

**Electronic Supplementary Information (ESI)**

**High-quality spinel  $\text{LiCoTiO}_4$  single crystals co-exposed  $\{111\}$  and  $\{110\}$  facets: flux growth, formation mechanism, magnetic behavior and their application in photocatalysis**

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## Experimental section

### Preparation of $\text{LiCoTiO}_4/\text{g-C}_3\text{N}_4$ composite photocatalysts

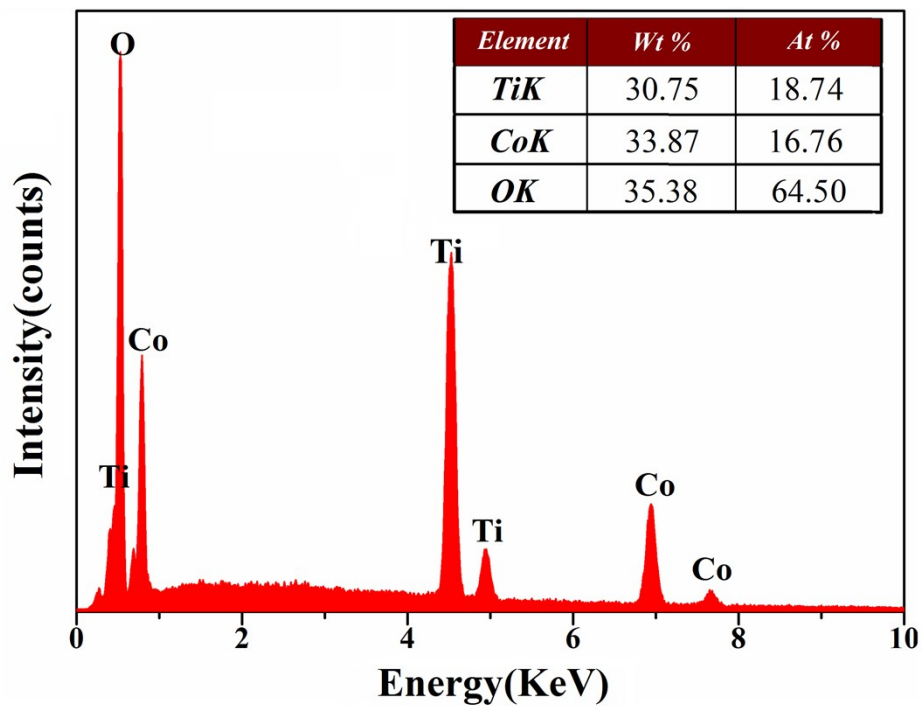
Melamine (analytical grade purity) was purchased from Sinopharm Chemical Reagent Co., Ltd. and used without further purification. Deionized water was used throughout.

In a typical synthesis run, different amounts of the flux-grown  $\text{LiCoTiO}_4$  powder (LCTO-1 sample) with a suitable amount of melamine were dispersed in 100 ml water by ultrasonication for 30 min and then the suspension was continuously stirred for 6 h at room temperature. After that, the precipitate was collected by centrifugation and dried at 80 °C in an oven for 12 h. Finally, the obtained mixture was putted into an electric furnace and then calcined at 550 °C for 4 h in air to obtain  $\text{g-C}_3\text{N}_4$  phase and make a firm connection between  $\text{LiCoTiO}_4$  and  $\text{g-C}_3\text{N}_4$  products. The as-prepared  $\text{LiCoTiO}_4/\text{g-C}_3\text{N}_4$  composite samples with expected  $\text{LiCoTiO}_4$  contents of 0.1, 0.5, 1.0 and 5.0 wt % were labeled as LCTO/CN-0.1, LCTO/CN-0.5, LCTO/CN-1.0 and LCTO/CN-5.0, respectively. As a reference, pure  $\text{g-C}_3\text{N}_4$  was prepared by directly heating melamine at 550 °C for 4 h at a heating rate of 2 °C/ min in a semi-closed alumina crucible. After heating treatment, the yellow products were collected and ground into powders.

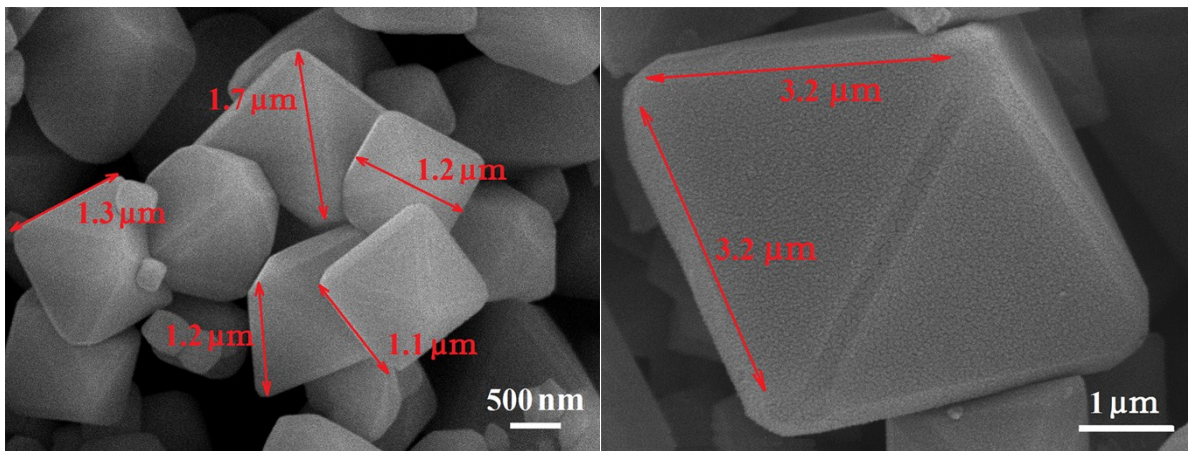
**Table S1 Comparative study of the diffraction data for the synthesized LiCoTiO<sub>4</sub> samples.**

hkl	interplanar spacings (d/ Å) <sup>a</sup>			
	LiCoTiO <sub>4</sub>	Sample	Sample	Sample
	PDF No. 38-0182	LCTO-1	LCTO-2	LCTO-3
111	4.8800	4.8497	4.8596	4.8398
220	2.9780	2.9725	2.9747	2.9656
311	2.5370	2.5341	2.5352	2.5284
222	2.4320	2.4301	2.4307	2.4235
400	2.1050	2.1017	2.1021	2.0972
422	1.7180	1.7139	1.7167	1.7126
511	1.6189	1.6169	1.6180	1.6143
440	1.4868	1.4856	1.4865	1.4831
620	1.3303	1.3288	1.3297	1.3274
533	1.2834	1.2815	1.2821	1.2796
444	1.2144	1.2119	1.2138	1.2103

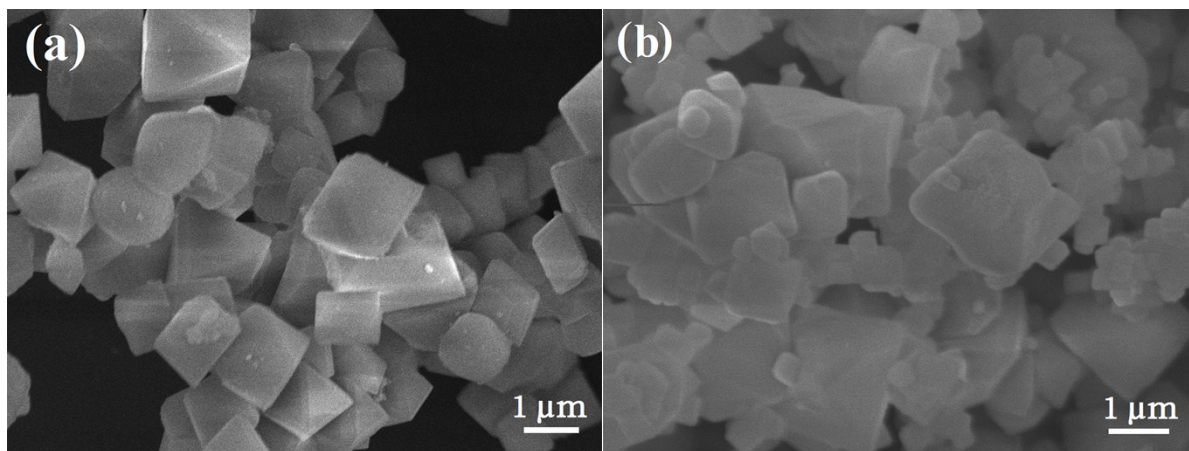
<sup>a</sup>Note: determined from the strong and medium lines of XRD patterns.



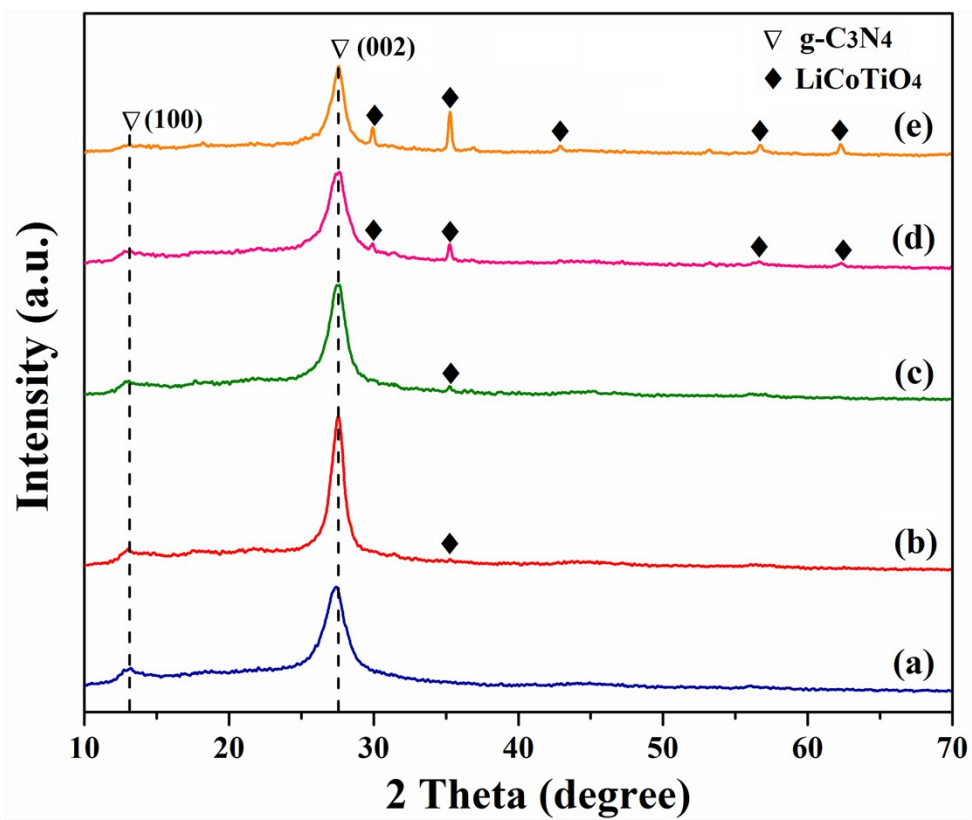
**Fig. S1** EDS spectra of as-synthesized sample LCTO-1 and the light Li element can't be detected.



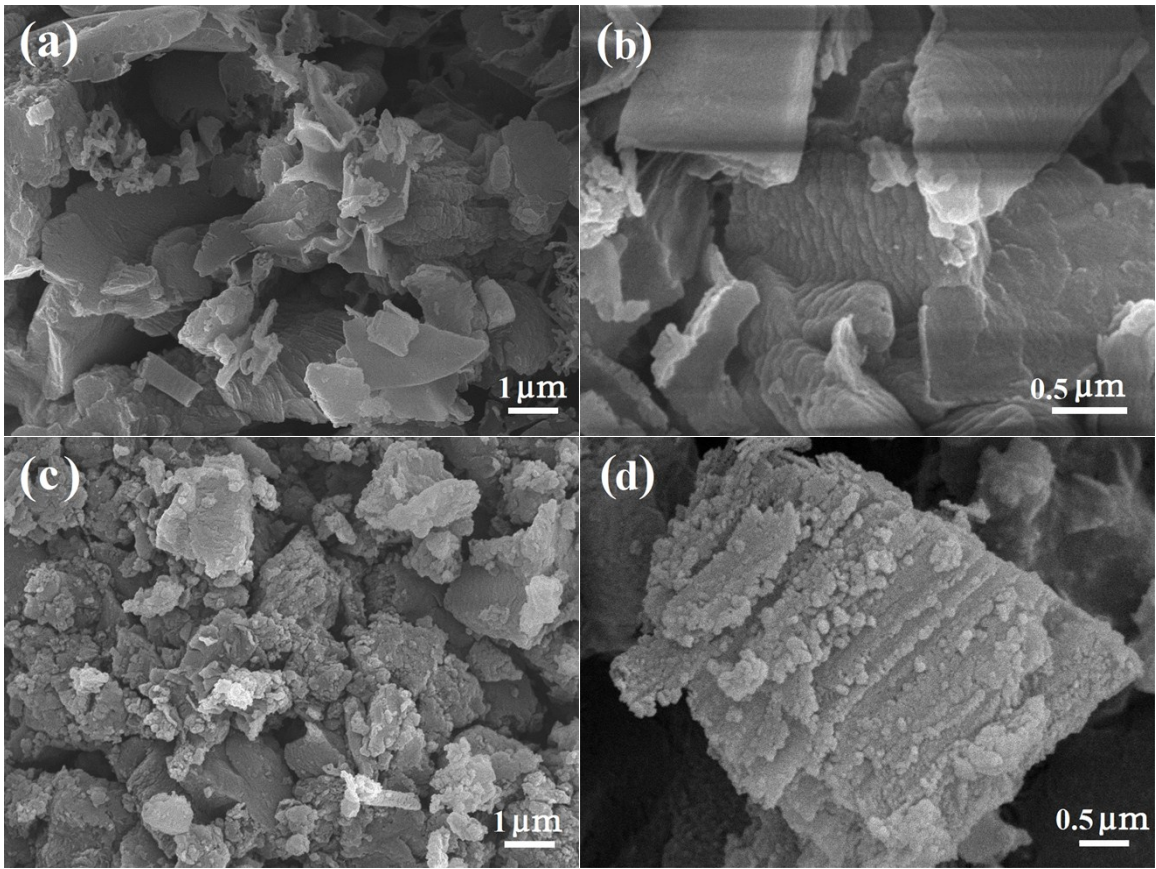
**Fig. S2** SEM images of the as-synthesized sample LCTO-1.



**Fig. S3** SEM images of the as-synthesized sample LCTO-2 (a) and LCTO-3 (b).

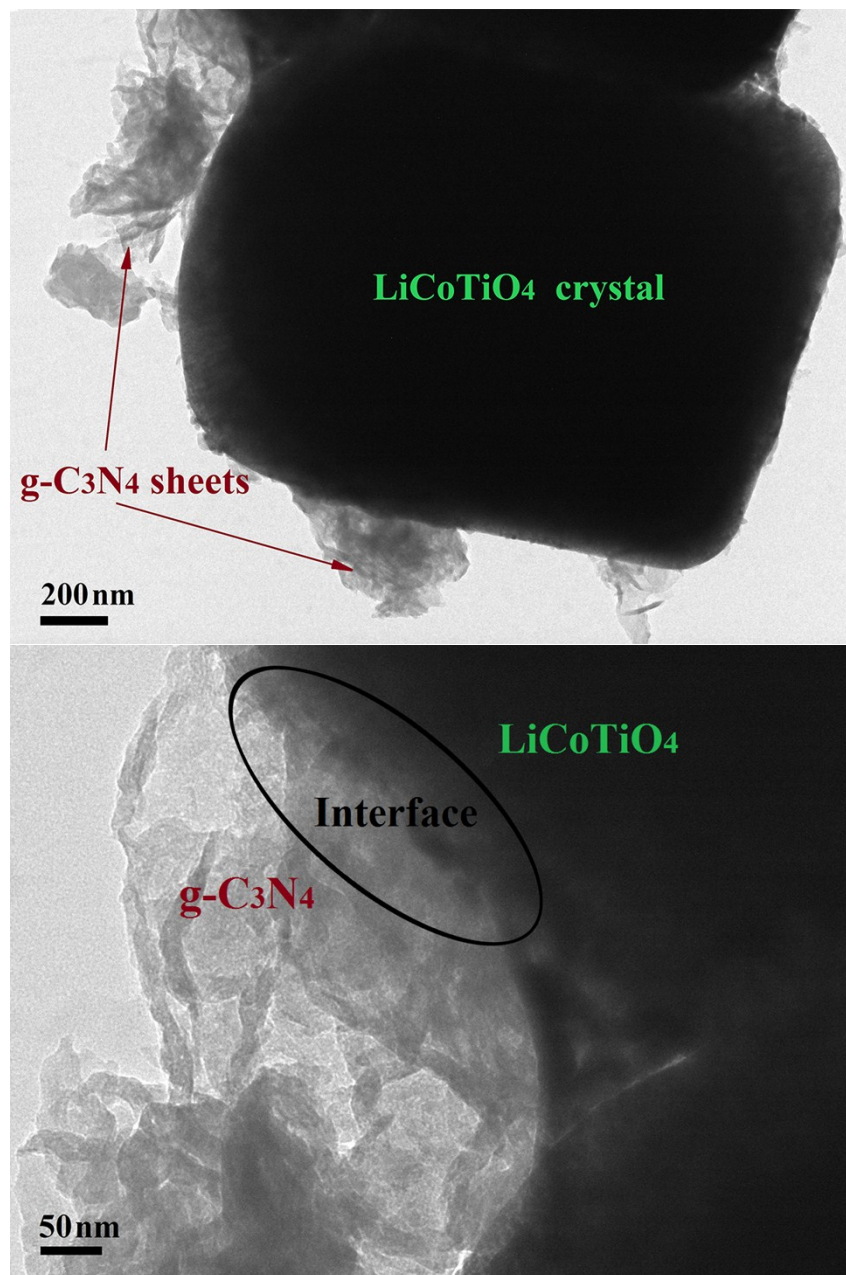


**Fig. S4** XRD patterns of pure g-C<sub>3</sub>N<sub>4</sub> (a), LCTO/CN-0.1 (b), LCTO/CN-0.5 (c), LCTO/CN-1.0 (d) and LCTO/CN-5.0 (e).

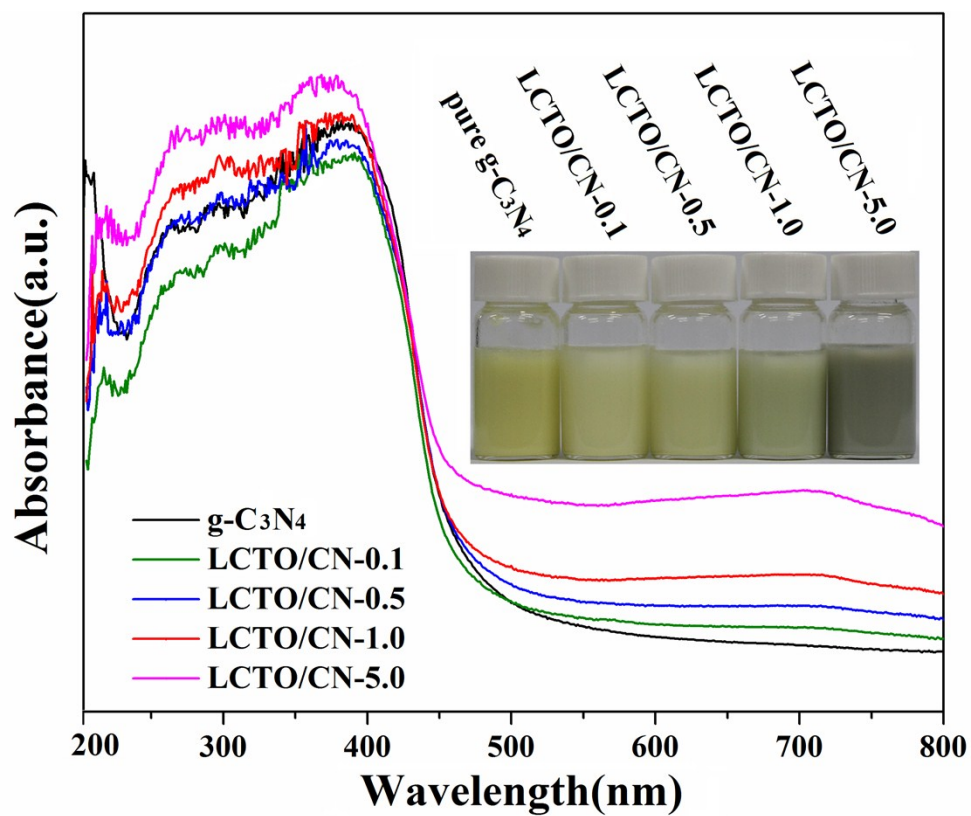


**Fig. S5** SEM images of pure g-C<sub>3</sub>N<sub>4</sub> (a, b) and the LCTO/CN-0.5 composite sample (c, d).

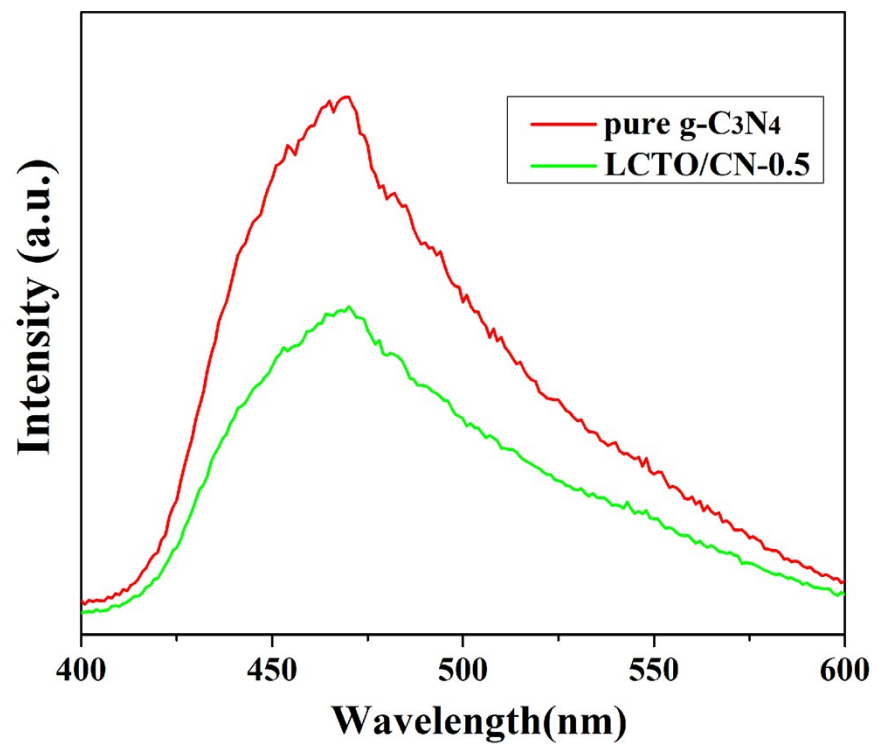




**Fig. S6** TEM images of the LCTO/CN-0.5 composite sample.



**Fig. S7** UV-vis diffuse reflectance spectra of the LiCoTiO<sub>4</sub>/g-C<sub>3</sub>N<sub>4</sub> composites and pure g-C<sub>3</sub>N<sub>4</sub>. Inset shows the photographs of stable dispersions in water of the samples.



**Fig. S8** Photoluminescence (PL) emission spectra of the pure g-C<sub>3</sub>N<sub>4</sub> and LCTO/CN-0.5 sample.