

Supporting Information

Surface States Modulation for Size-Controllable Photodeposition of Noble Metal Nanoparticles on Semiconductors

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Table S1. The designed and ICP estimated loading amount

Sample	Designed loading amount (wt.%)	Loading amount estimated by ICP (wt.%)
Ag/TiO₂(A)-9	2.5	2.50
Ag/TiO₂(A)-2	2.5	2.49
Pt/TiO₂(A)-6	2.5	2.48
Au/TiO₂(A)-6	2.5	2.47
Pd/TiO₂(A)-6	2.5	2.47

Table S2 A summary of size distribution of different metal nanoparticles based on the size statistics results.

Sample	TiO₂	Metal precursor	pH values	Size distribution
1	Anatase	AgNO ₃	2.0	4.2-72 nm
2	Anatase	AgNO ₃	4.5	10.3-39.6 nm
3	Anatase	AgNO ₃	9.0	0.6-2.3 nm, 2.9-16.9 nm
4	Rutile	AgNO ₃	2.0	7.9-128 nm
5	Rutile	AgNO ₃	6.0	0.7-2.3nm, 8-30.8 nm
6	Rutile	AgNO ₃	9.0	0.71-37.6 nm
7	Anatase	H ₂ PtCl ₆	2.0	1.3-20.2 nm
8	Anatase	H ₂ PtCl ₆	4.5	1.7-4 nm
9	Anatase	H ₂ PtCl ₆	9.0	1.1-13 nm
10	Rutile	H ₂ PtCl ₆	6.0	1.3-6 nm
11	Anatase	HAuCl ₄	4.5	2.4-34.4 nm
12	Rutile	HAuCl ₄	6.0	5.3-44.2 nm
13	Anatase	PdCl ₂	4.5	3-20.2 nm
14	Rutile	PdCl ₂	6.0	0.3-1.7nm, 2.3-9.4 nm

Table S3 A summary of size distribution of different metal nanoparticles obtained with different surface charge and metal precursors.

Samples	Surface charge	Metal Precursors	Size distribution
Ag/TiO ₂ (R)-2.0	44.6	AgNO ₃	7.9-128 nm
Ag/TiO ₂ (R)-6.0	-22	AgNO ₃	0.7-2.3 nm, 8-30.8 nm
Ag/TiO ₂ (R)-9.0	-38	AgNO ₃	0.71-37.61 nm
Pt/ TiO ₂ (R)-6.0	-22	H ₂ PtCl ₆	1.3-6 nm
Au/ TiO ₂ (R)-6.0	-22	HAuCl ₄	5.3-44.2 nm
Pd/ TiO ₂ (R)-6.0	-22	PdCl ₂	0.3-1.7nm, 2.3-9.4 nm
Ag/TiO ₂ (A)-4.5	4.5	AgNO ₃	10.3-39.6 nm
Pt/ TiO ₂ (A)-4.5	4.5	H ₂ PtCl ₆	1.7-4 nm
Au/ TiO ₂ (A)-4.5	4.5	HAuCl ₄	2.4-34.4 nm
Pd/ TiO ₂ (A)-4.5	4.5	PdCl ₂	3-20.2 nm

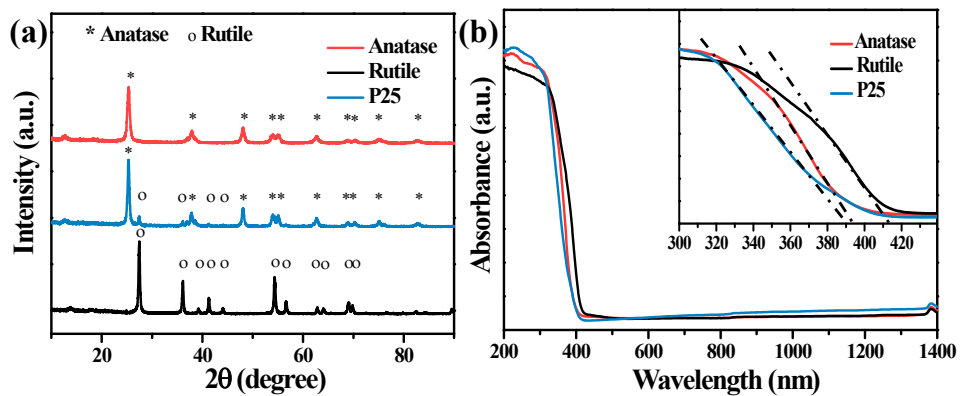


Figure S1. The XRD patterns (a) and UV-vis spectra (b) of anatase, rutile and P25. The inset in (b) is the amplified UV-vis spectra.

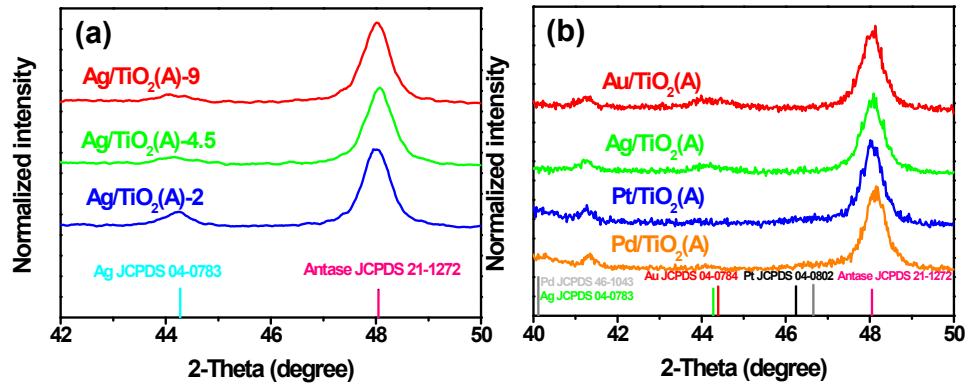


Figure S2. XRD patterns of different samples: (a) Ag/TiO₂(A) prepared at different pH and (b) different metals on TiO₂(A)-4.5.

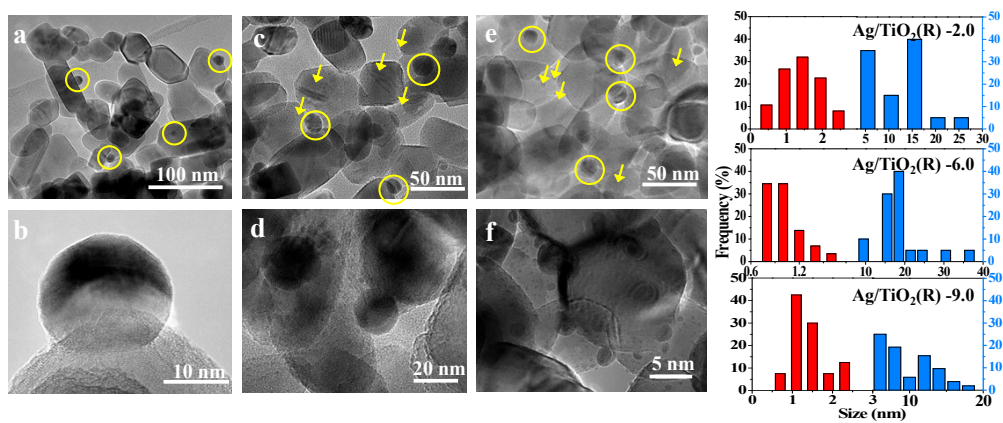


Figure S3. TEM and HRTEM images of (a-b) Ag/TiO₂(R)-2, (c-d) Ag/TiO₂(R)-6, (e-f) Ag/TiO₂(R)-9 and corresponding particle size distribution.

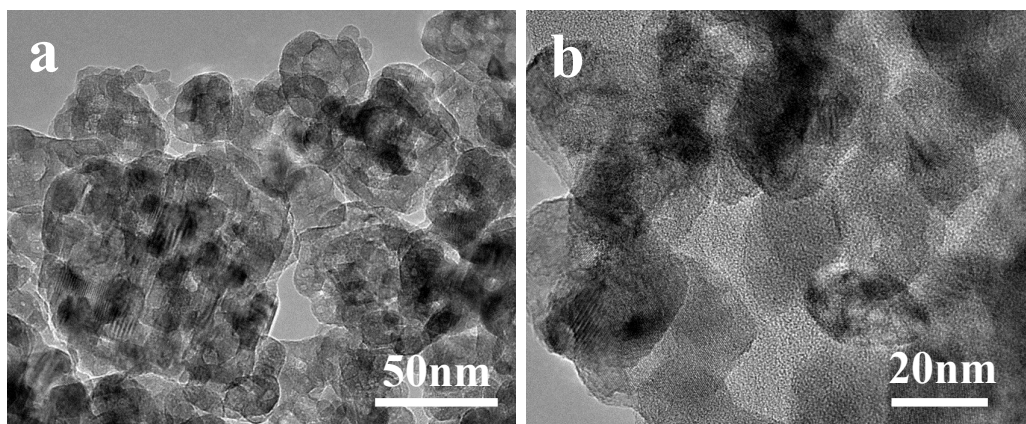


Figure S4. TEM images of $\text{TiO}_2(\text{A})$ impregnation in the AgNO_3 solution (pH=9) without irradiation.

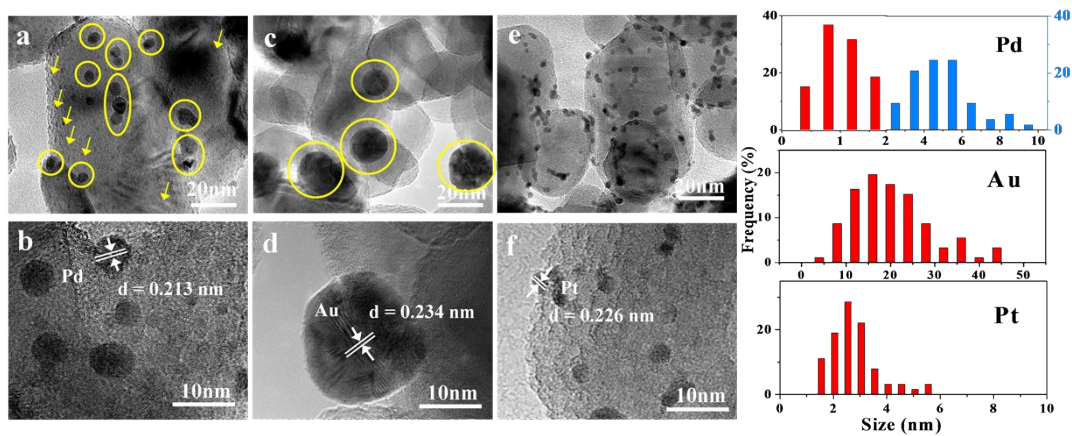


Figure S5. HRTEM images of (a-b) Pd/TiO₂(R)-6.0, (c-d) Au/TiO₂(R)-6.0, (e-f) Pt/TiO₂(R)-6.0 and corresponding particle size distribution. The yellow circles and the arrows indicate the type I and type II nanoparticles, respectively.

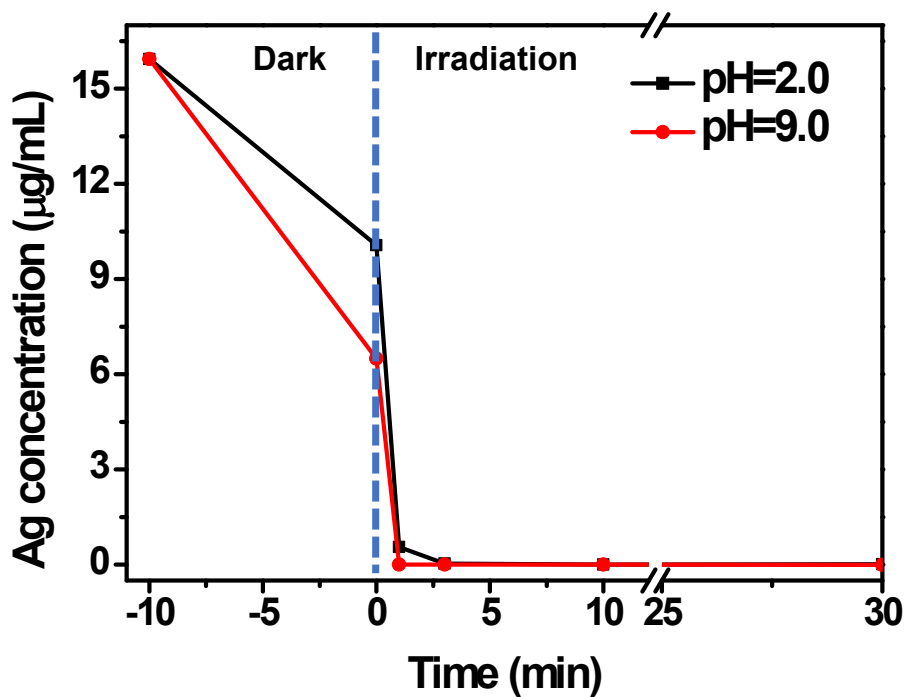


Figure S6. The evolution of Ag concentration in the solution during photodeposition on $\text{TiO}_2(\text{A})\text{-}2.0$ and $\text{TiO}_2(\text{A})\text{-}9.0$.

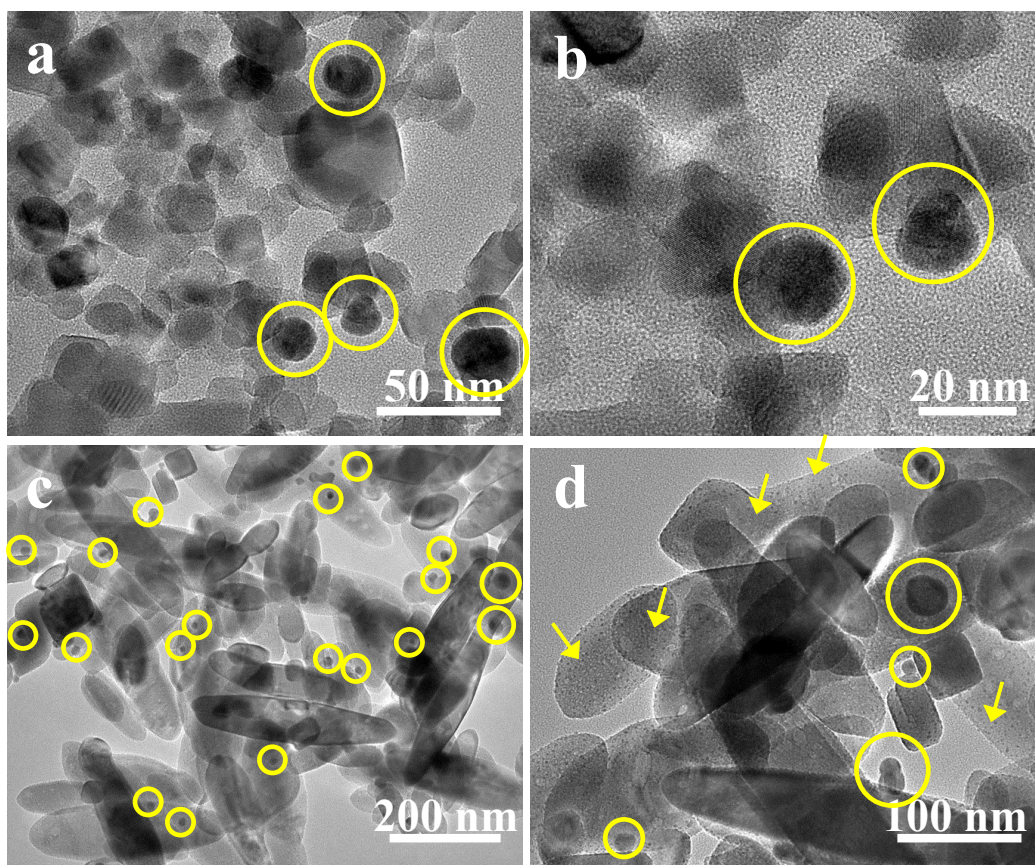


Figure S7. TEM and HRTEM images of (a, b) Ag/TiO₂(P25), (c, d) Ag/TiO₂(anatase rod). The yellow cycles and the arrows are indicating the type I and type II Ag nanoparticles, respectively.

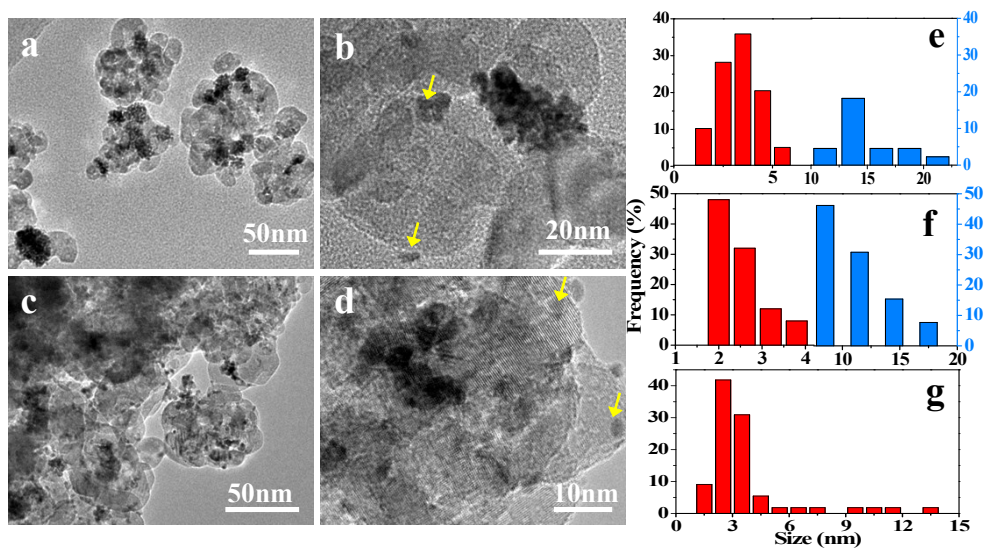


Figure S8. TEM images of Pt photodeposited on anatase TiO₂ at the pH of 2.0 (a, b) and 9.0 (c, d). (e-g) are the size distribution of Pt nanoparticles at the pH of 2.0, 4.5 and 9.0, respectively.

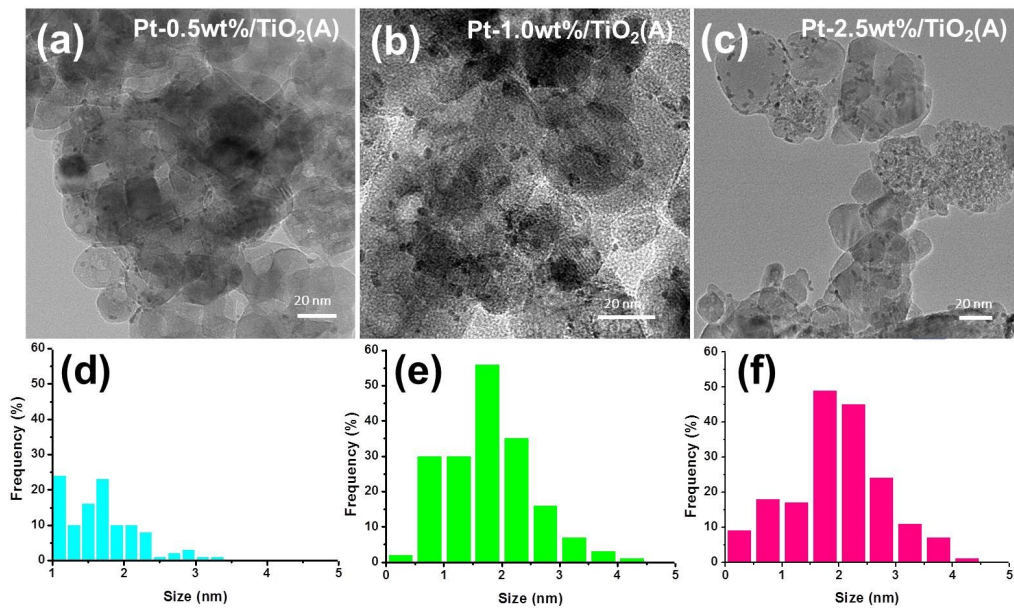


Figure S9. TEM image and size distribution of Pt on TiO₂ for different samples: (a) and (d) for 0.5 wt.% Pt/TiO₂(A)-6.0, (b) and (e) for 1.0 wt.% Pt/TiO₂(A)-6.0, (c) and (f) for 2.5 wt.% Pt/TiO₂(A)-6.0.

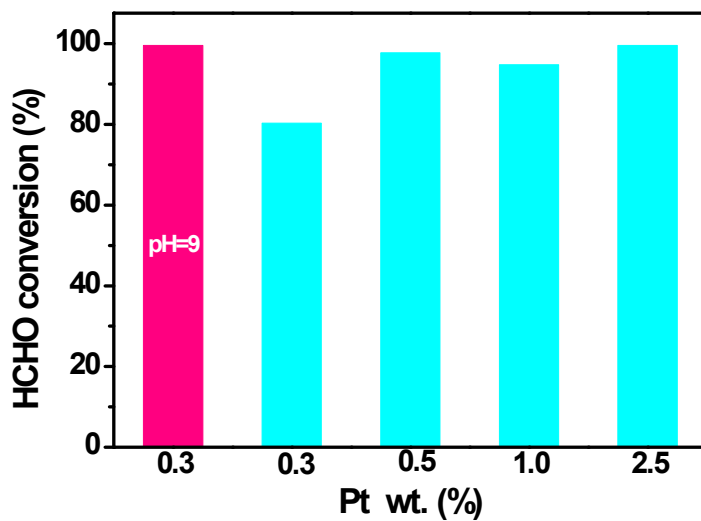


Figure S10. The influence of Pt loading amount for Pt/TiO₂(A) at pH 6.0 on HCHO conversion at room temperature.

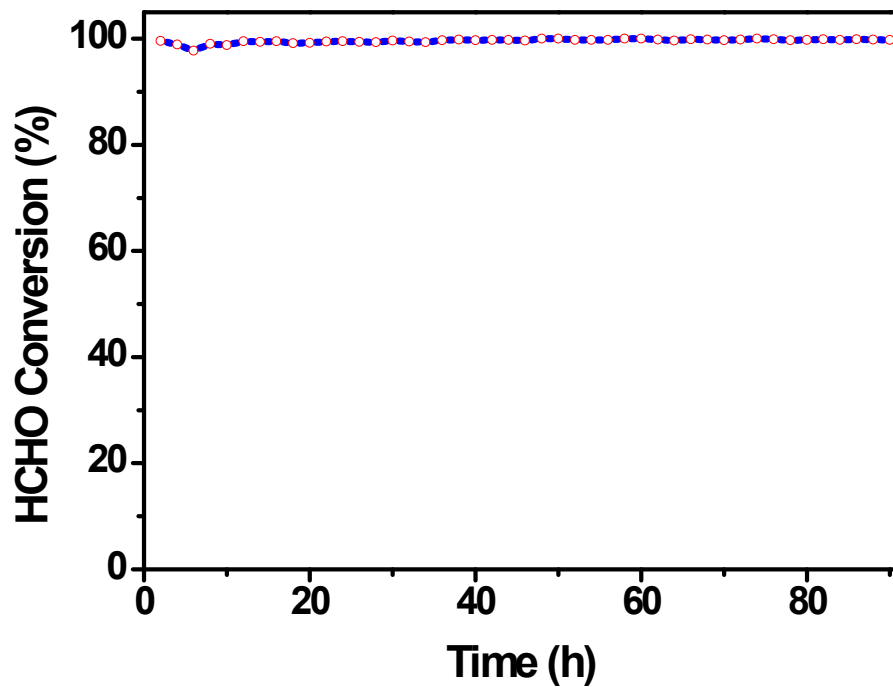


Figure S11 The longevity of 0.3wt.% Pt/TiO₂(A)-9 for 90 h at a total gas flow rate of 250 mL min⁻¹ and the concentration of HCHO is 300 ppm.