### 34 NH<sub>3</sub> in situ FTIR spectra of 1-Pd-80



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36Figure S3. NH3 in situ FTIR spectra of 1-Pd-80 (Temperature: 80 °C; Flow: 500ppm NH3, balanced37with N2, 500 ml/min)