Supporting Information

Aerosol Synthesis of Shape-Controlled Template Particles: a Route to Ta_3N_5 Nanoplates and Octahedra as Photocatalysts

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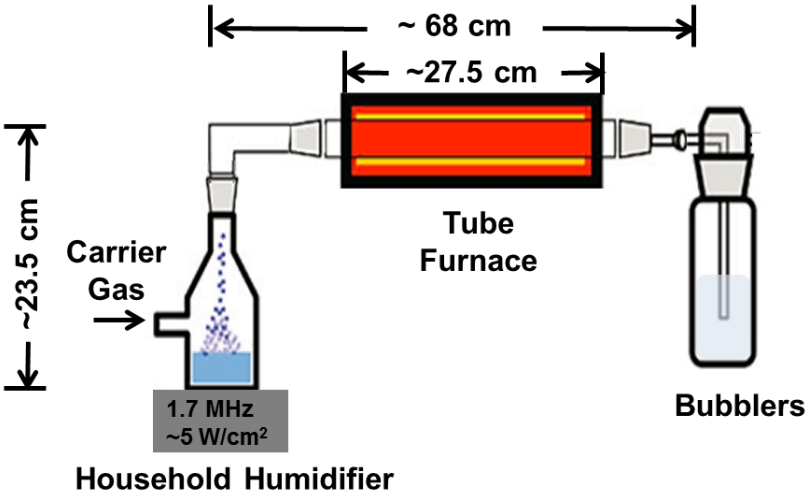

Figure S1. Schematic of experimental setup for aerosol-assisted molten salt synthesis.

The nebulization source consists of a Vicks V5100N Ultrasonic Humidifier base (1.7 MHz, ~5 W/cm2) filled with water as the media. The nebulization chamber has a gas inlet and an opening (diameter ~52 mm) with an O-ring groove (Chemglass: CG-138-02) at the bottom. A Saran wrap membrane is clamped between a Teflon base with a greased O-ring and the nebulization chamber. The nebulization chamber is then centered above the ultrasonic transducer at a distance of ~2 cm and filled with ~15 mL of precursor solution (room temperature). A stainless steel tube (inside diameter ~2.5 cm, length ~52 cm) is used with the single zone furnace (total heating region of ~27.5 cm, 1100 °C maximum).

Note: while a Vicks V5100N Ultrasonic Humidifier base was used in the study, the system is adaptable to other household humidifiers and small changes in dimensions without changing the properties of the product.

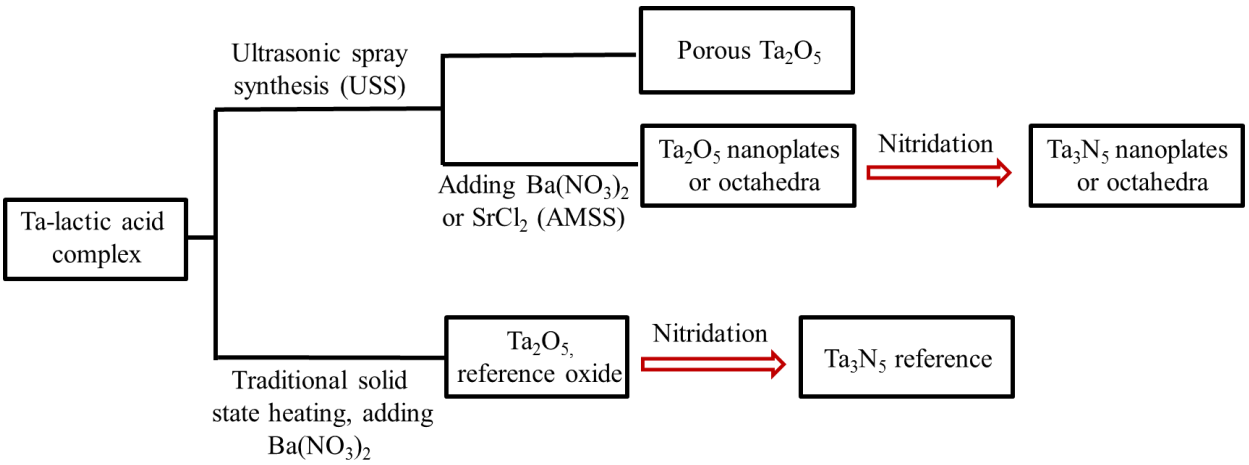

Figure S2. A block diagram of the synthetic routes for the main products.

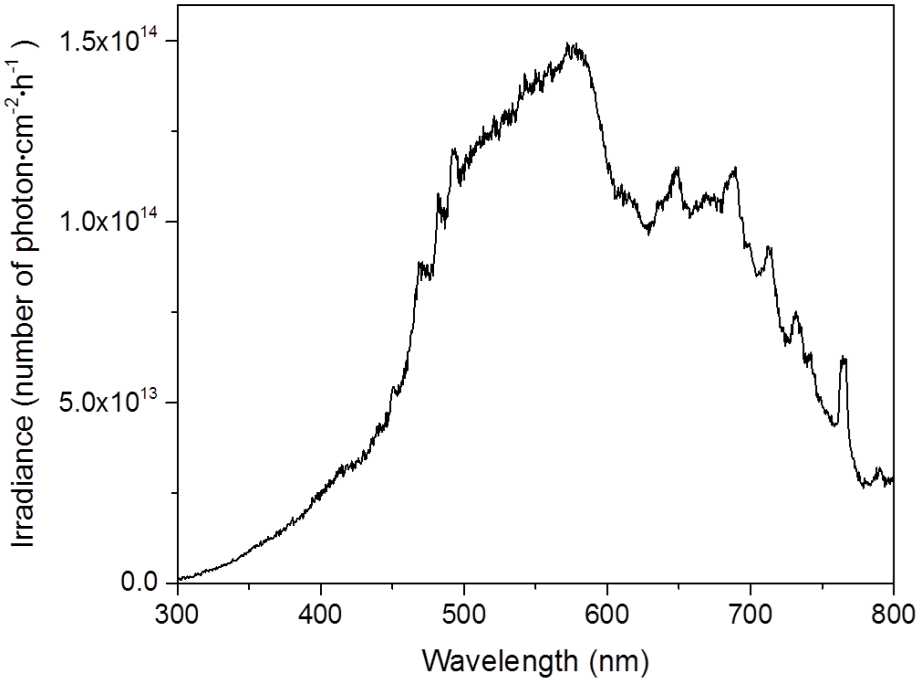

Figure S3. Flux irradiance of the xenon light source used for photocatalysis.

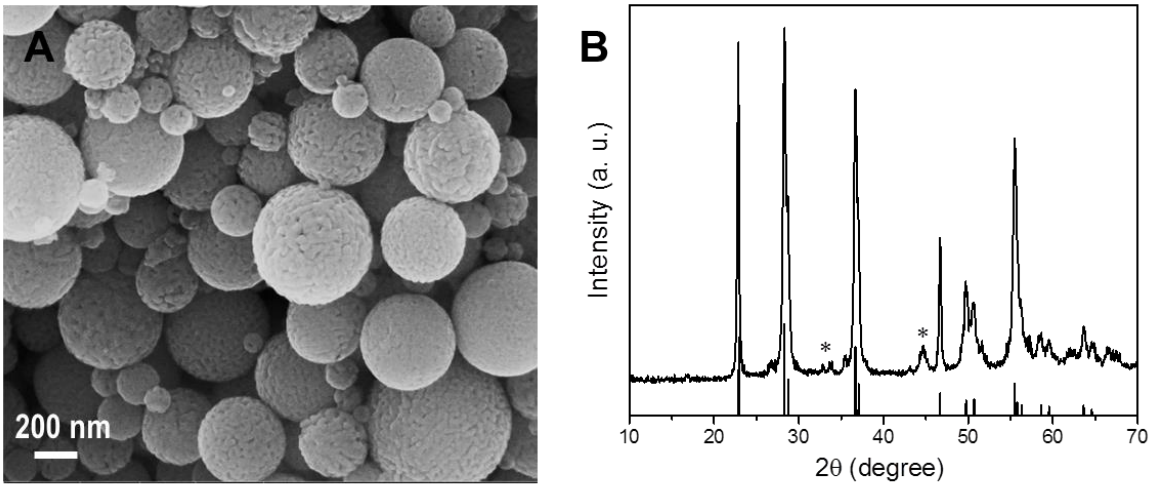

Figure S4. (A) SEM image and (B) XRD of Ta_2O_5 microspheres prepared by USS. Reference Ta_2O_5 ICDD # 01-089-2843, with an impurity denoted with asterisks in the XRD pattern.

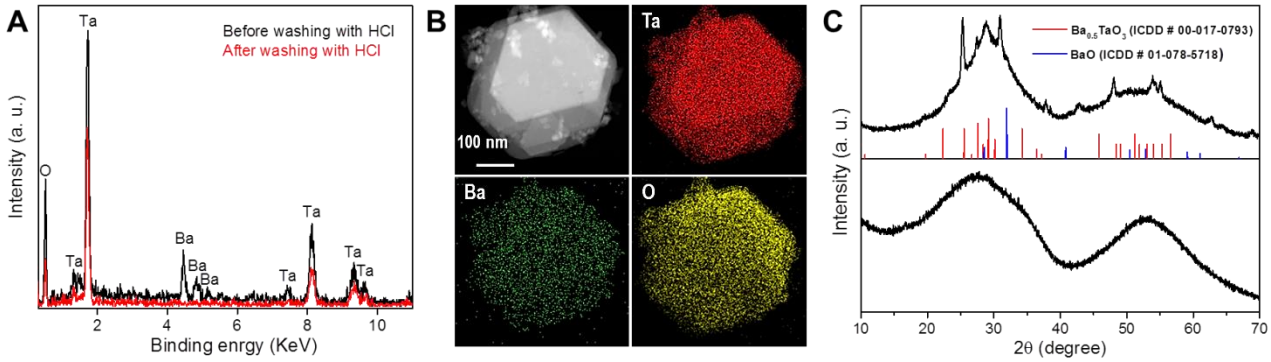

Figure S5. (A) EDX analysis of Ta_2O_5 nanoplates before and after washing with HCl, (B) STEM image (upper left panel) and elemental mapping by STEM-EDX of an individual nanoplate before washing with HCl (red corresponds to Ta, green corresponds to Ba, and yellow corresponds to O), (C) XRD patterns of Ta_2O_5 nanoplates before (top panel) and after (bottom panel) HCl washing.

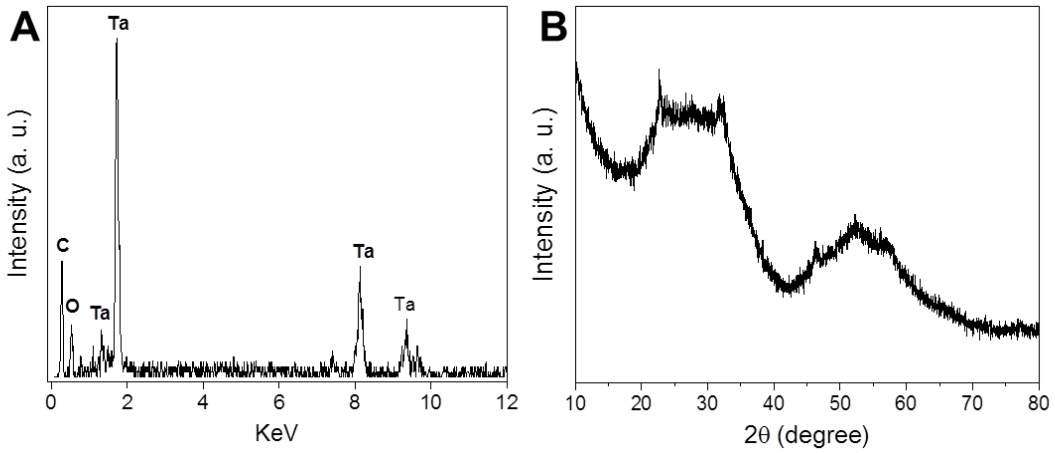

Figure S6. (A) EDX analysis and (B) XRD pattern of Ta_2O_5 octahedra.

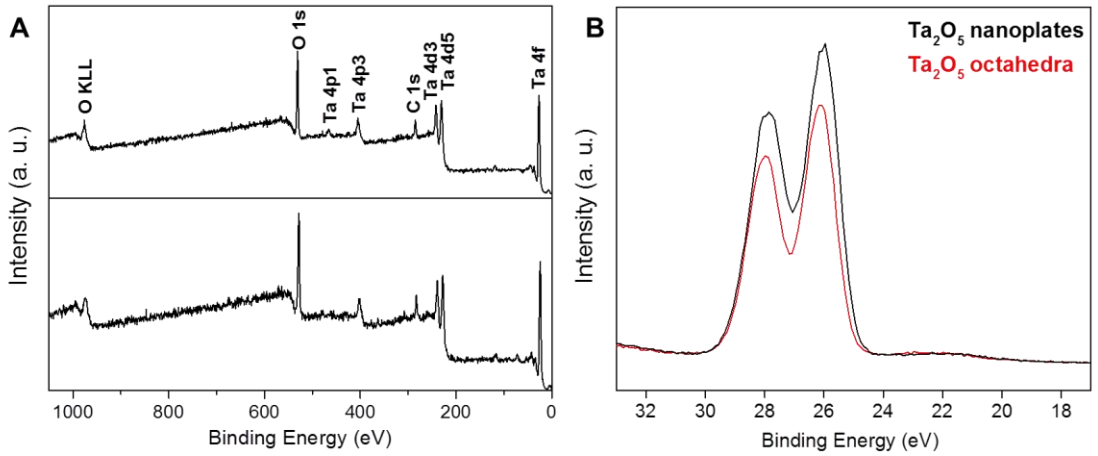

Figure S7. (A) The survey XPS spectra of Ta_2O_5 nanoplates (top panel) and octahedra (bottom panel). (B) High resolution XPS spectra of Ta 4f region for Ta_2O_5 nanoplates and octahedra.

	C	H	N
Ta_2O_5 nanoplates	0.40	1.04	0
Ta_2O_5 octahedra	0.35	0.73	0
Ta_3N_5 nanoplates	0.02	0	10.92
Ta_3N_5 octahedra	0.03	0	10.76
Ta_3N_5 reference	0.03	0	10.96

Table S1. A table of CHN analysis by atomic weight percent.

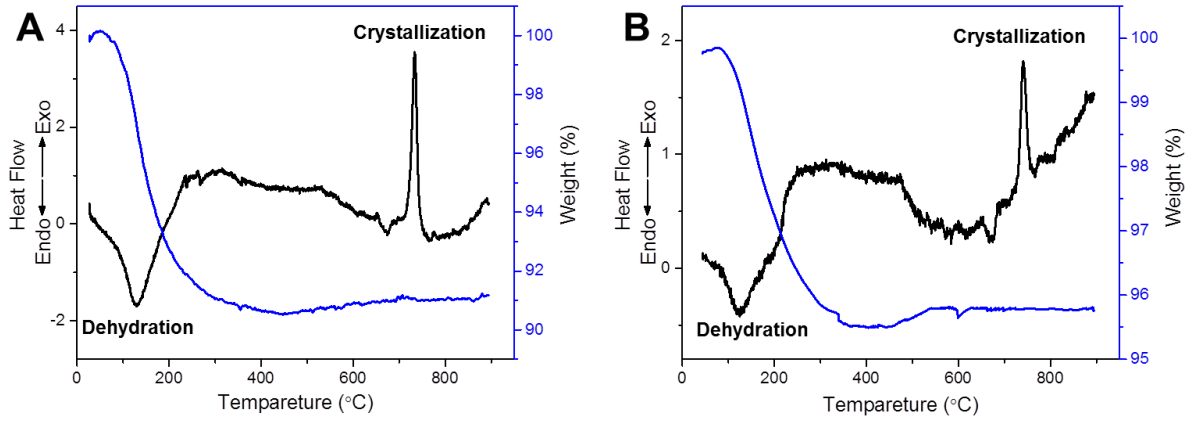

Figure S8. Simultaneous DSC-TGA of (A) Ta_2O_5 nanoplates and (B) Ta_2O_5 octahedra.

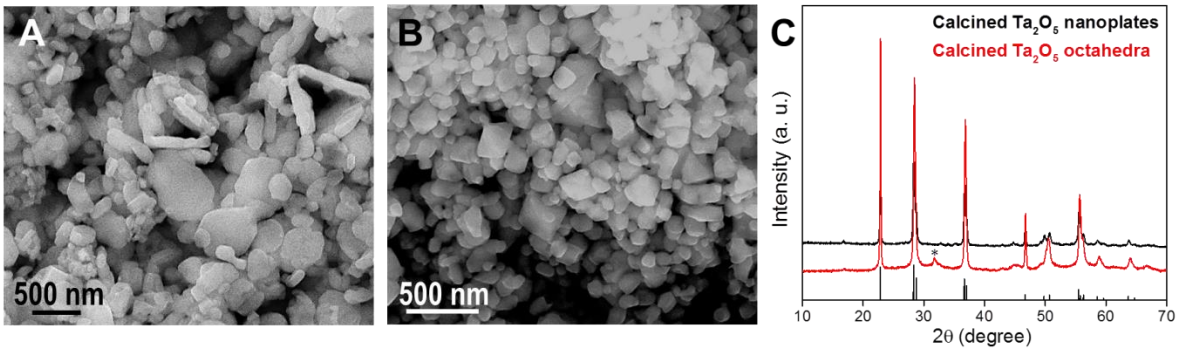

Figure S9. SEM images of calcined (A) Ta_2O_5 nanoplates and (B) Ta_2O_5 octahedra. (C) The corresponding XRD patterns, with reference Ta_2O_5 ICDD # 01-089-2843 included. An impurity is denoted with an asterisk.

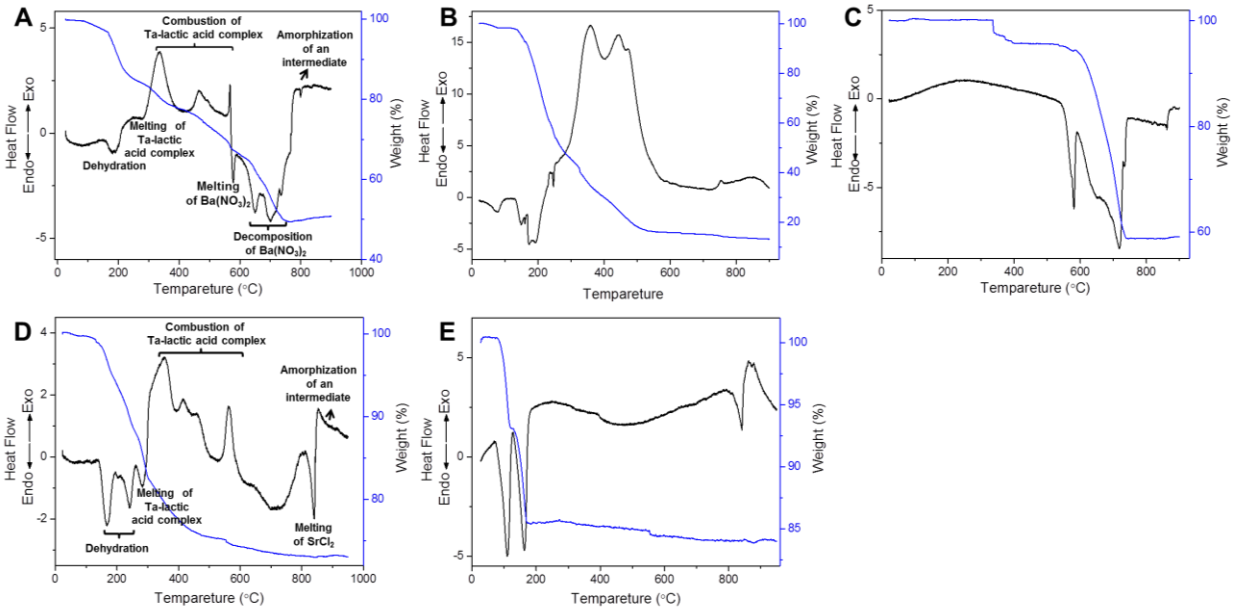

Figure S10. TGA (blue curves) and DSC (black curves) of (A) the dried precursor to Ta_2O_5 nanoplates, (B) the Ta-lactic acid complex, (C) $Ba(NO_3)_2$, (D) the dried precursor to Ta_2O_5 octahedra, and (E) $SrCl_2$.

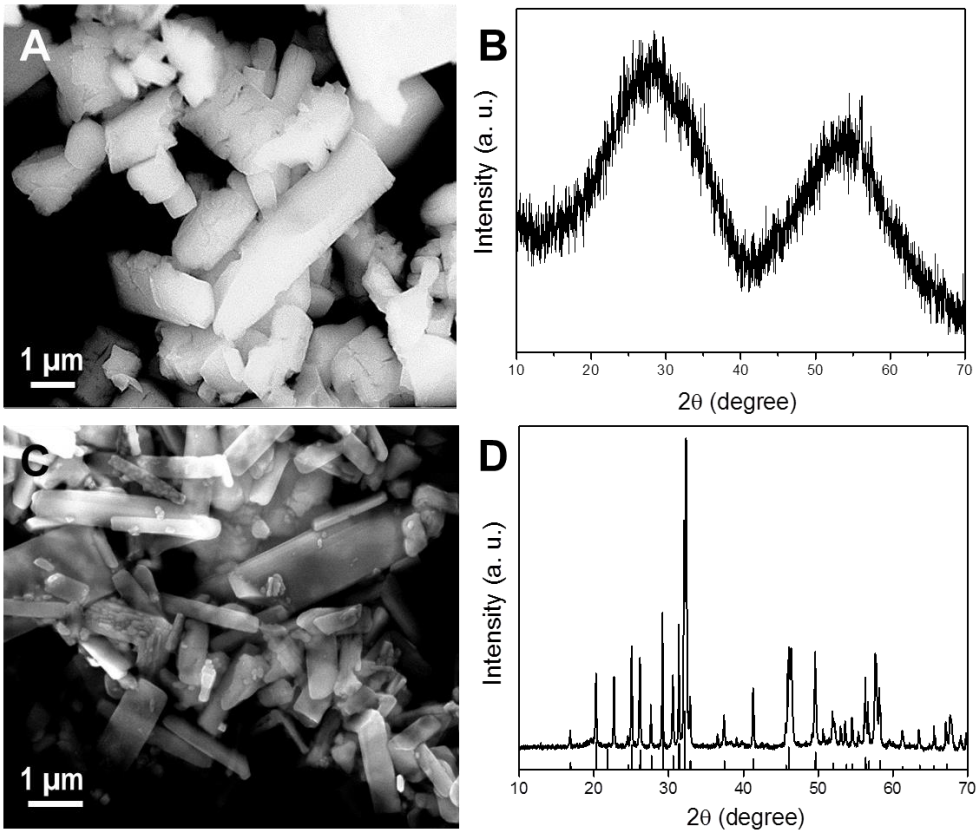

Figure S11. (A, C) SEM images and (B, D) XRD patterns of products obtained from heating the dried precursors to (A, B) Ta_2O_5 nanoplates and (C, D) Ta_2O_5 octahedra. The $Sr_2Ta_2O_7$ ICDD # 00-030-1304 reference is included in D.

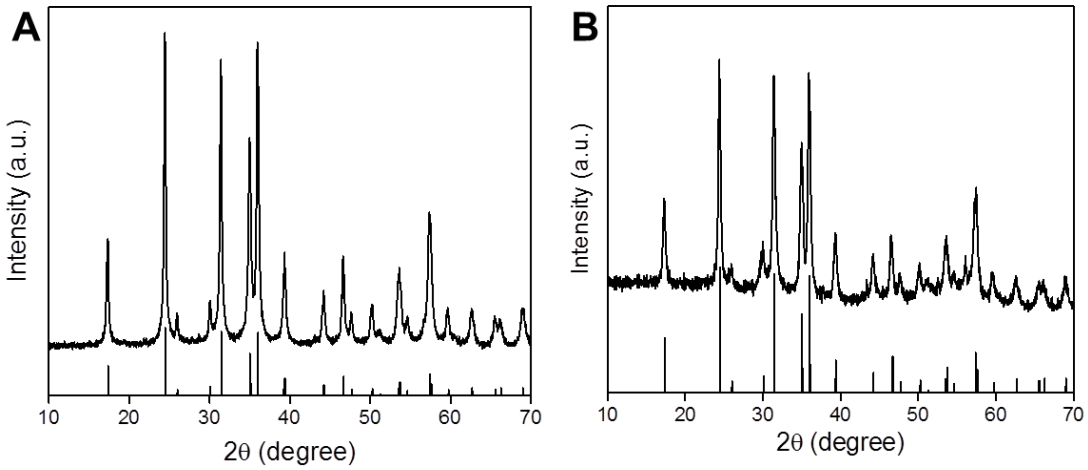

Figure S12. XRD patterns of (A) Ta_3N_5 nanoplates and (B) Ta_3N_5 octahedra. Ta_3N_5 ICDD # 01-079-1533 reference included in both.

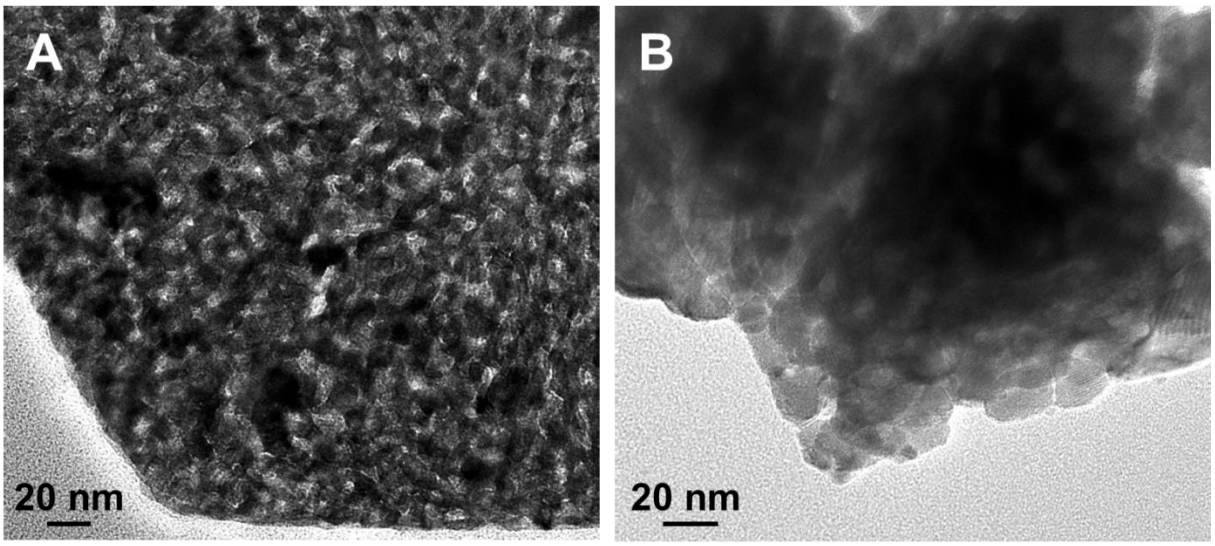

Figure S13. Higher magnification TEM images of a (A) Ta_3N_5 nanoplate and (B) Ta_3N_5 octahedron.

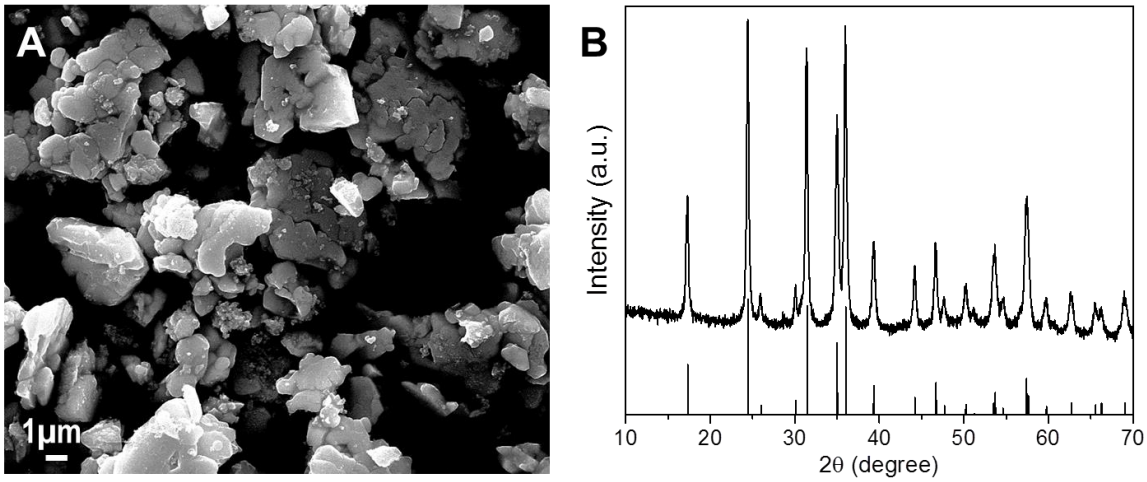

Figure S14. (A) SEM image of Ta_3N_5 reference from ammonolysis of Ta_2O_5 reference and (B) corresponding XRD pattern. Ta_3N_5 ICDD # 01-079-1533 reference is included in B.

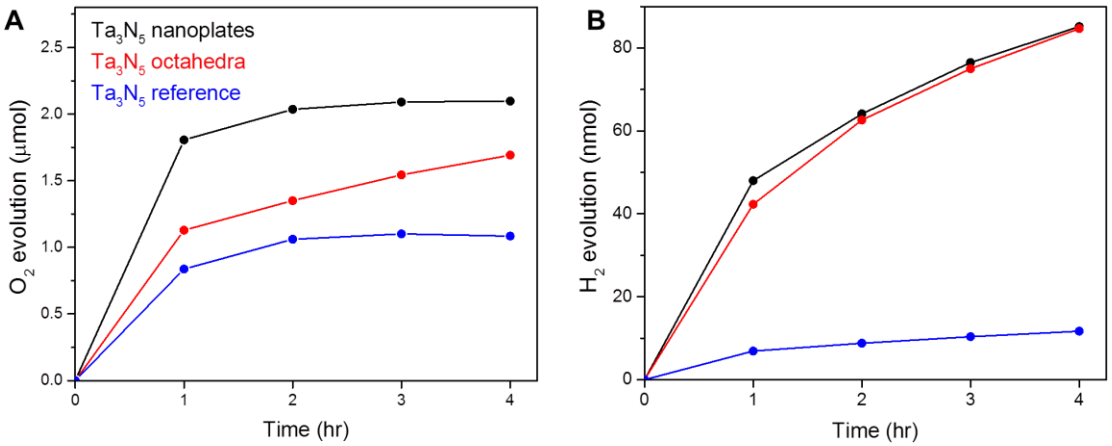

Figure S15. (A) OER and (B) HER time study with AMSS-derived nanoplates, octahedra, and reference Ta_3N_5 without co-catalyst deposition (photocatalysis conditions: light source: 300 W xenon lamp with a 400 nm long-pass filter. For OER, 20 mg Ta_3N_5 and La_2O_3 as pH buffer were dispersed in 0.05 M $AgNO_3$ solution. For HER, 20 mg Ta_3N_5 was dispersed in an aqueous solution containing 10 vol% methanol). The colour notations are the same for both graphs.