

**Electronic Supplementary Information**

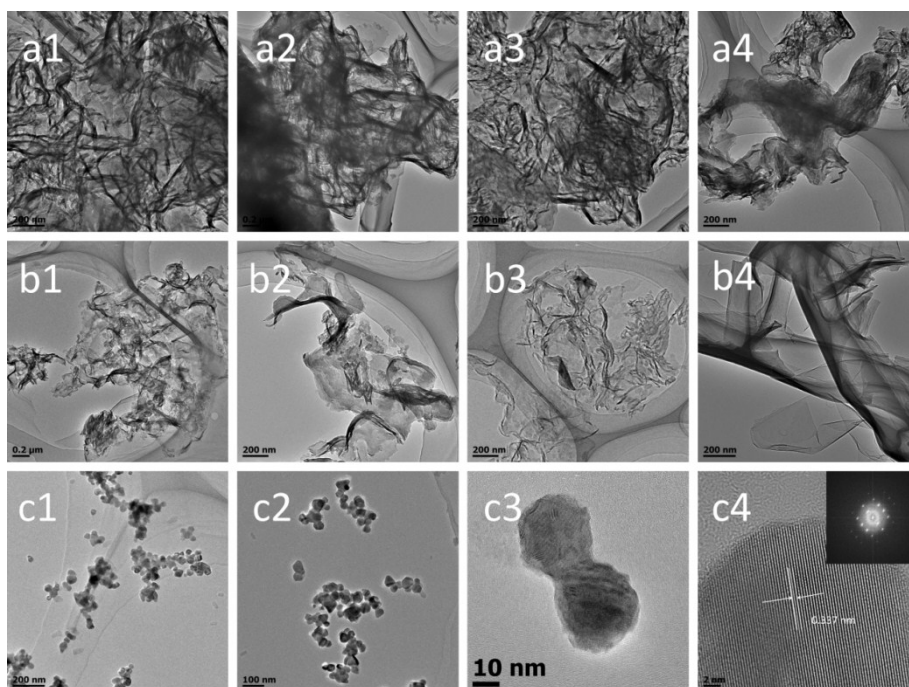
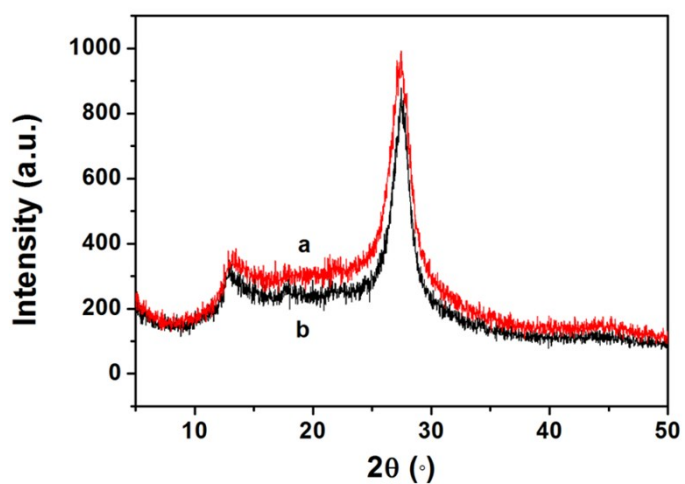
**Highly selective oxidation of sulfides on a CdS/C<sub>3</sub>N<sub>4</sub> catalyst with dioxygen under visible-light irradiation**

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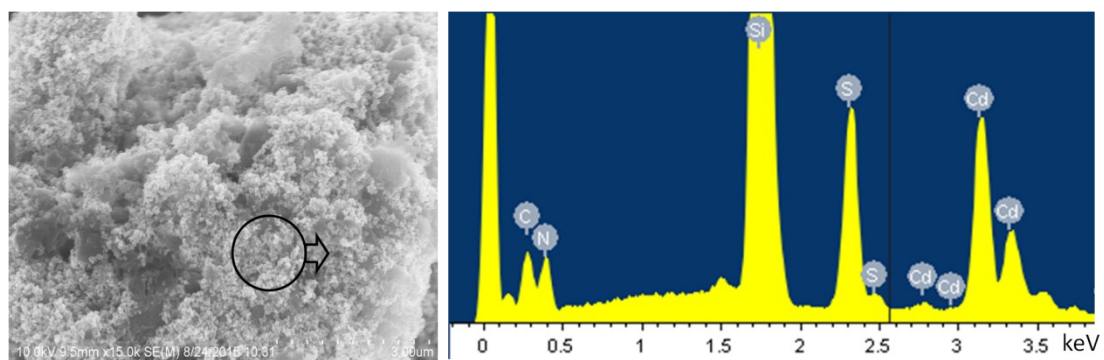
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**Fig. S1** XRD patterns and TEM images of (a) as-prepared  $C_3N_4$  and (b) after ultrasonic exfoliation, and (c) TEM images of CdS.



**Fig. S2** SEM-energy dispersive X-ray (EDX) analysis in random areas of cdn(30).

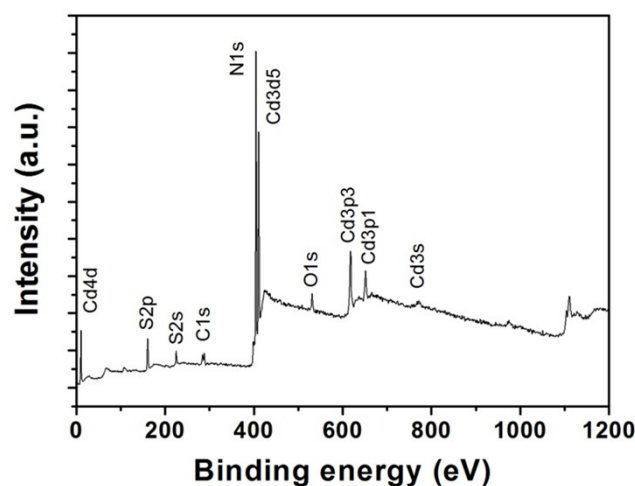


Fig. S3 XPS survey spectrum of cdcn(30).

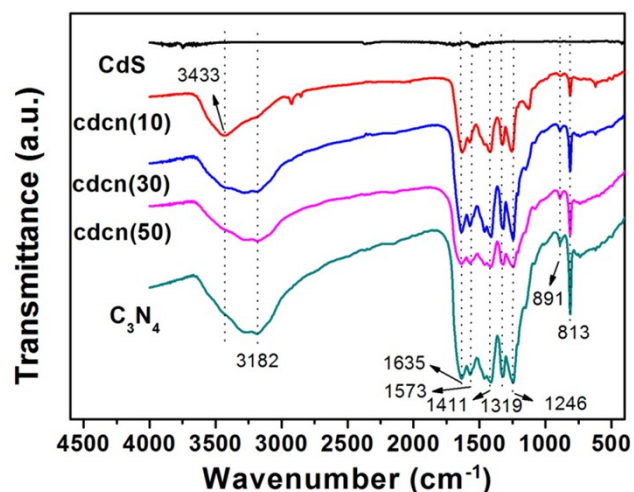
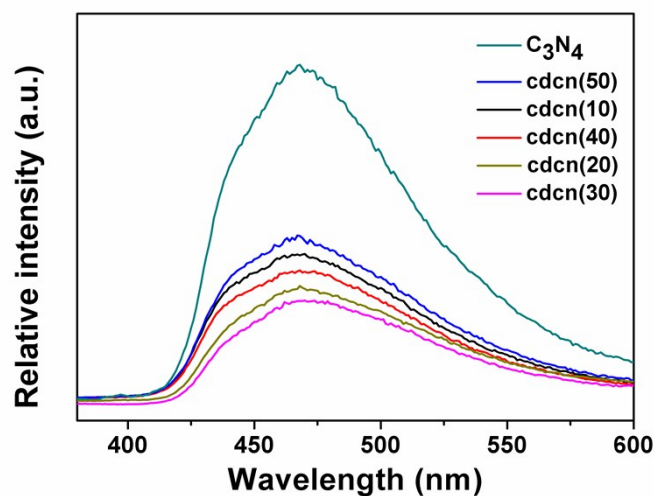


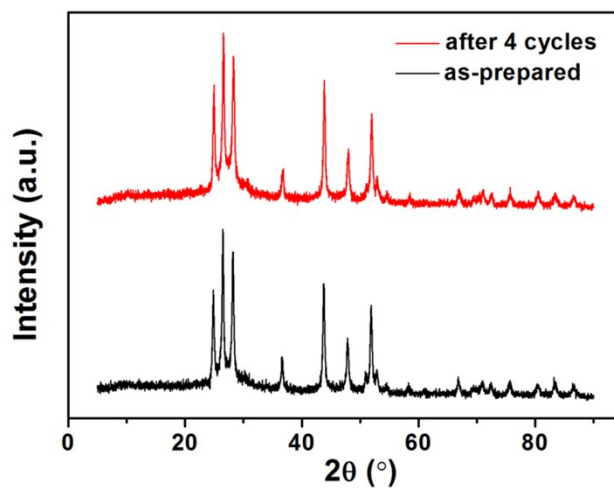
Fig. S4 FTIR spectra of the as-prepared samples.

The interaction of CdS nanoparticles with  $C_3N_4$  was further studied by FTIR spectroscopy. Fig. S4 shows a comparison of  $C_3N_4$  and CdS/ $C_3N_4$  composites. The pure  $C_3N_4$  presents three characteristic absorption region at  $>3000\text{ cm}^{-1}$ ,  $1200\text{--}1700\text{ cm}^{-1}$ , and  $<1000\text{ cm}^{-1}$ . The broad band between  $3000$  and  $3400\text{ cm}^{-1}$  in the spectra of  $C_3N_4$  corresponds to the stretching vibrations of terminal  $-NH_2$  or  $-NH-$  groups ( $3182\text{ cm}^{-1}$ ) at the defect sites of the aromatic ring. The characteristic peaks that appear at  $1246$ ,  $1319$ ,  $1411$ ,  $1573$  and  $1635\text{ cm}^{-1}$  can be assigned the typical stretching modes of CN heterocycles in  $C_3N_4$ . These peaks are all present in the CdS/ $C_3N_4$  composites, suggesting that no structural change of  $C_3N_4$  occurs during the hybridization process. The representative breathing mode of the triazine units in  $C_3N_4$  can be observed at  $813\text{ cm}^{-1}$ . The characteristic bands of  $C_3N_4$  gradually increase with the increase of  $C_3N_4$  mass ratio in the composites. In the case of CdS, the broad band centered at  $3430\text{ cm}^{-1}$  is contributed to the surface adsorption of water molecules, which is gradually decrease with the increase of  $C_3N_4$ . The absorption peaks of CdS are not obvious in the CdS/ $C_3N_4$  composites, which could be due to their low intensity. The results of FTIR are well in accordance with XRD, SEM, TEM and XPS.

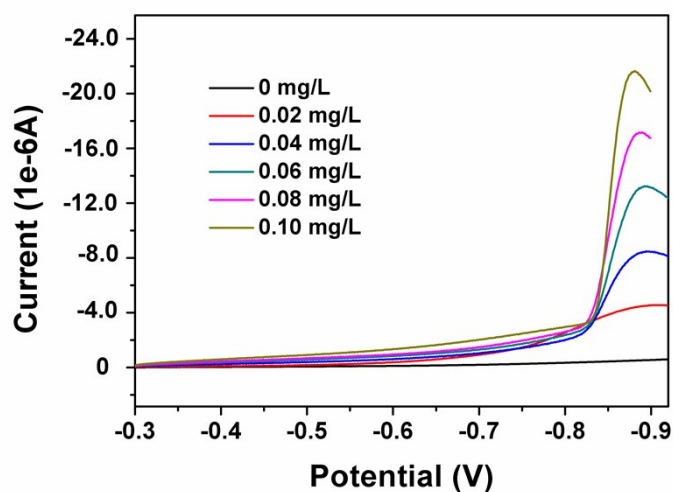


**Fig. S5** Comparison of photoluminescence (PL) spectra of pure  $C_3N_4$  and cdcn samples.

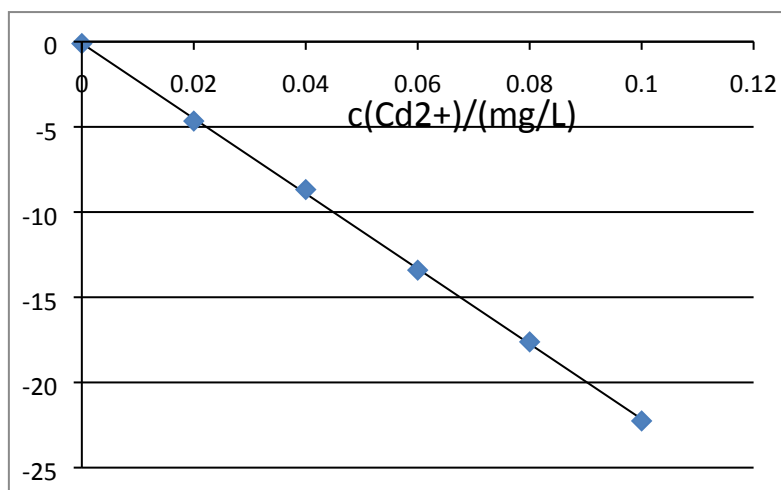
It is clear that pure  $C_3N_4$  shows a strong and wide peak ranged from 380 to 600 nm in the PL spectrum with excited at 325 nm. The principle peak of  $C_3N_4$  around 470 nm is attributed to  $n-\pi^*$  electronic transition. The high PL intensity indicates that  $C_3N_4$  has the high optical recombination rate, which may deteriorate photodegradation efficiency. However, in the case of cdcn, the peak strength decreases gradually from cdcn(50) to cdcn(30), which can be ascribed to the effective separation of photoinduced charge carriers in the composite.



**Fig. S6** XRD patterns of as-prepared cdcn(30) and the sample after it was used in cycling photocatalytic experiments.



**Fig. S7** i-E curves of cadmium ion standard solution measured by linear sweep voltammetry.



Irradiation time (h)	1	2	3	4	5
Concentrations of Cd <sup>2+</sup> (mg/L)	28.6	31.2	35.1	36.0	38.3

**Fig. S8** Cadmium ion concentration and peak current value of the corresponding regression equation and experimental results.

Reaction conditions: methyl p-methoxyphenyl sulfide 1 mmol, cdcn(30) 5 mg, methanol 3 mL, O<sub>2</sub> 1 atm, visible-light irradiation, at room temperature. 0.5 mL of reaction solution was taken into a 10 mL volumetric flask and brought to volume by methanol. And 1 mL of the solution was taken into a 25 mL volumetric flask and brought to volume by acetic acid-sodium acetate buffer solution (pH 4.7). A bismuth film electrode was used as work electrode, with a platinum as the counter electrode and an Ag/AgCl electrode as the reference electrode. After 5 h irradiation, the concentration of Cd<sup>2+</sup> was 38.3 mg/L in the reaction solution.

**Table S1** Comparison of photocatalytic oxidation of methyl p-methoxyphenyl sulfide on cdcn(30) with other similar systems.

Catalytic system	Sulfide (mmol)/ photocatalyst (mg)	Conversion (%)	Selectivity (%)	Time (h)	Reference
cdcn(30)	0.2	100	97	5	this work
mpg-C <sub>3</sub> N <sub>4</sub> , IBA	0.02	96	97	5	29
Pt/BiVO <sub>4</sub>	3 × 10 <sup>-3</sup>	96	99	12	34
TiO <sub>2</sub> , benzylamine	7.5 × 10 <sup>-3</sup>	91	92	4	27
TiO <sub>2</sub> , TEA	7.5 × 10 <sup>-3</sup>	85	93	10	28

**Table S2** The effects of acetic acid on photocatalytic oxidation of methyl p-methoxyphenyl sulfide.

Entry	Amount of added acetic acid (mmol)	Conv. (%)	Sel. (%)
1	0	17.0	100
2	0.5	34.5	99.8
3	1	36.4	99.8

Reaction conditions: methyl p-methoxyphenyl sulfide 1 mmol, cdcn(30) 5 mg, acetonitrile 3 mL, filled with oxygen (1 atm) every 2 h, at room temperature, white LEDs (30 × 3 W,  $\lambda \geq 420$  nm), 4 h irradiation.