Supporting Information

Selective hydrogenation of phenylacetylene over TiO_2 supported Ni_2P nanoparticles under visible light irradiation

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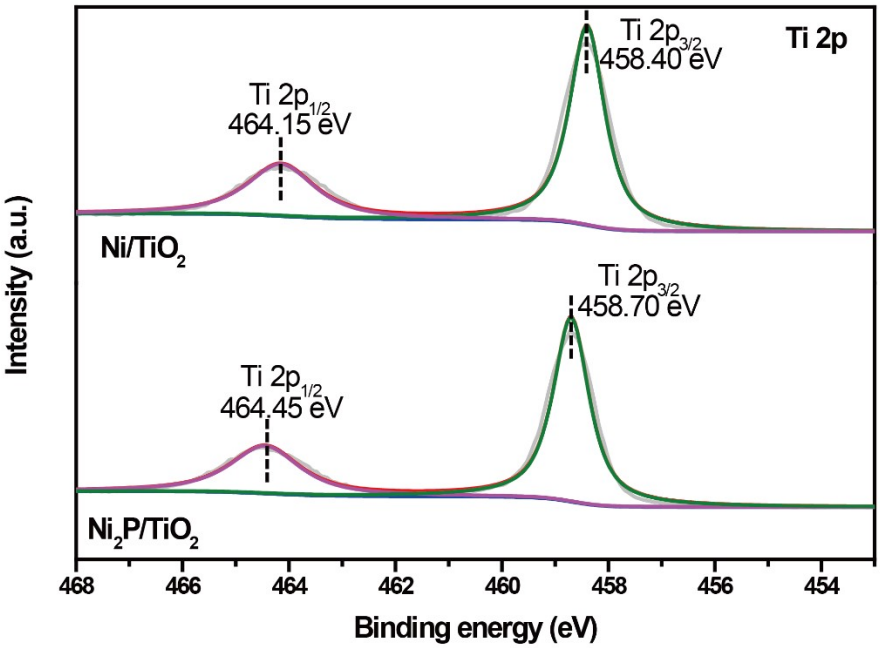


Fig. S1 High-resolution XPS Ni 2p of Ni_2P/TiO_2 and Ni/TiO_2

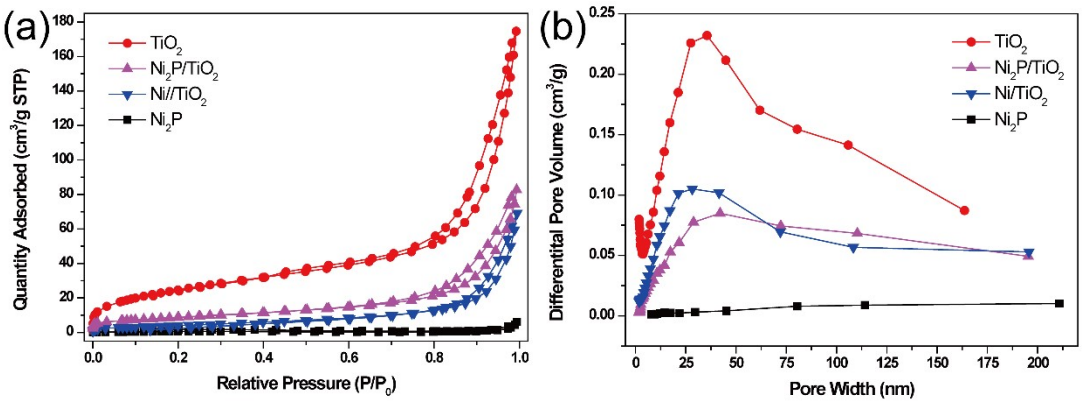


Fig. S2 (a) N_2 sorption isotherms and the (b) corresponding pore size distribution curves of the prepared catalysts.

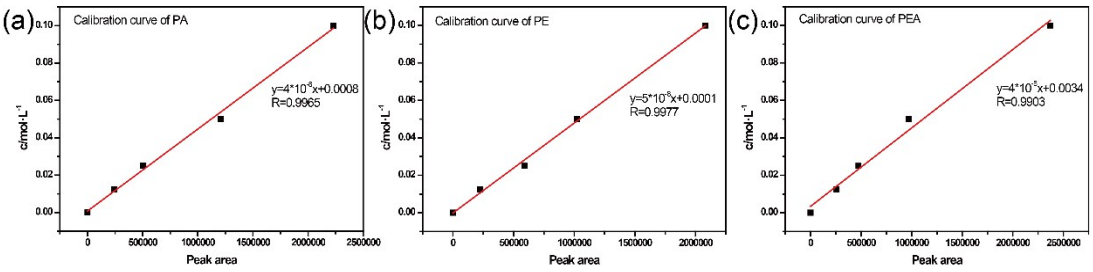


Fig. S3 Standard curves of PA, PE and PEA were plotted using the external standard method.

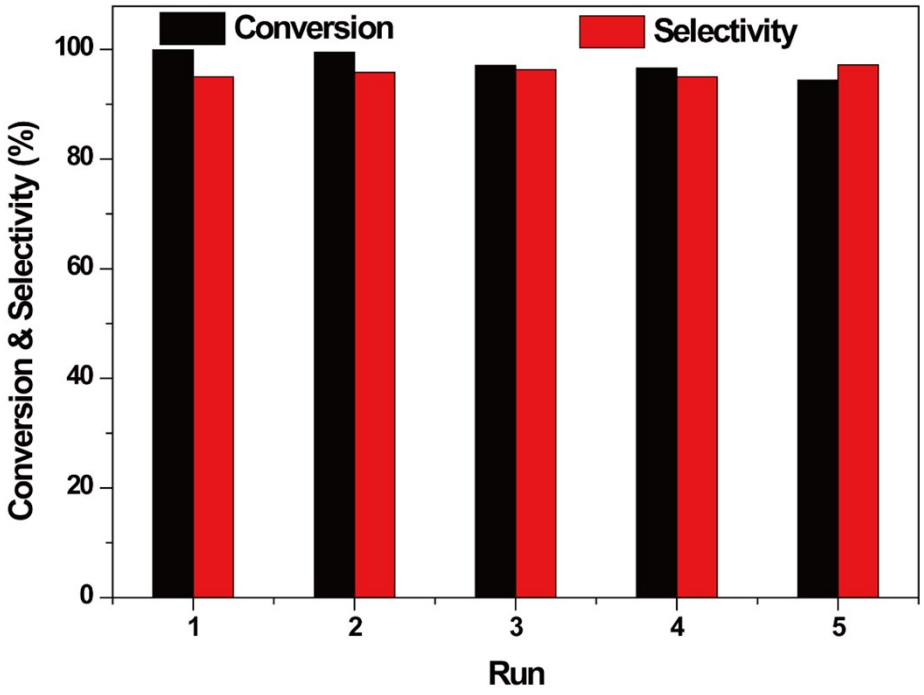


Fig. S4 Reuses of the Ni_2P/TiO_2(R) photocatalyst in selective hydrogenation of PA. Reaction conditions: 20 mg catalyst, 0.1 mmol PA, 2 mL i-PrOH, 12 h, 80 °C, 1 atm H_2, 0.5W/cm^{2}LED white.

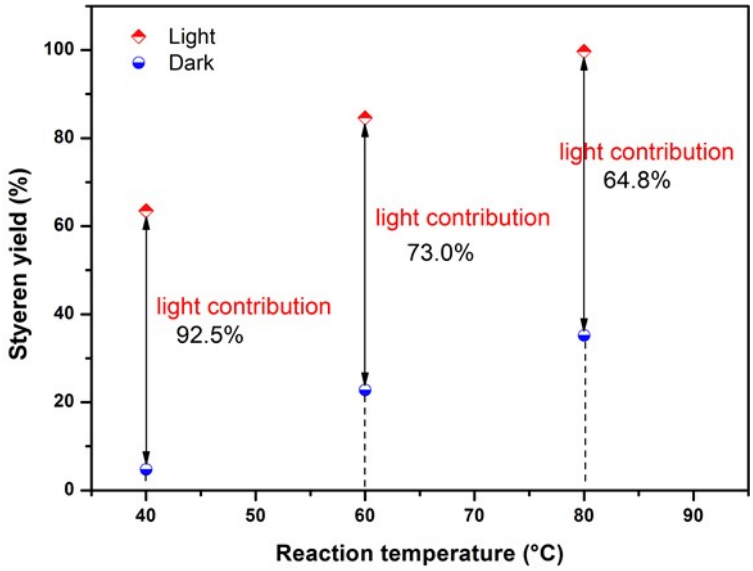


Fig. S5 Photocatalytic performance at different temperatures. Reaction conditions: 20 mg Ni_2P/TiO_2 catalyst, 0.1 mmol phenylacetylene, 2 mL, i-PrOH, 12 h, 80 °C, 1 atm H_2, LED white light (0.5 W cm^{-2}) or dark.

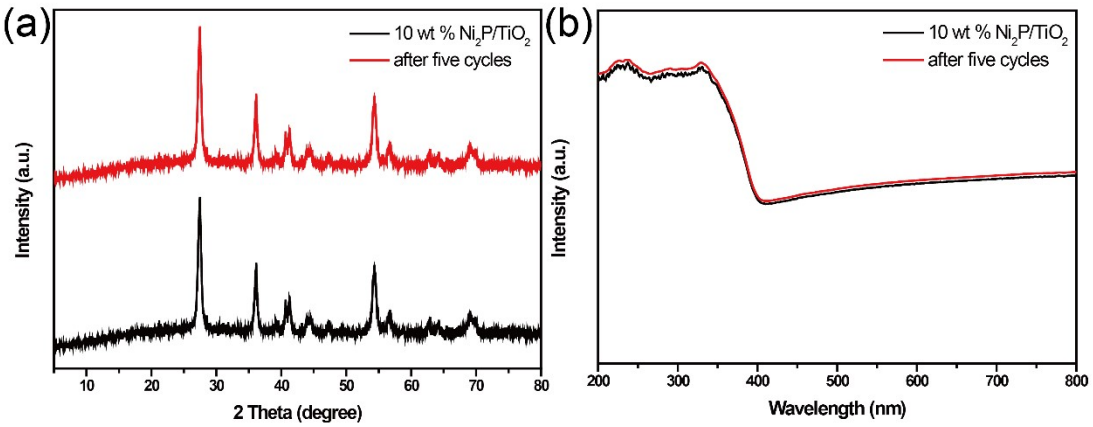


Fig. S6 The XRD (a) and UV-Vis DRS of fresh and recycled Ni_2P/TiO_2 catalyst.

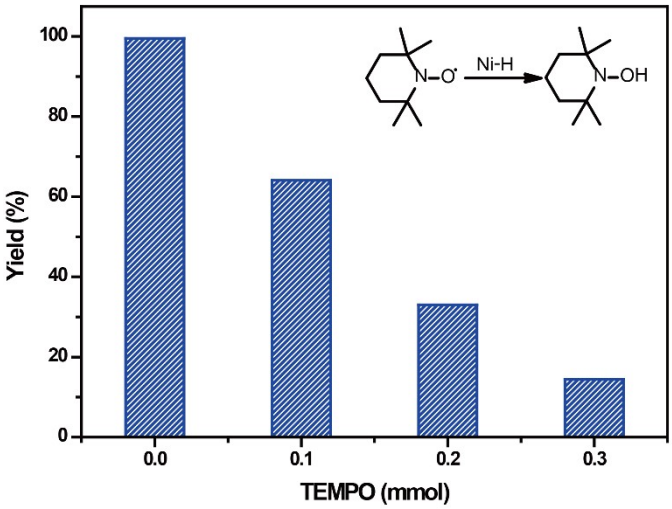


Fig. S7 Effect of TEMPO as the hydrogen abstractor on the catalytic activity for selective hydrogenation of phenylacetylene. Reaction conditions: 20 mg Ni_2P/TiO_2, 0.1 mmol phenylacetylene, 2 mL, i-PrOH, 12 h, 80 °C, 1 atm H_2, LED white light (0.5 W cm^{-2}).

Table S1 The structural properties of various catalysts.

Sample	S_{BET} (m^2 g^{-1})	Pore volume (cm^3 g^{-1})	Average pore diameter (nm)
Ni_2P	1.7	0.01	51.6
Ni_2P/TiO_2	19.8	0.12	23.22
Ni/TiO_2	15.3	0.11	20.59
TiO_2	31.8	0.12	16.6

Table S2 The concentrations of PA, PE and PEA in the reaction system at different reaction times.

Reaction time (h)	C_{PA}(mmol)	C_{PE}(mmol)	C_{PEA}(mmol)	$\mathbf{C_{all}}$(mmol)
0	0.0496	0	0	**0.0496**
1	0.0400	0.0060	0.0035	**0.0495**
4	0.0133	0.0332	0.0042	**0.0507**
8	0.0008	0.0371	0.0127	**0.0506**
12	0	0	0.05223	**0.0483**

Reaction conditions: 20 mg Ni/TiO_2, 0.1 mmol phenylacetylene, 2 mL, i-PrOH, 12 h, 80 °C, 1 atm H_2, LED white light (0.5 W cm^{-2}).

Table S3 Effect of Ni_2P loading on selective hydrogenation of PA.

Entry	Ni_2P loading (wt%)	Light source	Conv. (%)	Sel. (%)
1	2	0.5W/cm^{2}LED white	19.1	99.7
2	2	dark	5.0	97.2
3	5	0.5W/cm^{2}LED white	48.0	97.0
4	5	dark	22.2	96.7
5	10	0.5W/cm^{2}LED white	99.9	96.0
6	10	dark	33.1	97.3
7	15	0.5W/cm^{2}LED white	76.5	97.3
8	15	dark	29.0	97.2

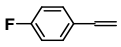
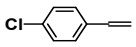
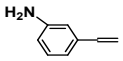
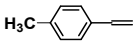
Reaction conditions: 20 mg catalyst, 0.1 mmol PA, 2 mL i-PrOH, 12 h, 80 °C, 1 atm H_2.

Table S4 The TiO_2 with different R value for selective hydrogenation of PA.

Entry	R	Light Source	Conv. (%)	Sel. (%)
1	1	0.5W/cm^{2}LED white	46.2	97.5
2	1	Dark	23.2	97.3
3	3	0.5W/cm^{2}LED white	70.3	97.5
4	3	Dark	30.4	96.9
5	5	0.5W/cm^{2}LED white	99.9	96.0
6	5	Dark	33.1	97.3
7	7	0.5W/cm^{2}LED white	54.3	97.2
8	7	Dark	23.1	97.5

Reaction conditions: 20 mg catalyst, 0.1 mmol PA, 2 mL i-PrOH, 6 h, 80 °C, 1 atm H_2. R=m(NaH_2PO_2):m($NiCl_2 \cdot 6H_2O$).

Table S5 The Ni_2P/TiO_2 photocatalyst selective hydrogenation of various alkynes.

Entry	Product	Light Source	Conv. (%)	Sel. (%)
1		0.5W cm^{-2}LED white	97.4	99.0
2		dark	27.5	99.5
3		0.5W/cm^2LED white	78.1	98.1
4		dark	21.4	99.0
5		0.5W/cm^2LED white	13.4	99.5
6		dark	1.7	98.3
7		0.5W/cm^2LED white	64.3	97.1
8		dark	23.8	97.6

Reaction conditions: 20 mg catalyst, 0.1 mmol substrate, 2 mL i-PrOH, 12 h, 80 °C, 1 atm H_2.

Table S6 Photocatalytic activity over various catalysts for selective hydrogenation.

Entry	Catalyst	Conditions	Light and performance	Ref.
1	Ni_2P/TiO_2	80 °C, 12 h, 1 atm H_2, 2mL i-PrOH, 0.1 mmol PA	white LED, 0.5 W cm^{-2} Conv.=99.9% Sel.=97.2%	This work
2	Au/BT	25 °C, 2 h, 2 MPa H_2, 2mL ethanol, 4.42 mmol PA	1.0 W cm^{-2} (λ≥400 nm) Conv.=51.4% Sel.=90.3%	41
3	$Au@CeO_2$	25 °C, 3h, 30 atm H_2, 5 mL toluene, 0.4 mmol PA	- Conv=99% Sel.=98%	42
4	Cu_3Pd_1/SN	25 °C, 1 h methanol 2 mL, , 1 atm H_2，0.1 mmol PA	300 W Xe lamp (λ≥400 nm) Conv.=99.6% Sel.=99.4%	37
5	$Pd_1/Ni@G$	25 °C, 1.25h, 2 bar H_2, 10 mL ethanol, 1.85 mmol PA	- Conv.=100% Sel.=93%	43
6	$H_{350}Ni/COF$	100 °C, 1h, 1 Mpa H_2, 0.4 mmol PA, 3 mL methanol	- Conv.=99% Sel.=85%	44
7	$NiZn_3$/AlSBA-15	40 °C, 15.5 h, 0.1 MPa, 4.5 g PA, 90 g methanol	- Conv.=99.6% Sel.=90.3%	5
8	Llysine/Ni/Nb_2O_5	80 °C, 12 h, 1 atm H_2, 2mL i-PrOH 0.1 mmol PA	white LED, 0.6 W cm^{-2} Conv.=99.9% Sel.=96.7%	39
9	Ni–Ga IMCs	50 °C, 5h 0.5 MPa H_2, 30 mL i-PrOH, 1.0 mL PA	- conv=95.1% sel.=92.2%	45
10	Ni_2Si/SBA-15	40 °C, 2h ,1.0 MPa H_2, 10 mL methanol, 1 mmol PA	- Conv.=81.5% Sel.=91.5%	46
11	Co/NC	120 °C, 2 h, 2 MPa H_2, 100 μL PA, 6 mL ethanol	- Conv.=88.7% Sel.=91.2%	47

12	Fe/NC	120 °C, 2 h, 2 MPa H_2, 100 μL PA, 6 mL ethanol	- Conv.=20.5% Sel.=82.2%	47