

Electronic Supplementary Information

Enhancing charge separation on high symmetry SrTiO₃ exposed with anisotropic facets for photocatalytic water splitting

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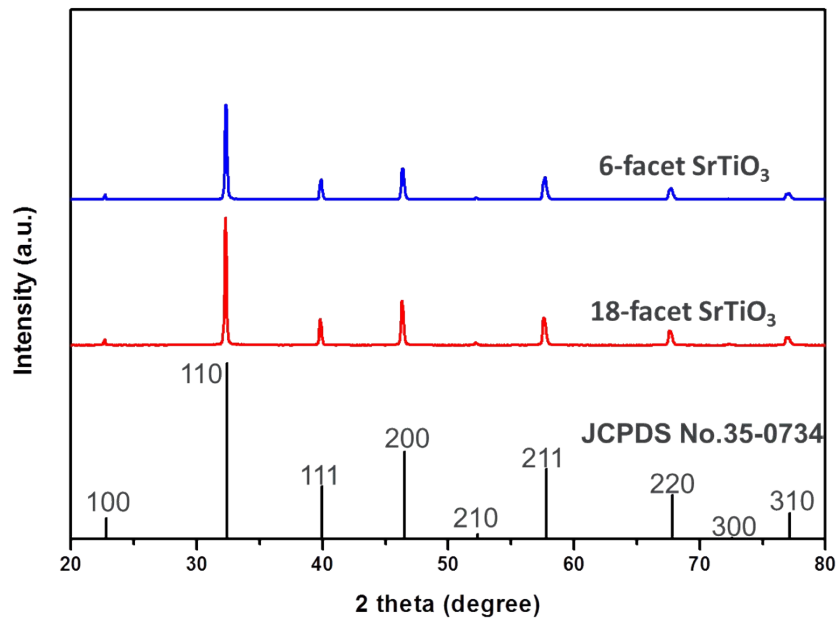


Figure S1 The XRD pattern of 6-facet and 18-facet SrTiO₃.

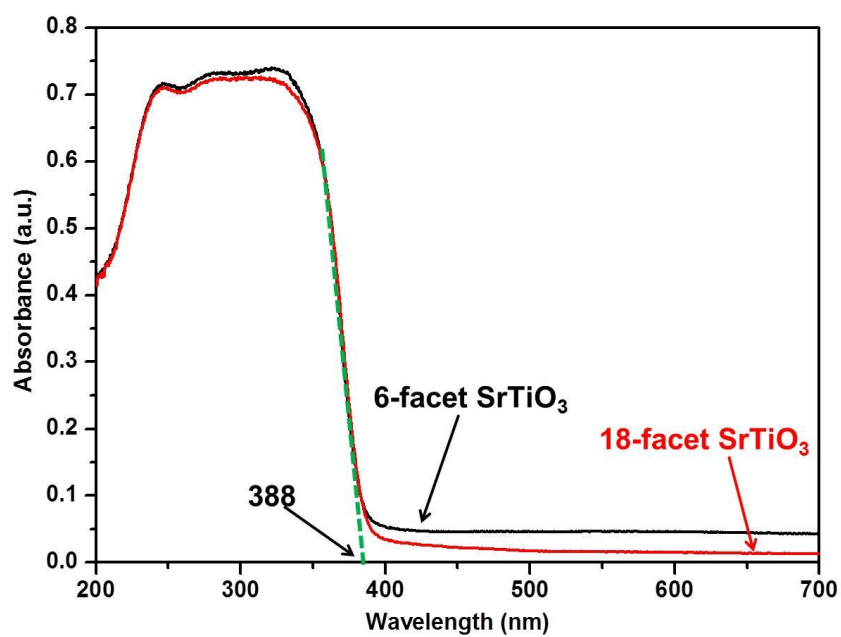


Figure S2 The UV-vis diffuse reflectance spectrum of 6-facet and 18-facet SrTiO₃.

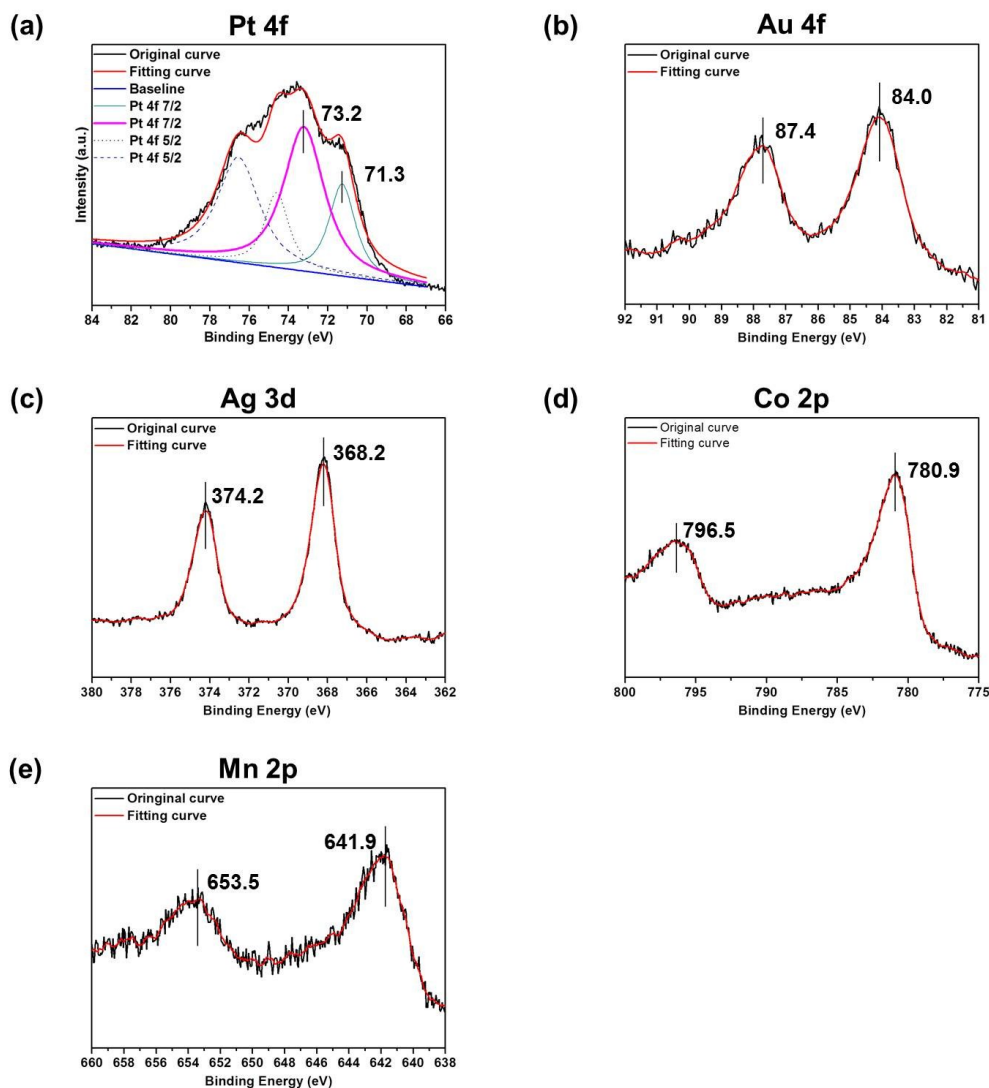


Figure S3 XPS of typical samples. **a**, Pt/SrTiO₃. **b**, Au/SrTiO₃. **c**, Ag/SrTiO₃. **d**, Co/SrTiO₃. **e**, Mn/SrTiO₃.

XPS of Pt 4f, Au 4f and Ag 3d revealed that the deposited elements were all in the metallic form (Pt, Au and Ag), although a small portion of incompletely reduced PtO species remained. According to the binding energy of Co 2p and Mn 2p in XPS, the species can be ascribed to Co₃O₄ and MnO_x, where x is between 1.5 and 2.0, since the observed binding energy of manganese oxides were between Mn₂O₃ and MnO₂.

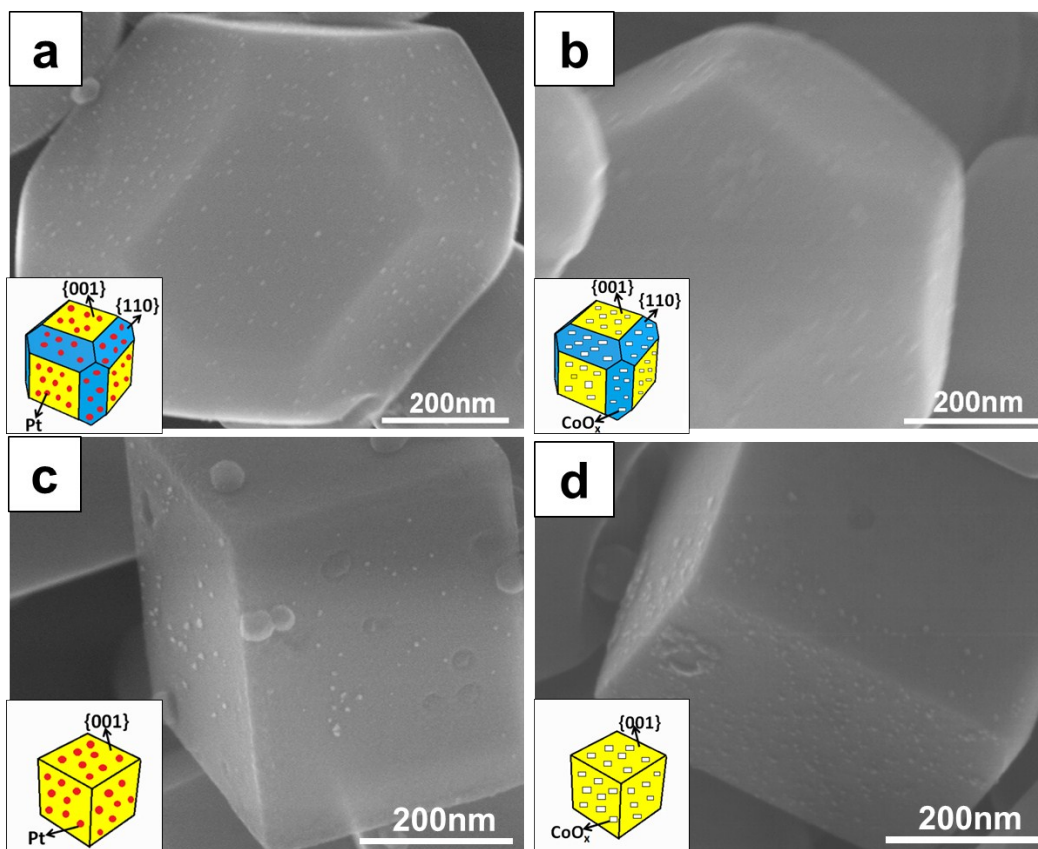


Figure S4 The SEM images of cocatalysts deposited on SrTiO₃ nanocrystals by impregnation method. **a**, Pt/18-facet SrTiO₃. **b**, Co₃O₄/18-facet SrTiO₃. **c**, Pt/6-facet SrTiO₃. **d**, Co₃O₄/6-facet SrTiO₃.

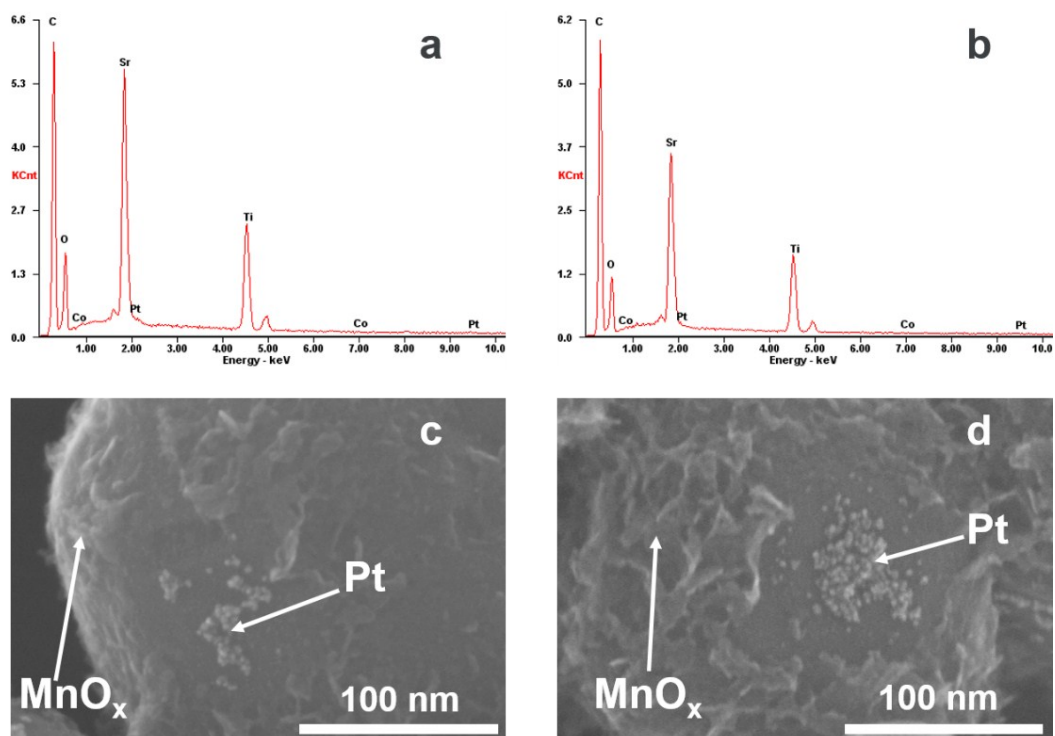


Figure S5 a, EDS of Pt-Co/6-facet SrTiO₃. b, EDS of Pt-Co/18-facet SrTiO₃. a-b match with Figure 3. c-d, HRSEM image of Pt-MnO_x/18-facet SrTiO₃.

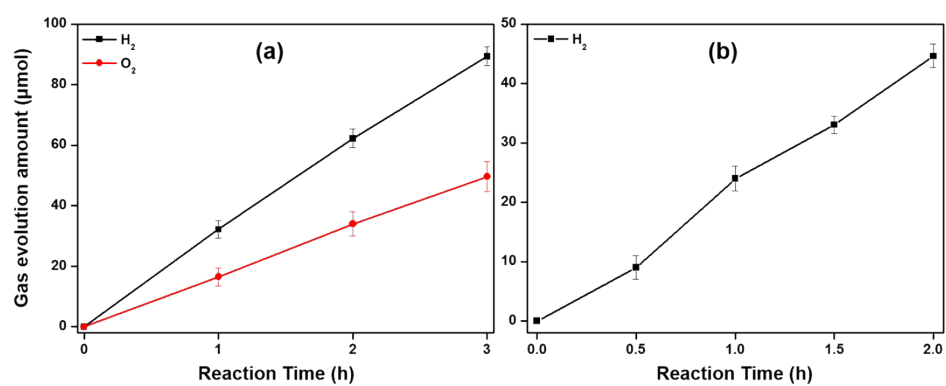


Figure S6 a, Overall water splitting performance of Pt-Co₃O₄/18-facet SrTiO₃. **b**, HER of Pt/18-facet SrTiO₃ with CH₃OH as sacrificial reagent.

Table S1 The active sites on the surface of photocatalysts for two kinds of SrTiO₃ nanocrystals.

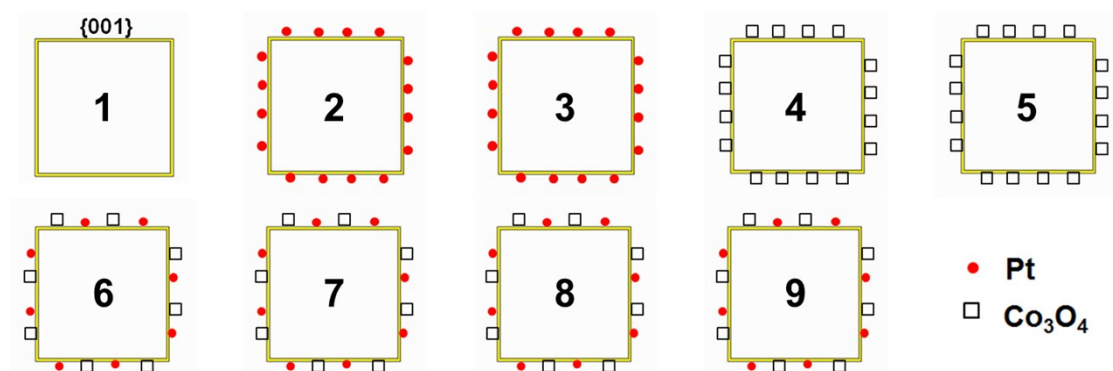
Photocatalyst	Active Metal Surface Area (m ² ·g ⁻¹)
Pt/6-facet SrTiO ₃	0.34
Pt/18-facet SrTiO ₃	0.29

Table S2 The apparent quantum efficiency for half reaction.

Half Reaction	Sacrificial Agent	Photocatalyst	AQE (365 nm)
Water Oxidation	AgNO ₃	6-facet SrTiO ₃	3.4%
	AgNO ₃	18-facet SrTiO ₃	12.2%
Proton Reduction	CH ₃ OH	Pt/6-facet SrTiO ₃	1.1%
	CH ₃ OH	Pt/18-facet SrTiO ₃	0.8%

Reaction time: 0.5 h. AgNO₃ was used as sacrificial reagent for oxidation half reaction (0.002 M), CH₃OH was used as sacrificial reagent for reduction half reaction (20% CH₃OH-H₂O solution). The content of the deposited Pt is 0.1 wt%.

Table S3 Photocatalytic overall water splitting performance of 6-facet SrTiO₃ nanocrystals with cocatalysts deposited.



Entry	Pt Cocatalyst	Co ₃ O ₄ Cocatalyst	H ₂ Evolution (μmol·h ⁻¹ ·m ⁻²)	O ₂ Evolution (μmol·h ⁻¹ ·m ⁻²)	H ₂ /O ₂
1	-	-	0	0	-
2	Imp ^a	-	800	406	2.0
3	P.D. ^b	-	787	381	2.1
4	-	Imp	0	0	-
5	-	P.D.	0	0	-
6	Imp	P.D.	838	419	2.0
7	P.D.	Imp	799	406	2.0
8	Imp	Imp	888	407	2.2
9	P.D.	P.D.	660	356	1.9

^a Impregnation method. ^b Photo-deposition method. Reaction time: 1 h. The contents of the deposited Pt and Co₃O₄ are optimized to be 0.1 wt% and 0.01 wt%, respectively.

The activities are normalized by the number of Pt active sites.

Table S4 Raw data of photocatalytic overall water splitting on SrTiO₃ nanocrystals.

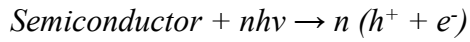
Entry	Photocatalyst	H ₂ Evolution ($\mu\text{mol}\cdot\text{h}^{-1}$)	O ₂ Evolution ($\mu\text{mol}\cdot\text{h}^{-1}$)
1	6-facet SrTiO ₃	0	0
2	Pt/6-facet SrTiO ₃	6.2	3.0
3	Co ₃ O ₄ /6-facet SrTiO ₃	0	0
4	Pt-Co ₃ O ₄ /6-facet SrTiO ₃	5.2	2.8
5	18-facet SrTiO ₃	0	0
6	Pt/18-facet SrTiO ₃	16.4	9.0
7	Co ₃ O ₄ /18-facet SrTiO ₃	0	0
8	Pt-Co ₃ O ₄ /18-facet SrTiO ₃	32.2	16.5

Table S5 Raw data of photocatalytic performance of 18-facet SrTiO₃ with cocatalysts deposited.

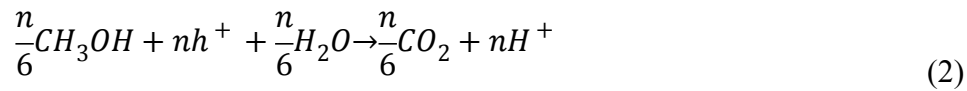
Entry	Pt Cocatalyst	Co ₃ O ₄ Cocatalyst	H ₂ Evolution (μmol·h ⁻¹)	O ₂ Evolution (μmol·h ⁻¹)
1	-	-	0	0
2	Imp	-	8.7	3.9
3	P.D.	-	16.4	9.0
4	-	Imp	0	0
5	-	P.D.	0	0
6	Imp	P.D.	5.9	3.2
7	P.D.	Imp	9.5	4.5
8	Imp	Imp	4.2	2.2
9	P.D.	P.D.	32.2	16.5

Scheme S1 In-situ photodeposition.

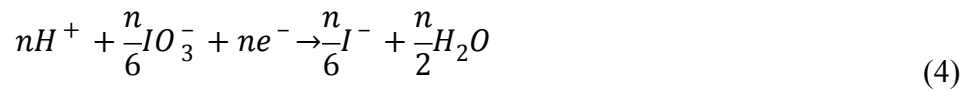
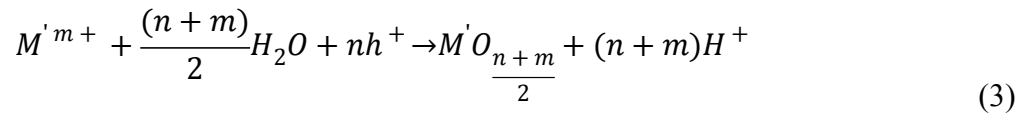
The photo-reduction and photo-oxidation reactions can be described as follows:



For photo-reduction deposition,



For photo-oxidation deposition,



Where,

M is the noble metal for reduction, such as Pt, Au, Ag...

M' is the metal for oxidation, such as Mn, Co, Pb...

CH_3OH and IO_3^- are used as sacrificial reagents.

For a simultaneous photo-reduction and photo-oxidation deposition, the whole reaction can be divided into two half reactions, (1) and (3), sacrificial reagents are not used.