Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Highly Dispersed Ultra-Small Pd Nanoparticles on Gadolinium Hydroxide Nanorods for Efficient Hydrogenation Reactions

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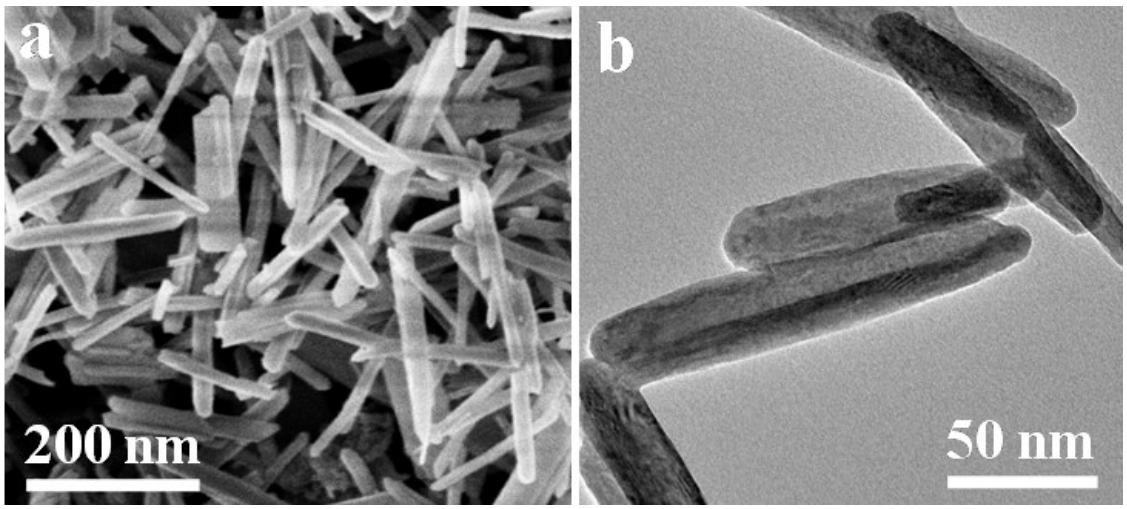

Fig. S1 (a) SEM and (b) TEM images of $Gd(OH)_3$ NRs without loading Pd nanoparticles.

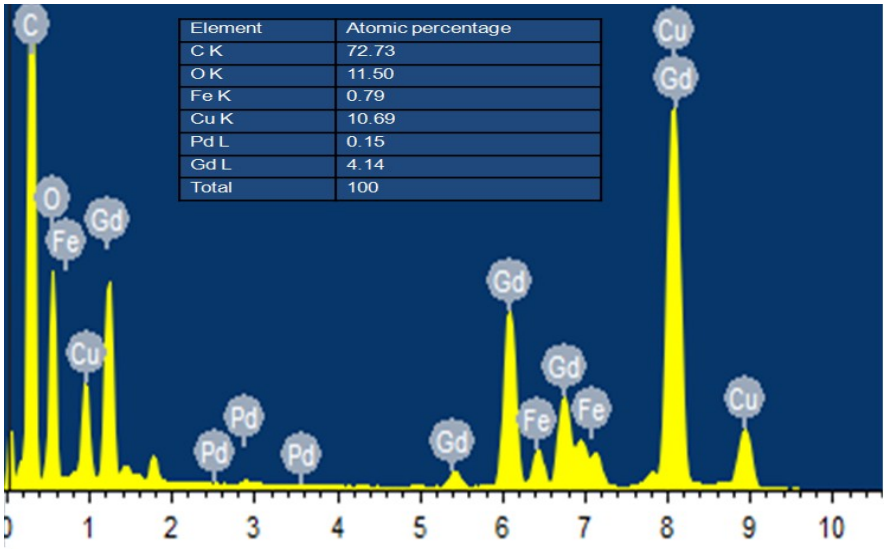

Fig. S2 EDS elemental spectra and elemental compositions of $Pd/Gd(OH)_3$ sample.

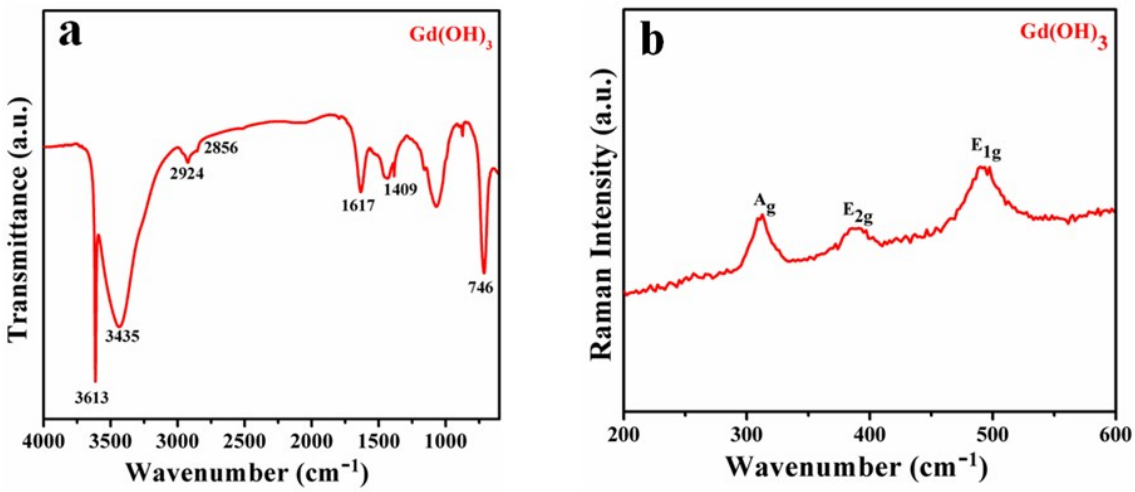

Fig. S3 FTIR spectrum (a) and Raman spectrum (b) of $Gd(OH)_3$ NRs.

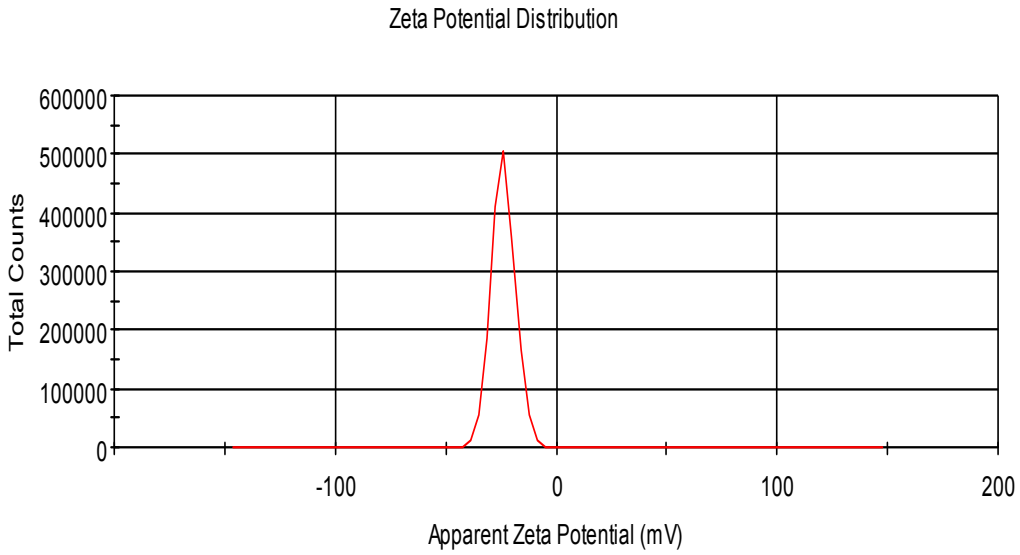

Fig. S4 Zeta potential measurement of bare $Gd(OH)_3$ NRs.

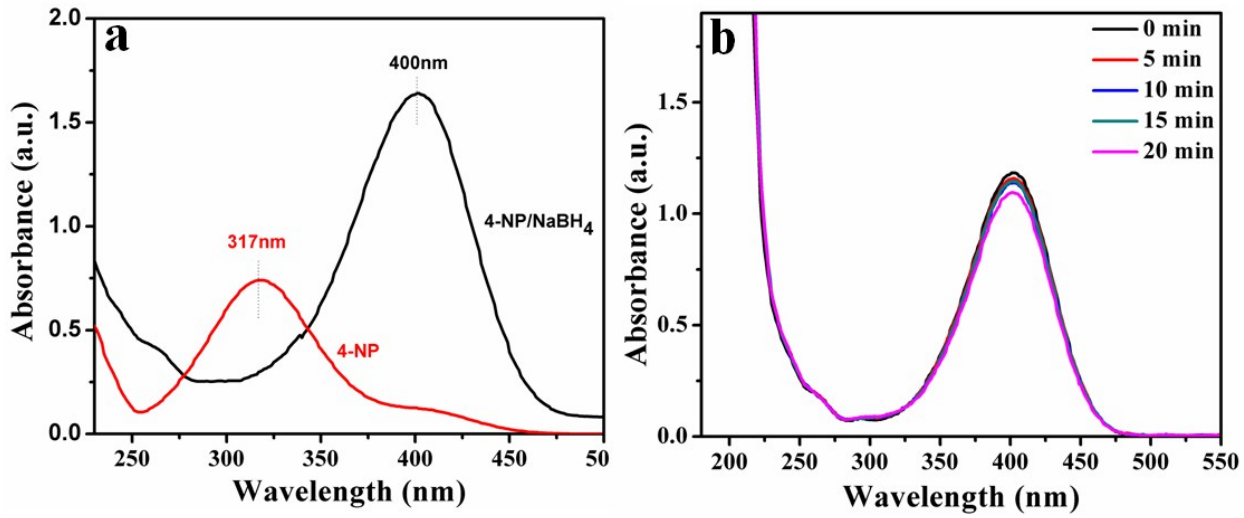

Fig. S5 (a) UV-Vis absorption spectra of 4-nitrophenol (4-NP) and 4-NP/$NaBH_4$,

(b) UV-Vis absorption spectra of time-dependent 4-NP reduction over $Gd(OH)_3$.

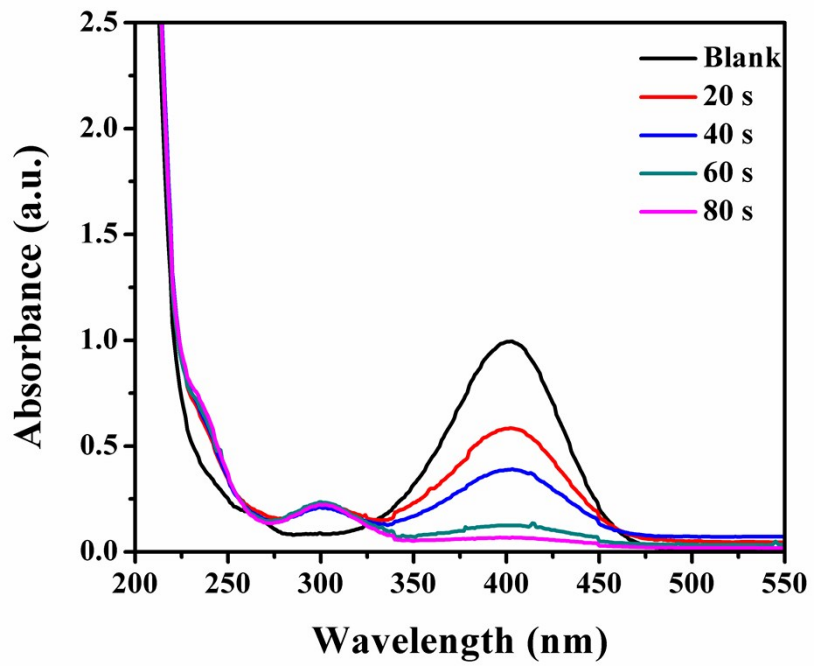

Fig. S6 Time dependent UV-Visible spectra of the reduction of 4-nitrophenol over Pd/Gd_2O_3.

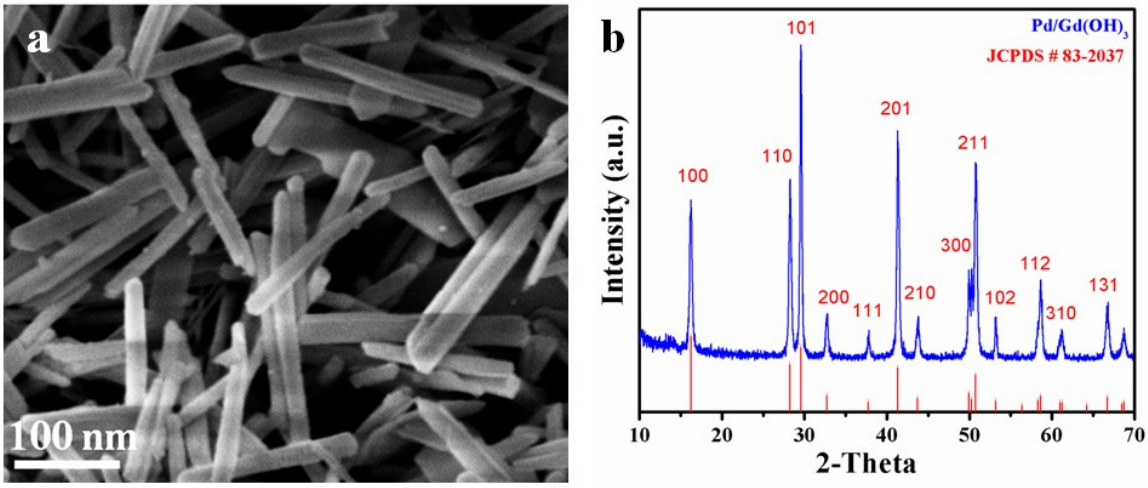

Fig. S7 (a) SEM image and (b) XRD pattern of the recycled Pd/Gd(OH)$_3$ catalyst.

Table S1 Pd weight content in Pd/Gd(OH)$_3$ determined by inductively coupled plasma atomic emission spectroscopy (ICP-AES)

No.	ICP-AES Pd(μg/mL)	Calculated Percentage (%)
1	0.949	0.93
2	0.985	0.98
3	0.921	0.94
Average		0.951

Table S2 Comparison of 4-NP reduction over Pd NPs supported on different oxide supports

Catalyst	**t (sec)**	**Amount of Catalyst (mg)**	**k (s^{-1})**	**Mol. Ratio $NaBH_4$/4-NP**	**Ref.**
$Pd/Gd(OH)_3$	60	0.2	47×10^{-3}	10	This study
$Pd/PPy/TiO_2$	420	1.75	12.2×10^{-3}	7.4	1
$Pd/w\text{-}Nb_2O_5$	480	7.5	19.2×10^{-3}	-	2
$h\text{-}Pd–CeO_2$	120	1.5	39.3×10^{-3}	2	3
$Pd/Fe_3O_4–Ag$	120	1	33×10^{-3}	-	4
Pd–rGO	20	5	-	0.1	5

References

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