

Supplementary Information

Improving Hydrogenation of 4-Nitrophenol using Pd catalysts homogenously anchored on WN-TiO₂: A synergistic interaction between WN and Pd nanoparticles

Yanping Dong,^a Xiqiang Tian,^{*b} Enxin Liu,^b Shoulei Huang^{*b} and Muhammad Zahid^{*c}

^a *School of Food Engineering, Department of Chemistry, Harbin University, Harbin, Heilongjiang 150086, P. R. China*

^b *Heilongjiang Province Key Laboratory of Environmental Catalysis and Energy Storage Materials, Department of Food and Pharmaceutical Engineering, Suihua University, Suihua, 152061, P. R. China*

^c *Interdisciplinary Research Center for Refining and Advanced Chemicals, King Fahd University of Petroleum and Minerals, Dhahran 31261, Saudi Arabia*

*** Corresponding author**

E-mail address: tianxiqiang@163.com (X. Q. Tian), , huangshoulei@126.com (S. L. Huang), muhammad93zahid@uop.edu.pk (M. Zahid)

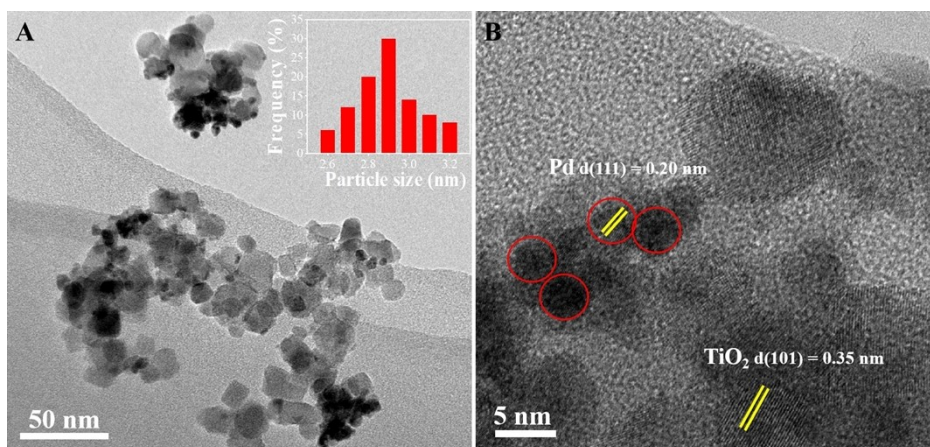


Fig. S1 TEM images of Pd@TiO₂ (inset: size distribution of the Pd NPs).

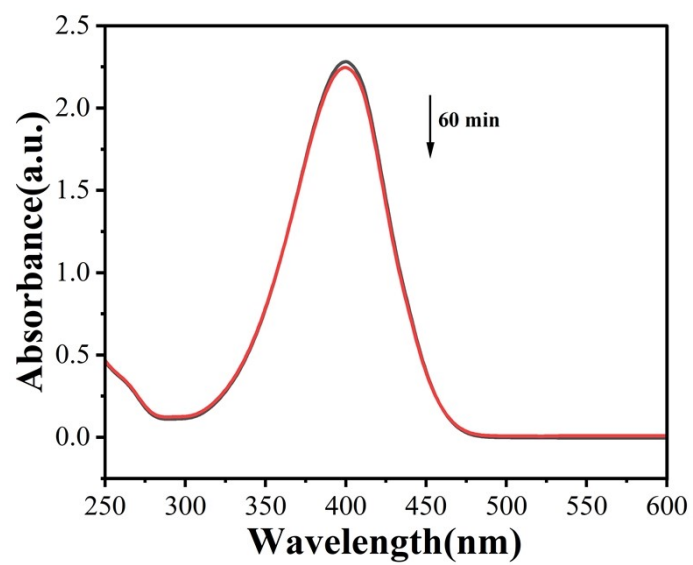


Fig. S2 UV-vis spectra of the 4-NP hydrogenation reaction at a certain time interval over TiO₂.

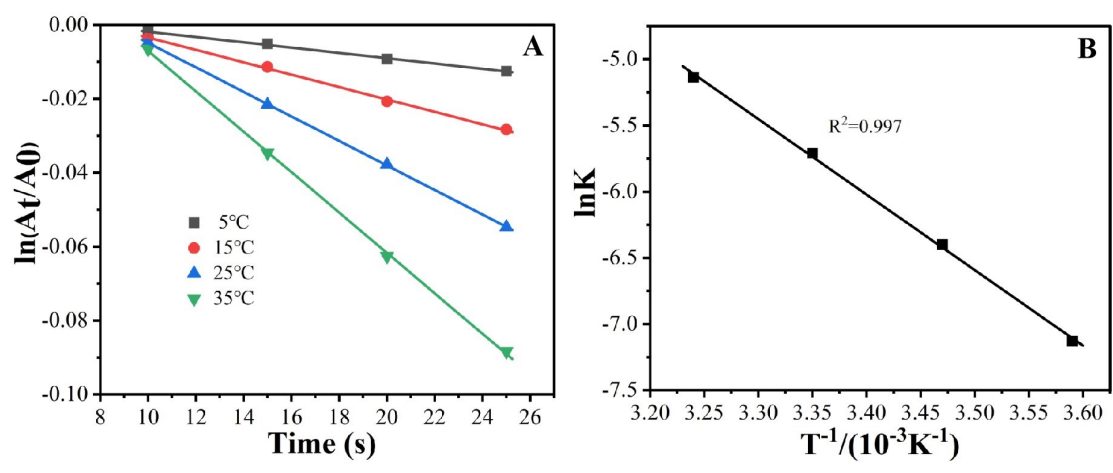


Fig. S3 The relation of $\ln A_t/A_0$ versus time for the hydrogenation of 4-NP over four different temperature (A) and Plots of $\ln k$ against T^{-1} (B) over Pd@TiO₂.

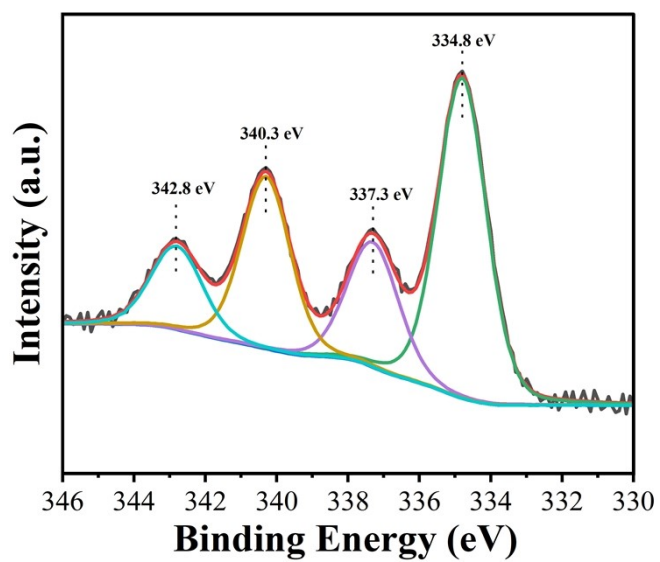


Fig. S4 Pd3d XPS spectra of the used Pd@WN-TiO₂ catalyst.

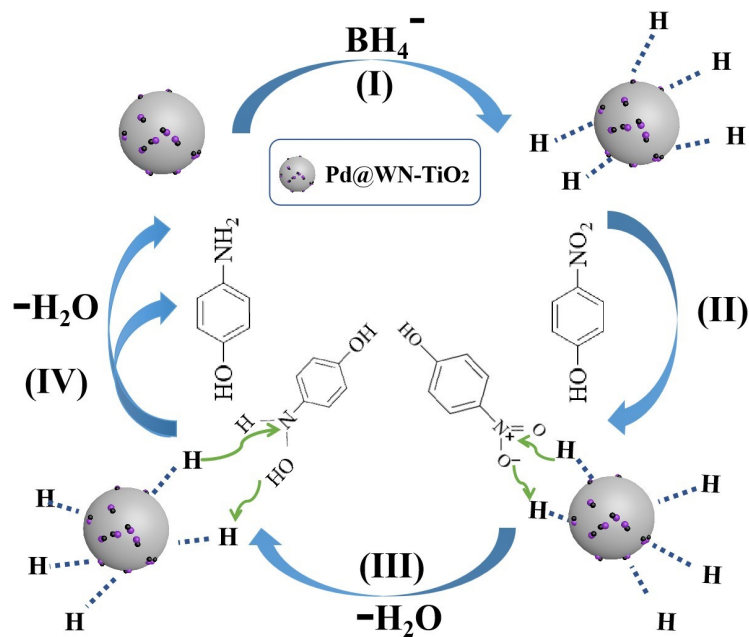


Fig. S5 Catalytic pathway of 4-NP to 4-AP over 1.0wt%Pd@WN-TiO₂ in the presence of NaBH₄.

Table S1. The performance of our Pd@WN-TiO₂ and recent reported noble metal-based catalysts.

No	Catalyst	Noble metal Content (wt%)	C ₄ -NP (mmol/L)	Time (S)	K (S ⁻¹)	References
1	Pd@WN-TiO ₂	1.0	0.23	180	1.07×10 ⁻²	This work
2	PPy/TiO ₂ /Pd	2.1	0.11	420	1.22×10 ⁻²	1
3	Pd/ZnO	3.39	0.11	720	5.8×10 ⁻³	2
4	Pd-Ni/rGO	30	0.5	720	2.66×10 ⁻³	3
5	Ag/SiO ₂	5.46	0.02	780	3.2×10 ⁻³	4
6	Pd@Fe ₃ O ₄	1.58	0.1	300	0.354	5
7	Au/g-C ₃ N ₄ -6	6.0	0.072	480	0.356	6

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Table S2. Comparison of the activation energies for recent reported noble metal catalysts.

No	Catalyst	Noble metal Content (wt%)	C _{4-NP} (mmol/L)	Time (S)	Ea(kJ/mol)	References
1	Pd@WN-TiO ₂	1.0	0.23	180	38.2	This work
2	Ag@Pt/sepiolite	2	0.2	900	69.02	1
3	SPB-30-Pd9	-	0.1	1200	44	2
4	Pd/TiO ₂ -BT	1.0	0.25	120	45.6	3
5	Pd/TiO ₂ -FT	1.0	0.25	120	43.1	3
6	Pd/Al ₂ O ₃	0.6	0.1	3600	43	4
7	Au@Pd	-	0.17	-	43.32	5
8	Pt/MSPB	9.57	0.11	900	49	6

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