Electronic Supplementary Material (ESI) for Dalton Transactions.

Supporting Information

Photothermal catalytic properties of layered titanium chalcogenide nanomaterials

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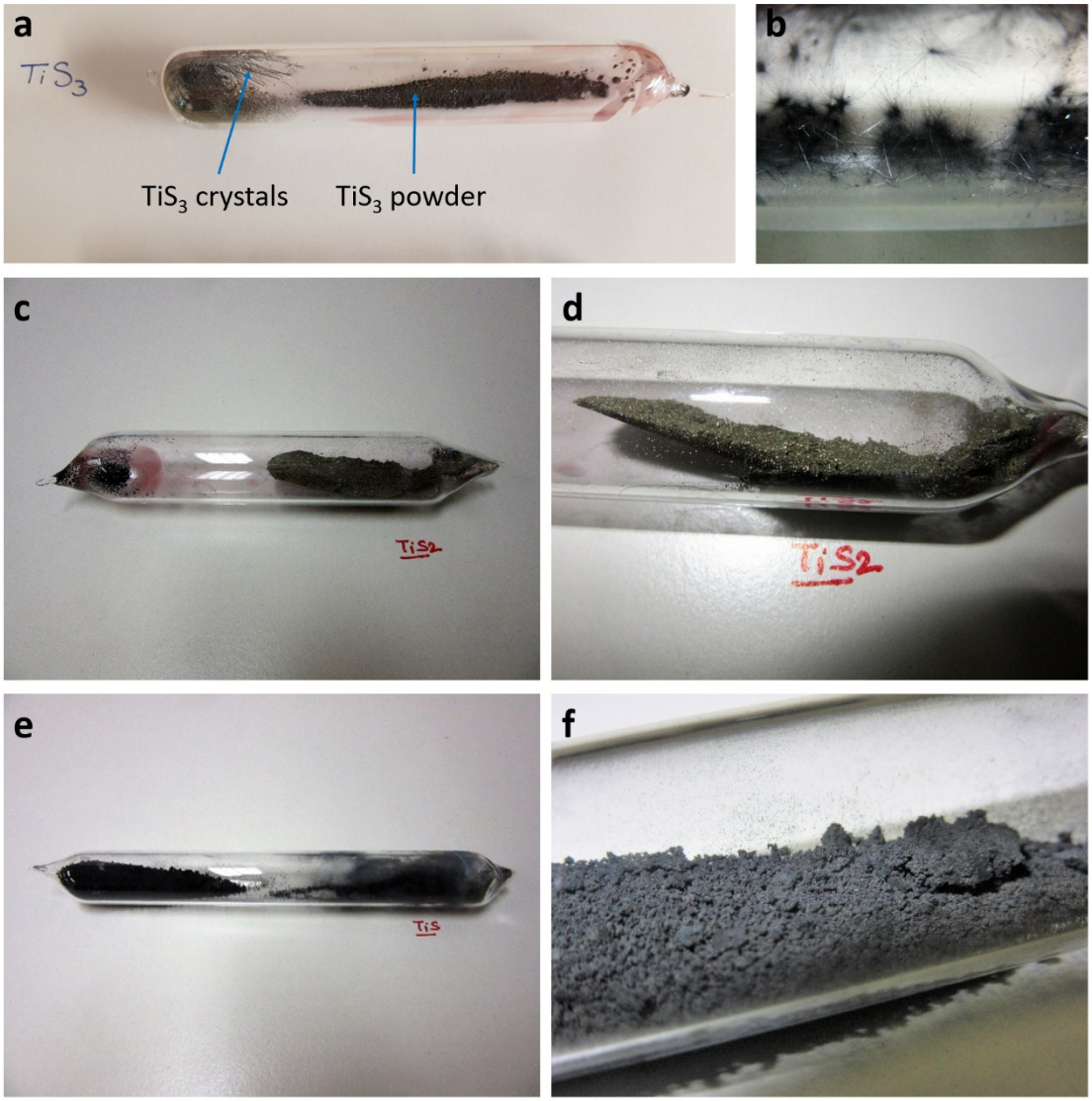


Figure S1. Optical photograph of (a) the ampule after TiS_3 synthesis showing the presence of TiS_3 crystals and power side-by-side, (b) magnification of the nucleation points on the inner ampule wall with TiS_3 crystals attached, (c) the ampule after TiS_2 synthesis, (d) magnification of the TiS_2 ampule showing the dark greenish shiny TiS_2 crystals, (e) the ampule after lt-TiS synthesis, (f) magnification of the powder obtained from the lt-TiS synthesis.

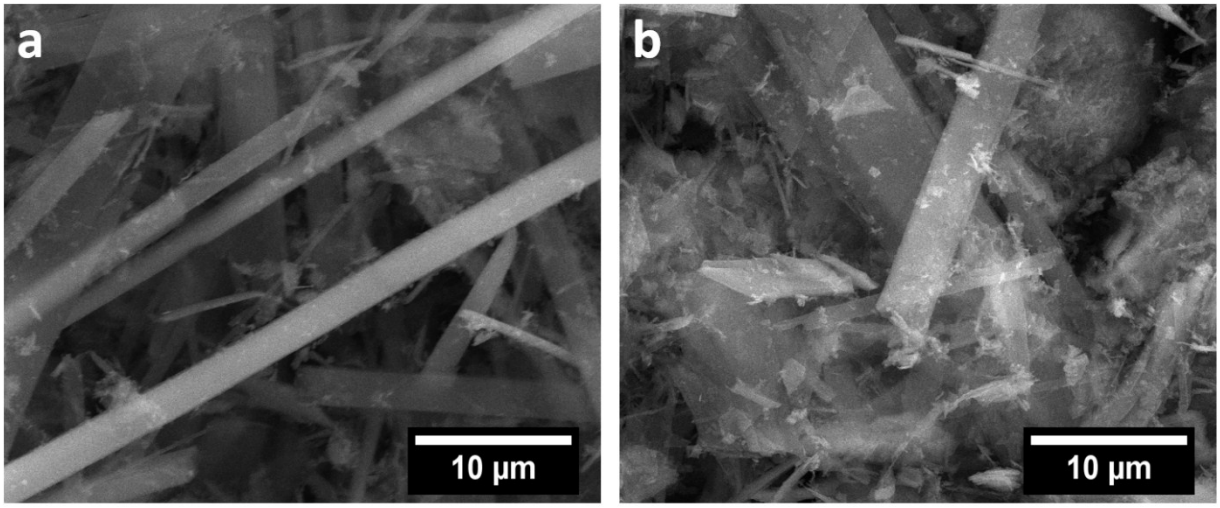


Figure S2. SEM image of TiS_3 powder heated at 450°C under argon atmosphere for (a) 20 min (TiS_{3-x}/20 min) and (b) 60 min (TiS_{3-x}/60 min).

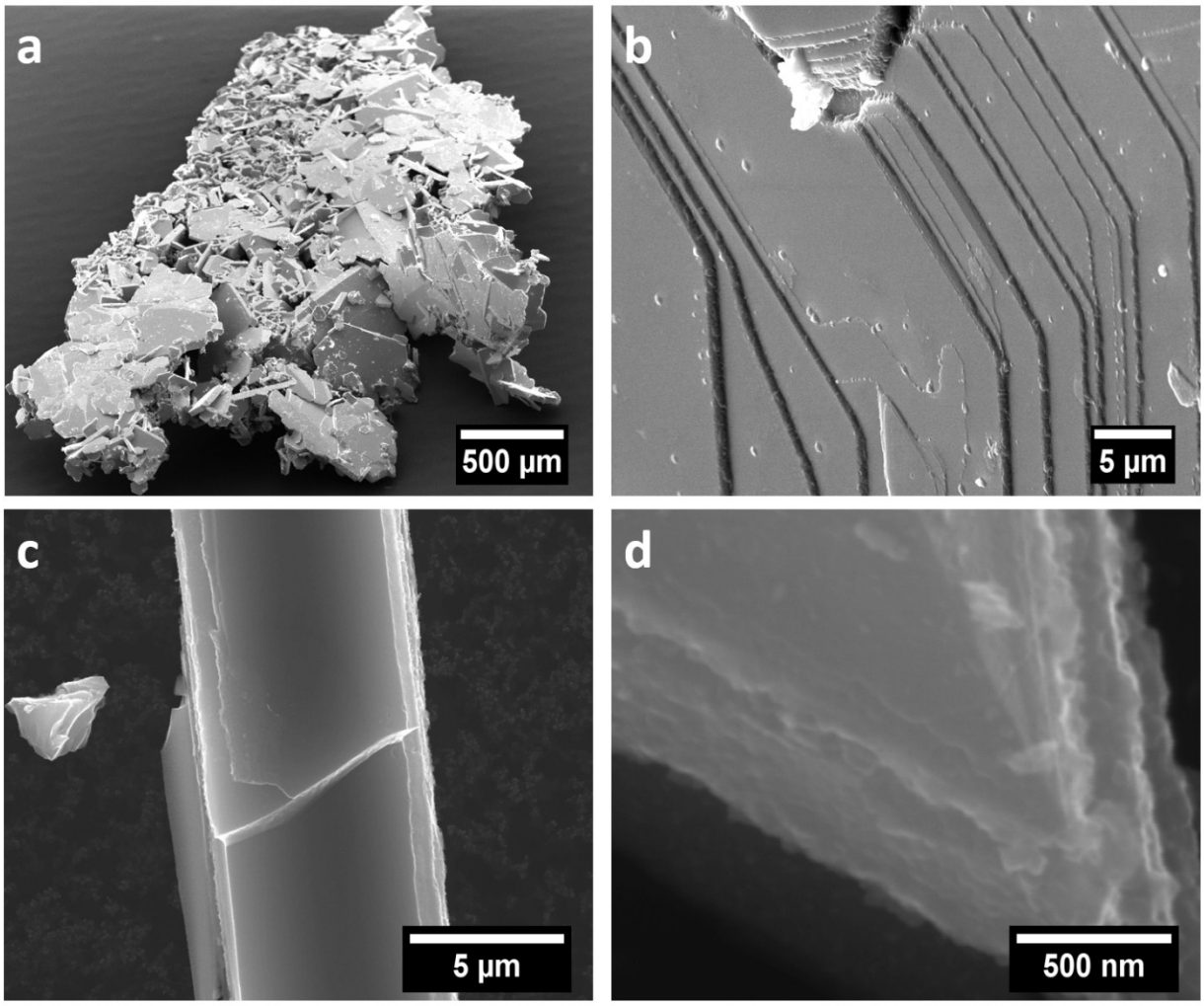


Figure S3. SEM image of (a,b) $TiSe_2$ crystals and (c,d) TiTe crystals at different magnifications showing (a,c) overview of the crystals and (b,d) the layered structure of these crystals.

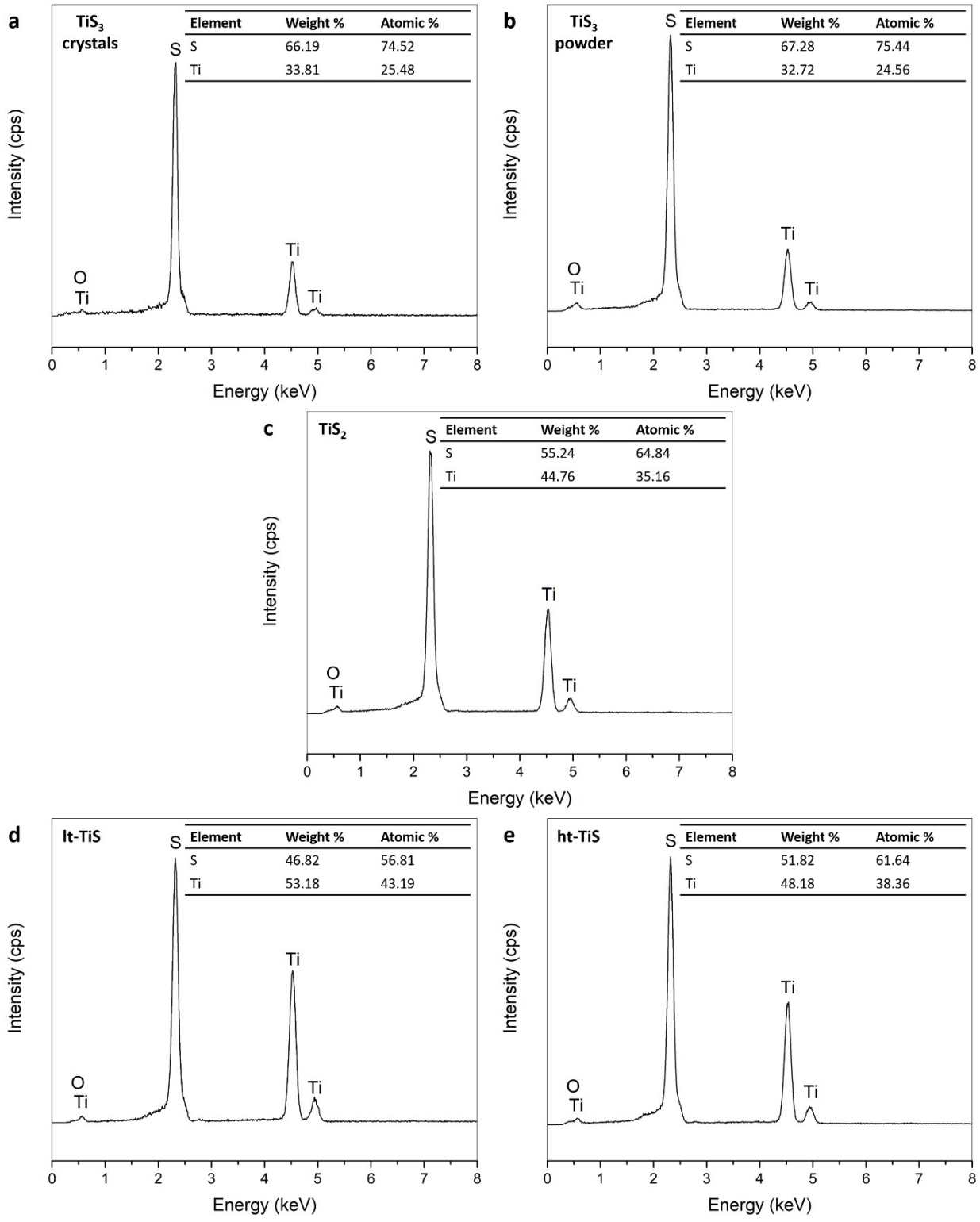


Figure S4. EDX analysis of (a) TiS_3 crystals, (b) TiS_3 powder, (c) TiS_2, (d) low temperature TiS (lt-TiS) and (e) high temperature TiS (ht-TiS) showing the weight and atomic percentages of the elements sulfur and titanium in these materials.

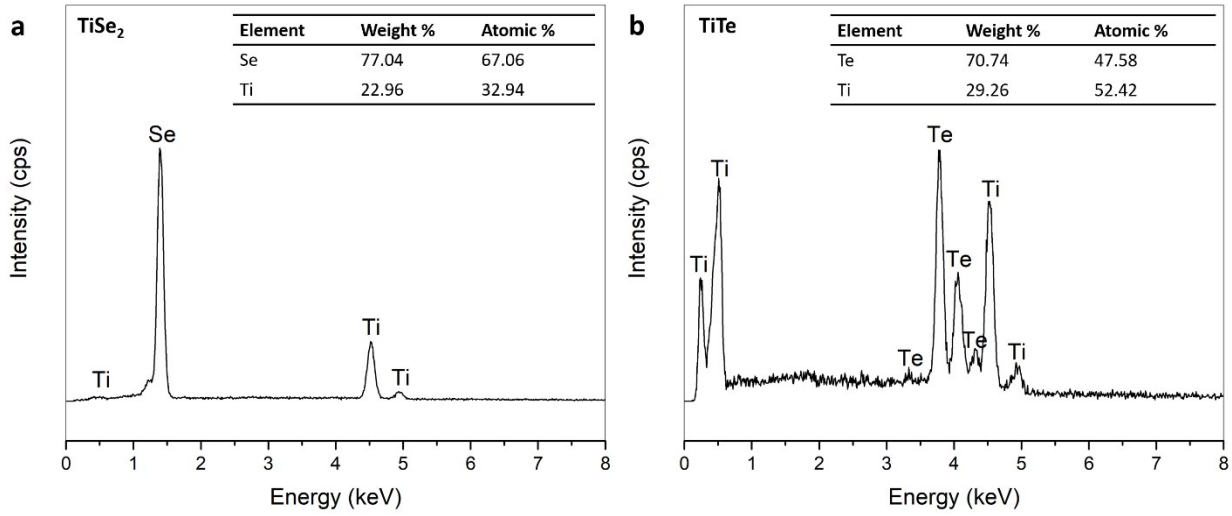
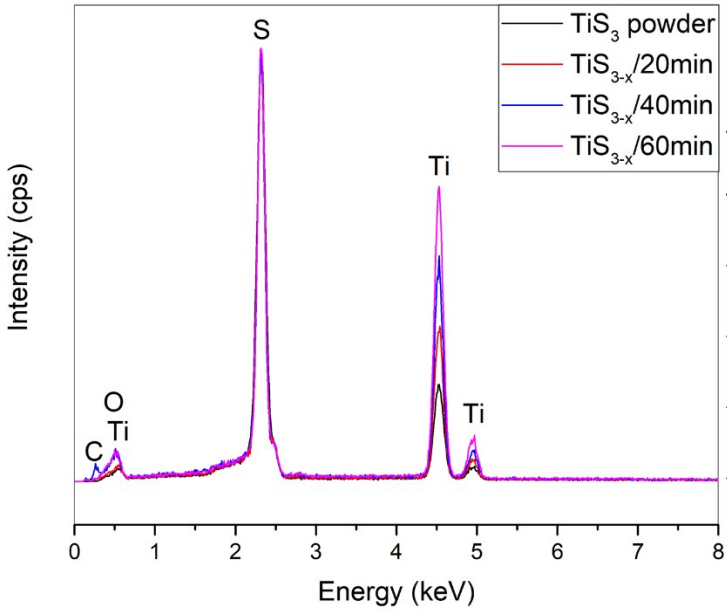


Figure S5. EDX analysis of (a) $TiSe_2$ and (b) TiTe showing the weight and atomic percentages of the elements in these materials.



	Element	Weight %	Atomic %	S/Ti ratio
TiS_3 powder	S	67.28	75.44	3.07
	Ti	32.72	24.56	
TiS_{3-x}/20 min	S	59.07	68.32	2.16
	Ti	40.93	31.68	
TiS_{3-x}/40 min	S	51.49	61.33	1.59
	Ti	48.51	38.67	
TiS_{3-x}/60 min	S	45.12	55.12	1.23
	Ti	54.88	44.88	

Figure S6. EDX analysis of TiS_3 powder before and after heat treatment at 450°C under argon atmosphere for 20 min, 40 min and 60 min for sulfur removal showing the change in the weight and atomic percentages of titanium and sulfur and the resulting decrease in the S/Ti ratio.

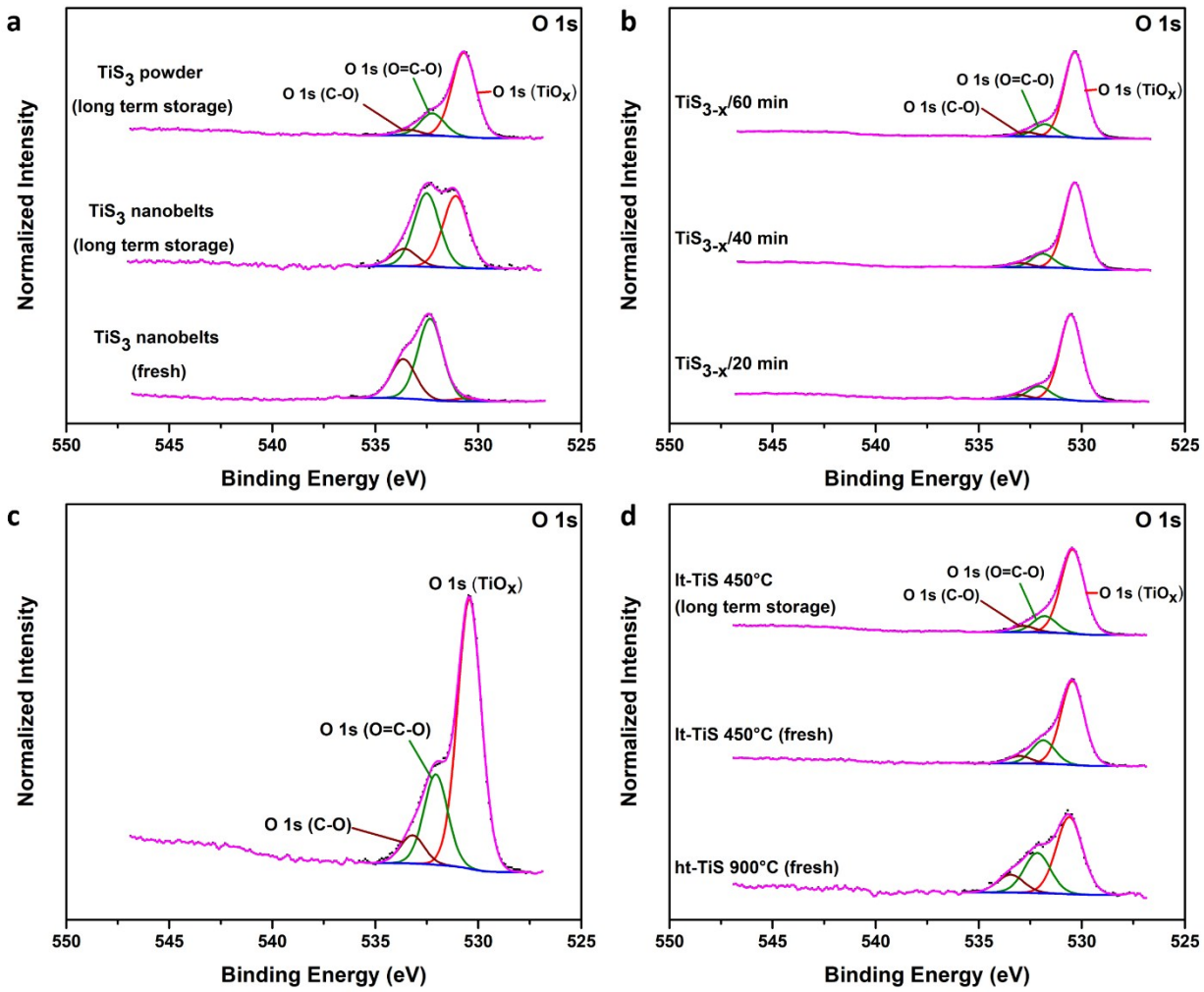


Figure S7. High-resolution XPS deconvoluted O 1s core level spectra of (a) TiS_3 powder and nanobelt crystals (freshly prepared and after two years of storage), (b) TiS_3 powder treated at 450°C under argon for 20 min, 40 min and 60 min, (c) TiS_2 and (d) low temperature TiS (freshly prepared and after two years of storage) and high temperature TiS.

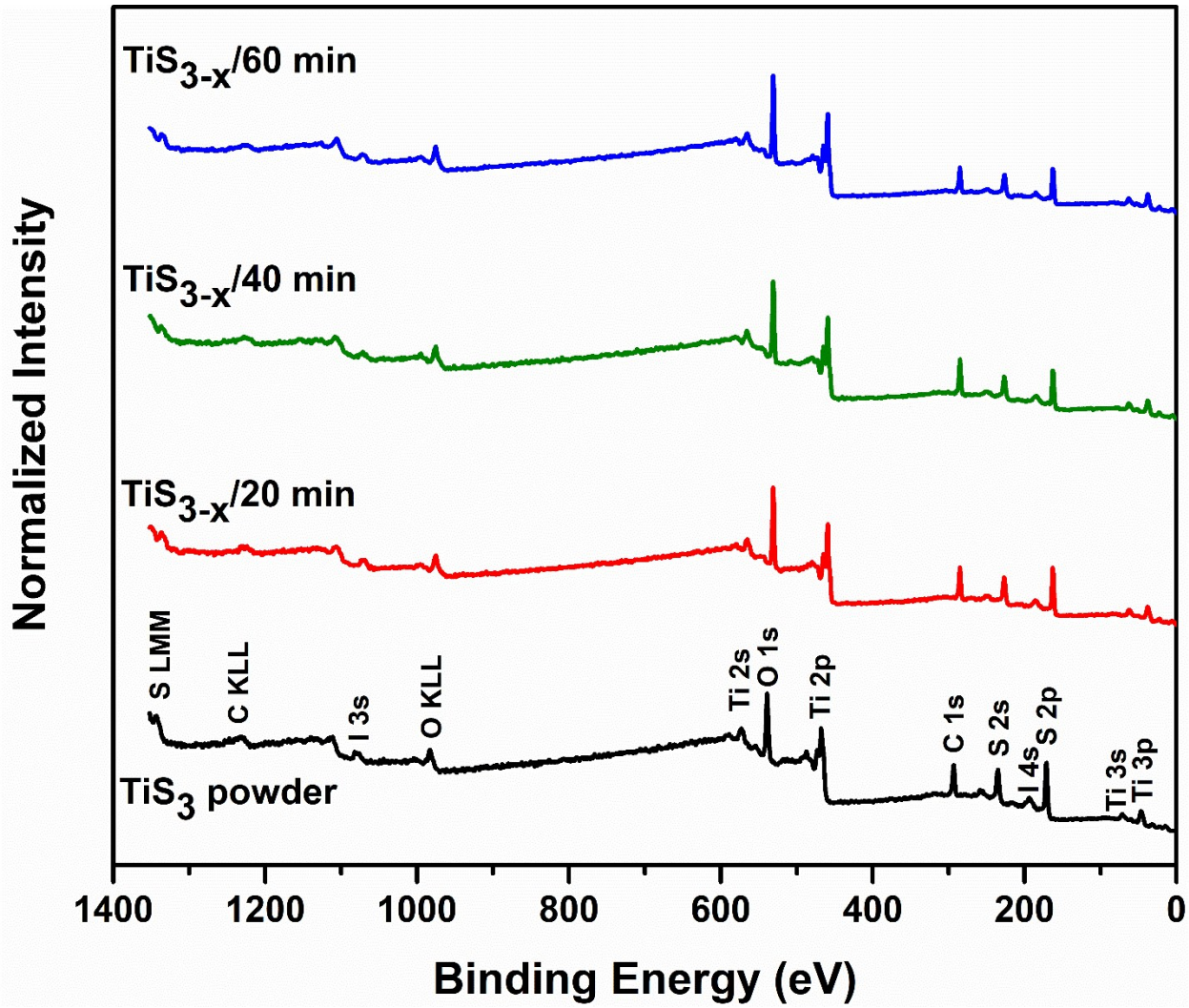


Figure S8. XPS survey spectra of TiS_3 powder and heat treated TiS_3 powder at 450°C for 20, 40 and 60 min (TiS_{3-x}/20min, TiS_{3-x}/40min, TiS_{3-x}/60min).

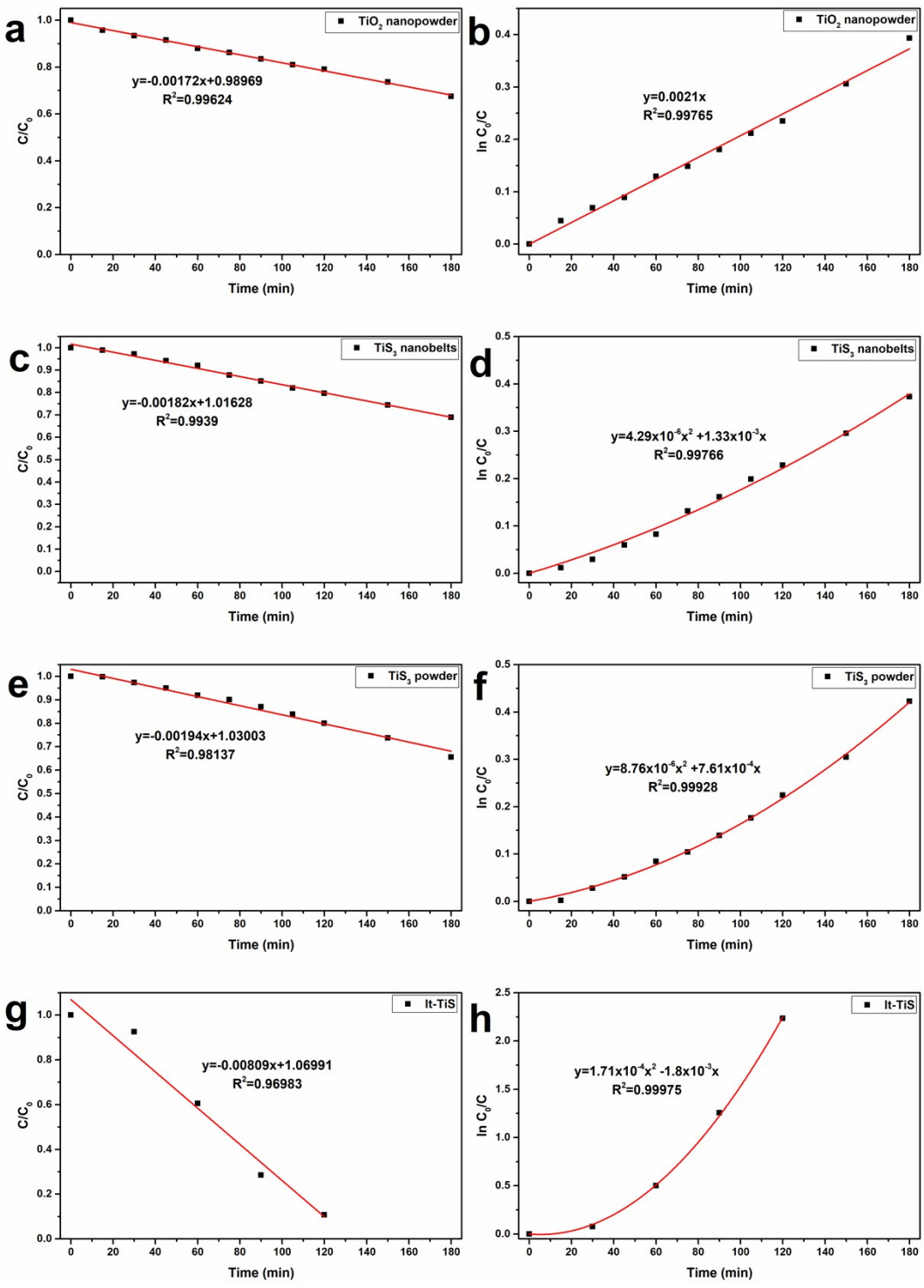


Figure S9. Zero order and first order plots of (a,b) TiO_2 nanoparticles (EMPROVE® ESSENTIAL Ph Eur,BP,USP,JP,E 171, Merck), (c,d) TiS_3 nanobelts, (e,f) TiS_3 powder and (g,h) lt-TiS for determination of the order of reaction for the different catalysts.

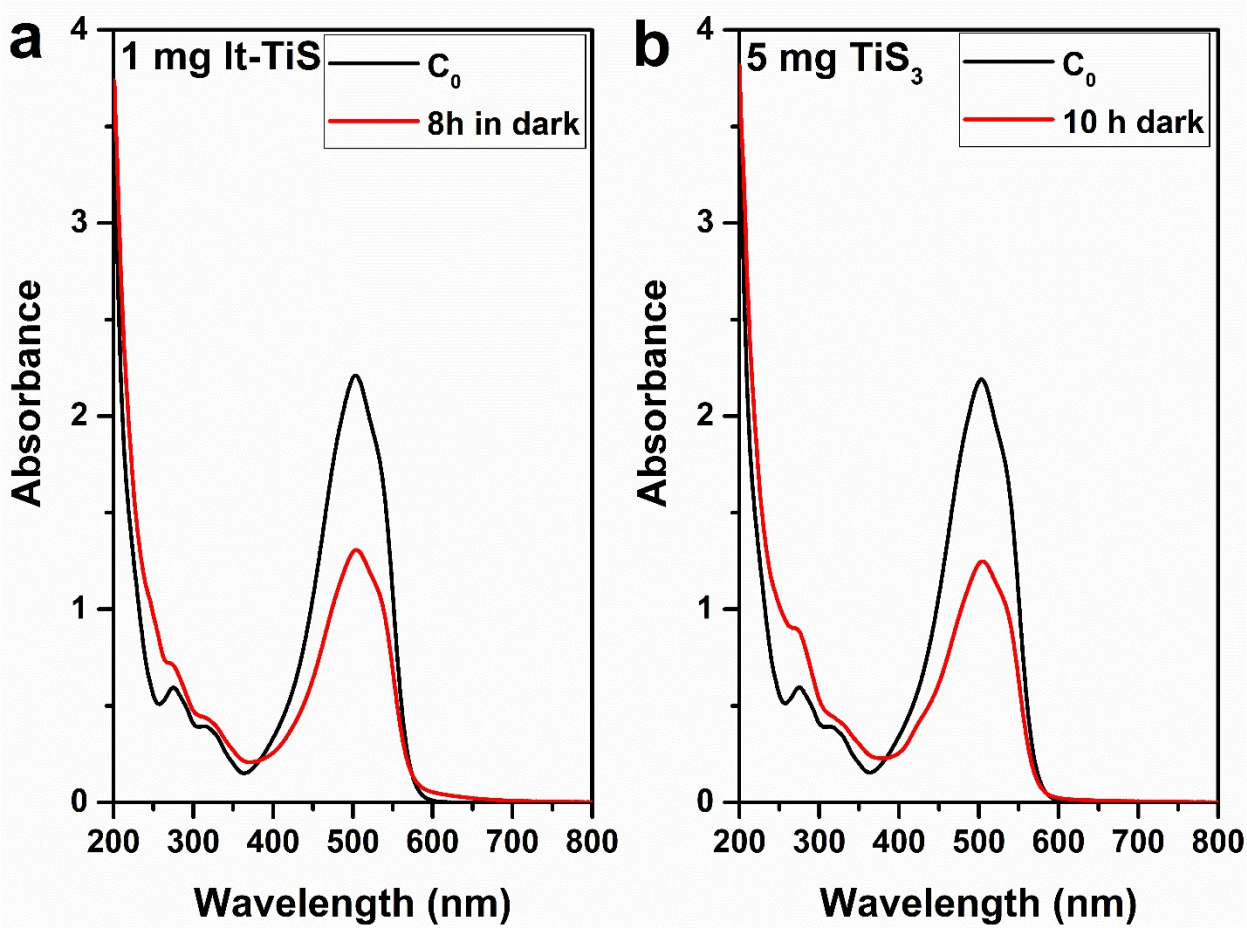


Figure S10. UV-VIS absorption spectra of methyl orange showing the thermocatalytic activity of (a) one mg of lt-TiS and (b) 5 mg of TiS_3 nanobelts at room temperature in the degradation of methyl orange.

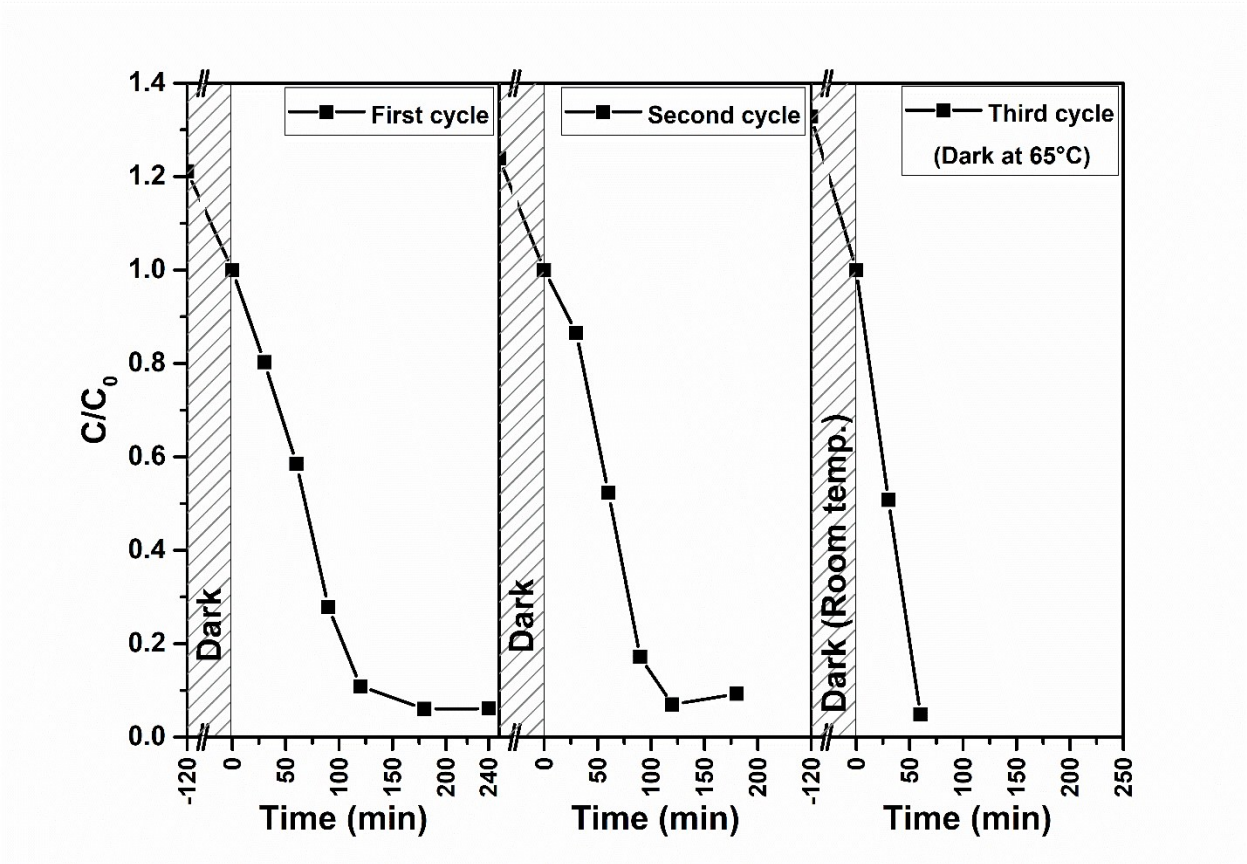
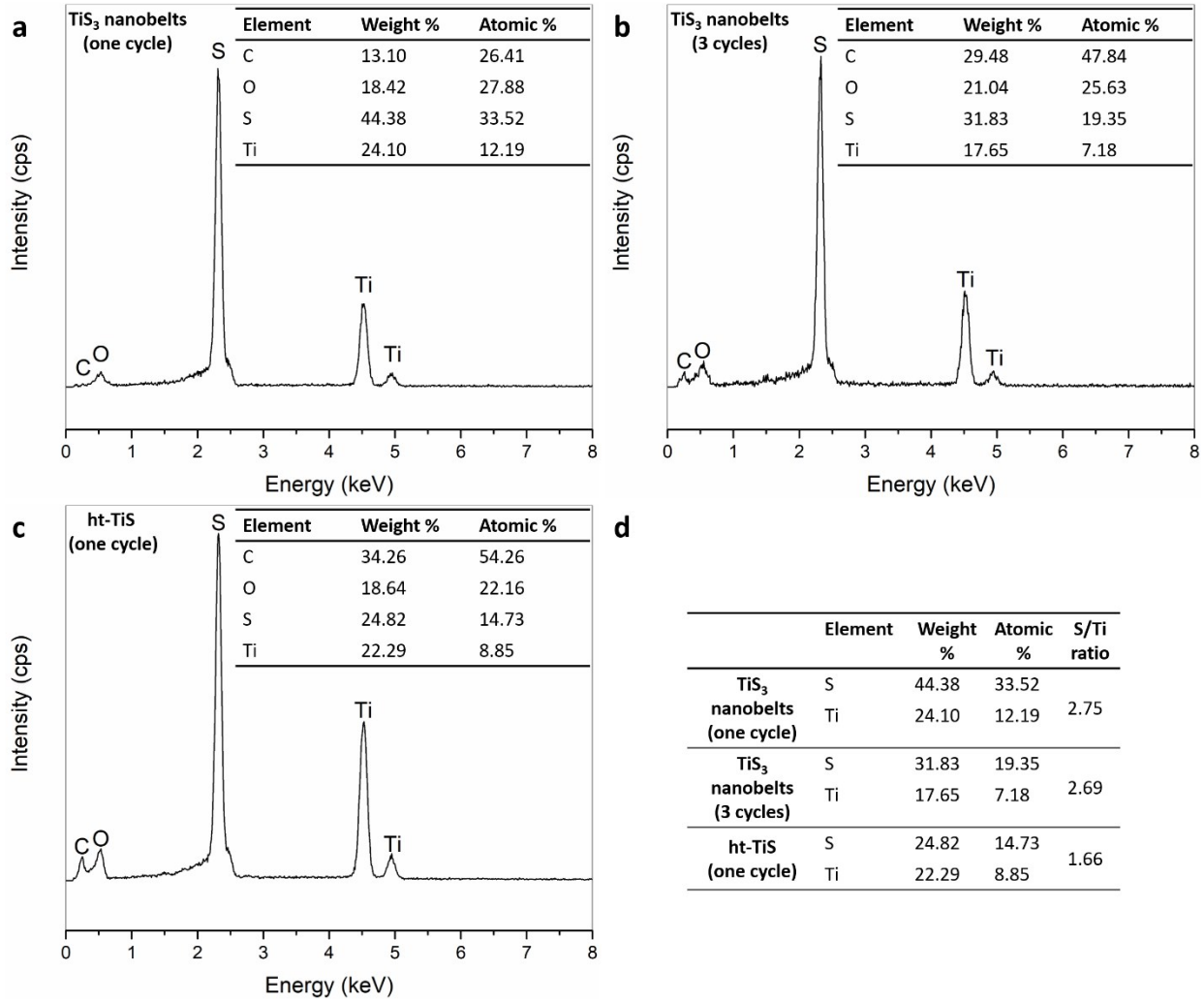


Figure S11. Recyclability of 5 mg TiS_3 powder over three cycles where the first two cycles are performed using simulated sunlight and the third cycle is performed in dark at 65°C to show the thermocatalytic activity.



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	Element	Weight %	Atomic %	S/Ti ratio
TiS_3 nanobelts (one cycle)	S	44.38	33.52	2.75
	Ti	24.10	12.19	
TiS_3 nanobelts (3 cycles)	S	31.83	19.35	2.69
	Ti	17.65	7.18	
ht-TiS (one cycle)	S	24.82	14.73	1.66
	Ti	22.29	8.85	

Figure S12. EDX analysis of (a) TiS_3 nanobelts after one photocatalytic cycle, (b) TiS_3 nanobelts after three photocatalytic cycles and (c) ht-TiS after one photocatalytic cycles showing the weight and atomic percentages of the elements in these materials, (d) the weight and atomic percentages of sulfur and titanium in each case and the corresponding S/Ti ratio.