

**Synergistic enhancement of photocatalytic hydrogen production in TiO<sub>2</sub> nanosheets  
through light-induced defect formation and Pt single atoms**

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Table S1. Summary of experimental conditions for each TiO<sub>2</sub>-NSs sample

Conditions	Abbreviation	Total time under UV illumination (min.)	Resting time before precursor addition (min.)
Light-induced samples	LI0	10	0
	LI5	10	5
	LI10	10	10
	LI20	10	20
	LI60	10	60
Photo-deposited samples	PD5	15	0
	PD10	20	0

Table S2. AQY values for various TiO<sub>2</sub>-NSs under UV illumination.

Sample	AQY (%)
Ref	0.01
LI0	0.69
LI5	2.36
LI10	1.92
LI20	1.41
LI60	1.56
PD5	0.63
PD10	0.32

Table S3. Comparison of the maximum photocatalytic performance of various TiO<sub>2</sub>-based nanomaterials with Pt as the cocatalyst.

Photocatalyst	Photoactivity, H <sub>2</sub> generation rate	Maximum AQY (%) / Wavelength (nm)	Incident light	Ref.
TiO <sub>2</sub> NSs	1170.35 μmol g <sup>-1</sup> h <sup>-1</sup>	2.4 / 365	680 mW cm <sup>-2</sup> UVLED	Current work
TiO <sub>2</sub> NSs	385 μmol g <sup>-1</sup> h <sup>-1</sup>	--- / 365	---	17
TiO <sub>2</sub> NSs-BNS	575.6 μmol g <sup>-1</sup> h <sup>-1</sup>	2.9 / 365	450 W Xe arc lamp	38
TiO <sub>2</sub> NSs-Pt	3.75 mL h <sup>-1</sup> g <sup>-1</sup>	--- / 365	---	45
TiO <sub>2</sub> nanoflakes	900 μL	--- / 365	150 W Xe arc lamp	54
TiO <sub>2</sub> film	4900 μL	--- / 365	---	55
TiO <sub>2</sub> nanobelts	38.33 mmol mg <sub>Pt</sub> <sup>-1</sup> h <sup>-1</sup>	--- / 320	300 W Xe lamp	56
Black TiO <sub>2</sub>	3.30 mmol g <sup>-1</sup>	33 / 375	Fluorescent	57
TiO <sub>2</sub> nanofiber	1400 μmol g <sup>-1</sup> h <sup>-1</sup>	--- / 365	300 W Xe lamp	58

---: The corresponding value has not been reported.

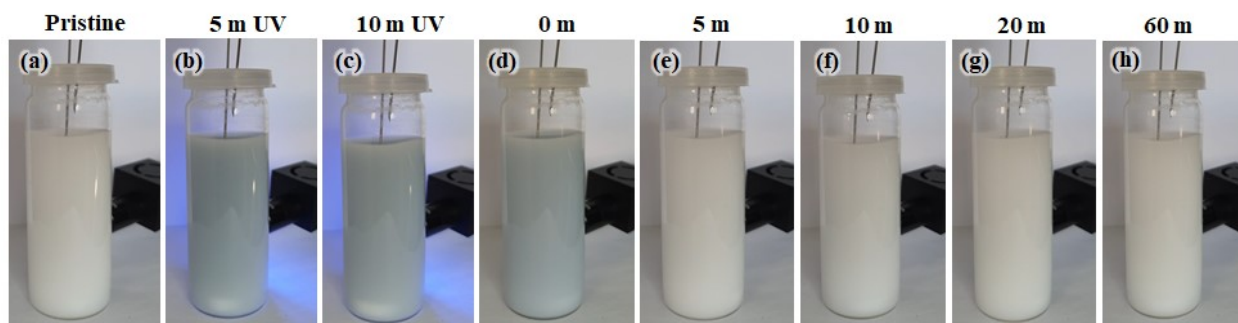


Fig. S1. Various states of  $\text{TiO}_2\text{-NSSs}$ : (a) before light-induced and without Ar purging, and after (b) 5, and (c) 10 minutes only under UV exposure, and after (d) 0, (e) 5, (f) 10, (g) 20, and (h) 60 minutes rest after cutting off the UV-light.

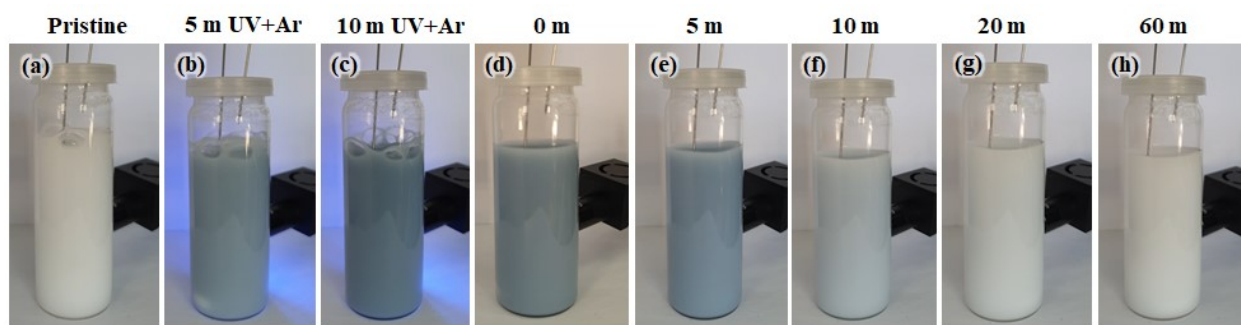


Fig. S2. Various states of  $\text{TiO}_2\text{-NSSs}$ : (a) before light-induced and with Ar purging, and after (b) 5, and (c) 10 minutes under UV exposure and Ar purging, and after (d) 0, (e) 5, (f) 10, (g) 20, and (h) 60 minutes rest after cutting off the UV-light and Ar purging.

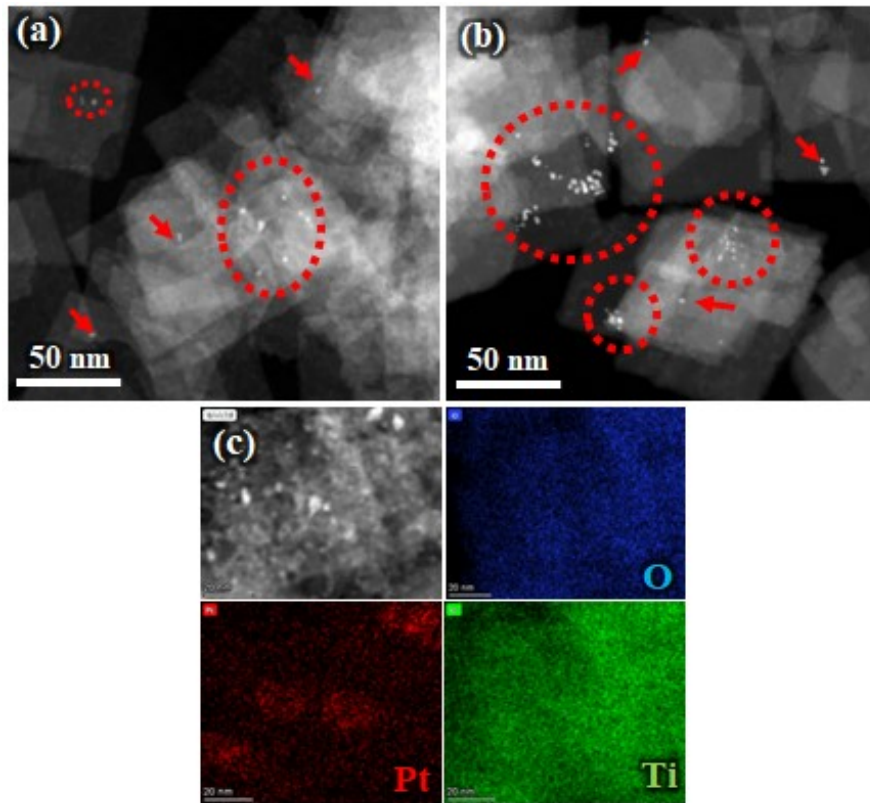


Fig. S3. STEM images from (a) PD5 and (b) PD10 samples. (c) Corresponding elemental mapping of Ti, O, and Pt taken from PD10 sample.

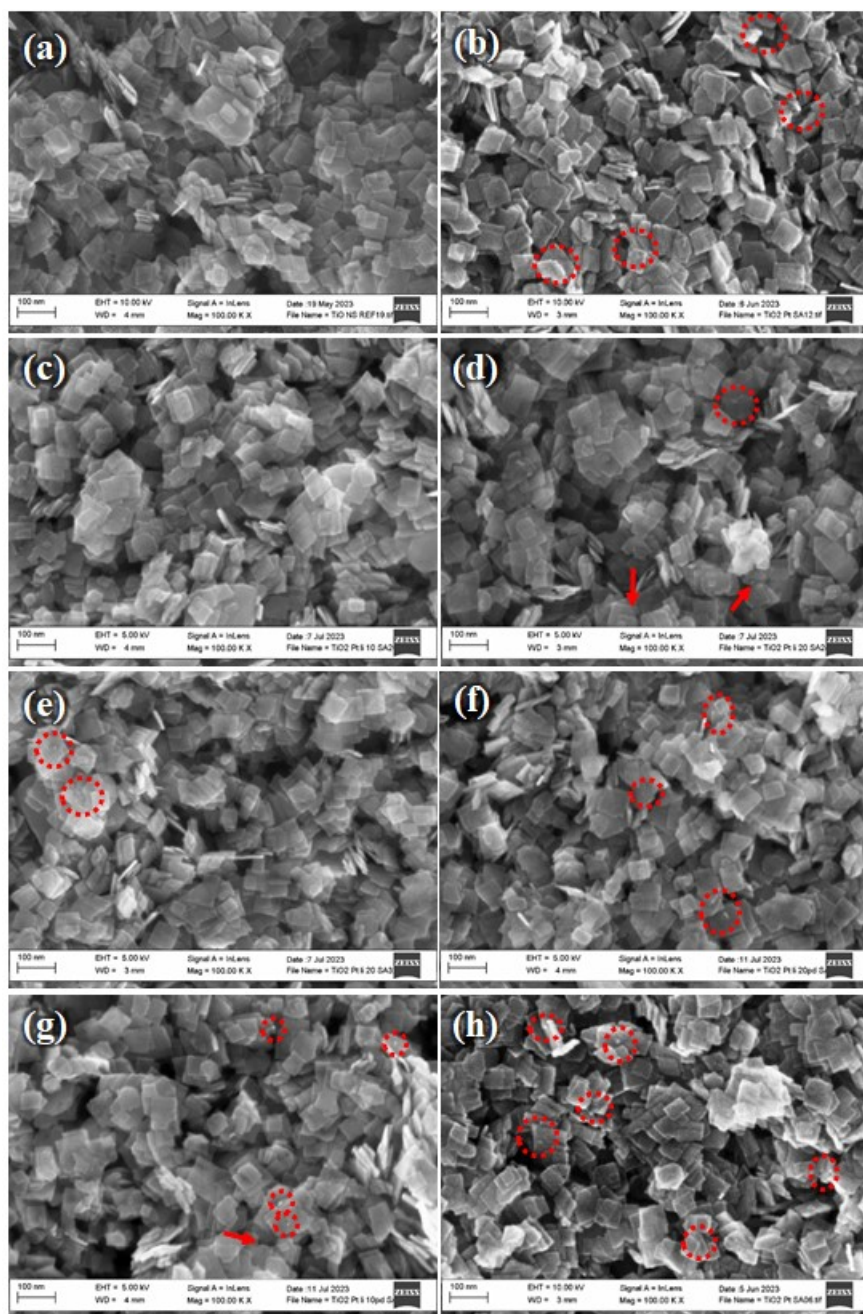


Fig. S4. FESEM images of various samples: (a) pristine  $\text{TiO}_2$ -NSs, (b) LI0, (c) LI5, (d) LI10, (e) LI20, (f) LI60, (g) PD5, and (h) PD10.

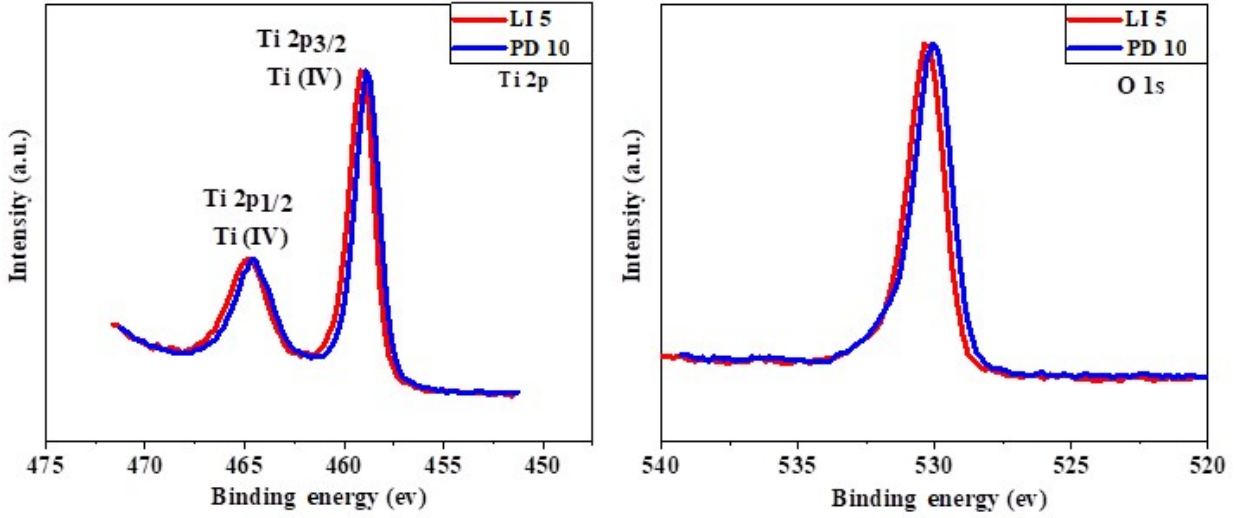


Fig. S5. High-resolution XPS spectra of Ti 2p and O 1s from e LI5 and PD20 samples.

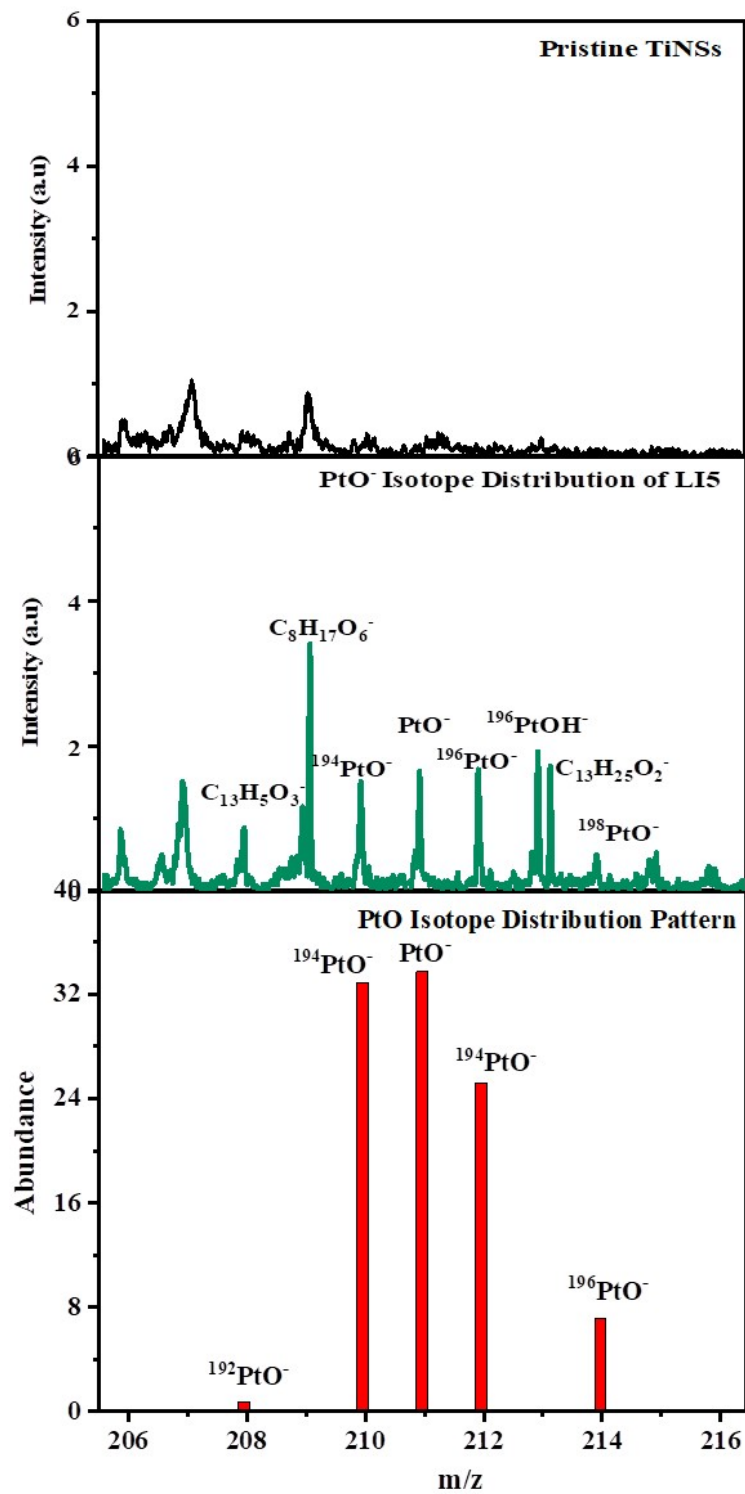


Fig. S6. Negative ToF-SIMS spectra of pristine and LI5 samples, along with the corresponding PtO isotope distribution pattern.



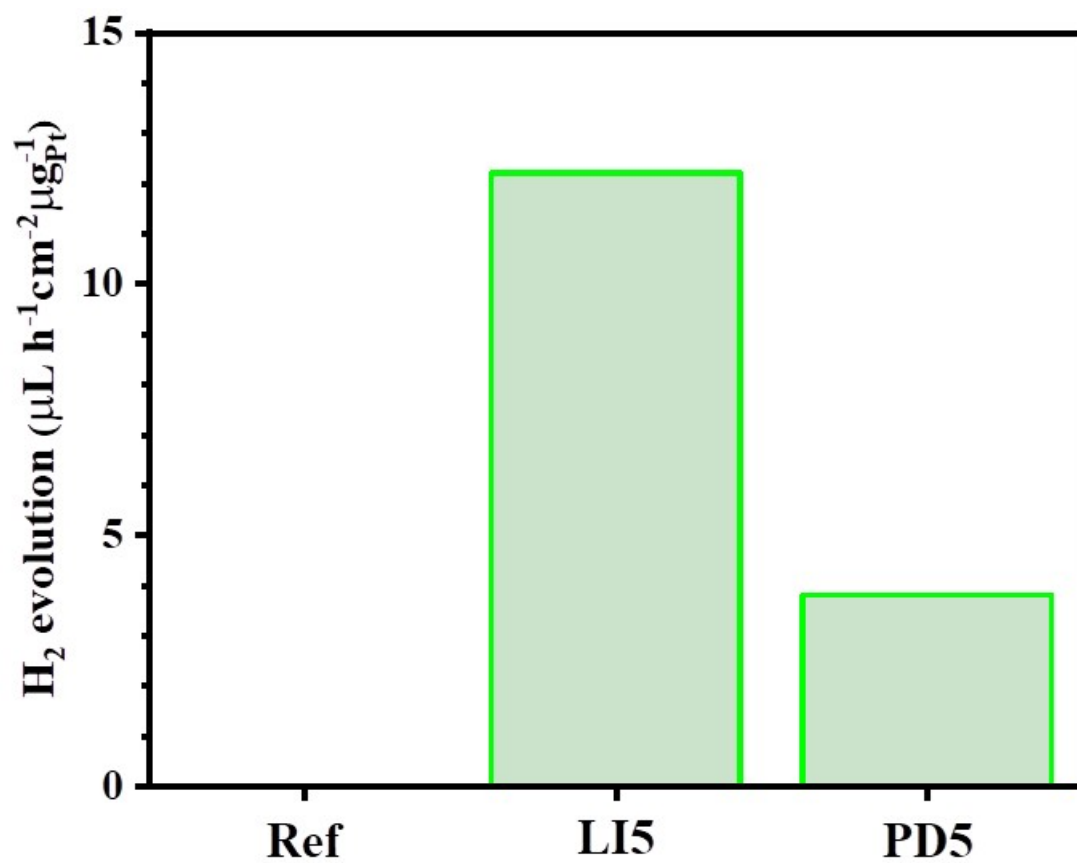


Fig. S7. Normalized hydrogen evolution rate of Ref, LI5, and PD5 samples with respect to Pt loading.