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ARTICLE TYPE

CdS nanorods/reduced graphene oxide nanocomposite for photocatalysis and electrochemical sensing

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1. Morphology of CdS/RGO composites fabricated from thiourea and thioacetamide.

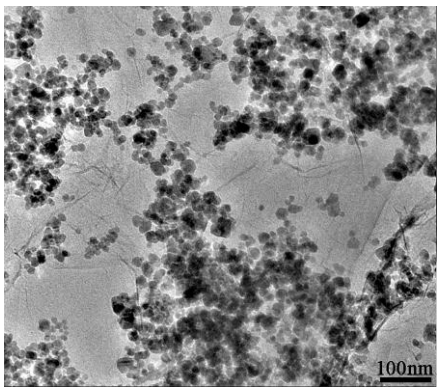

Fig. s1 TEM images of CdS nanoparticles/ RGO composite fabricated from thioacetamide

2. The influence of sulfide source on the photocatalytic property

In Fig. s2, the activity of CdS nanorods/RGO-1% photocatalyst is further compared with that of CdS nanoparticles/RGO composites fabricated from thiourea and thioacetamide as sulfur donors. As can be seen, the photocatalytic efficiency follows the order CdS/RGO-cysteine > CdS/RGO- thioacetamide > CdS/RGO- thiourea.

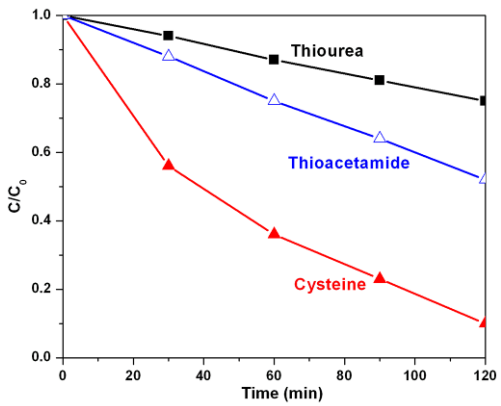

Fig. s2 Visible-light-driven photodegradation of MO over CdS/RGO composites fabricated from different sulfide source.

To explain the difference, CdS nanoparticles/RGO-thioacetamide and CdS nanoparticles/RGO-thiourea were also characterized by XPS, as shown in Fig. s3. The contents of the sp2 carbon in CdS/RGO-thioacetamide (Fig. s3a) are estimated to be 62%. This value decreases to 57% for CdS/RGO-thiourea (Fig. s3b). Therefore, the activity of photocatalysts is directly proportional to the contents of graphitic carbon in RGO, following the order CdS nanorods/RGO-cysteine (75.3%) > CdS nanoparticles/RGO- thioacetamide (62%) > CdS nanoparticles/RGO- thiourea (57%). Although the influence of morphology on the photocatalytic activity cannot be excluded completely, the dominative effect of reduction degree can be easily deduced from the strong dependence between the activity and the graphitic carbon content in the composites. Our findings that the stronger reducing ability of cysteine contributes to the better performance of CdS nanorods/RGO composites is in good agreement with our previous study on In_2S_3/RGO.[1]

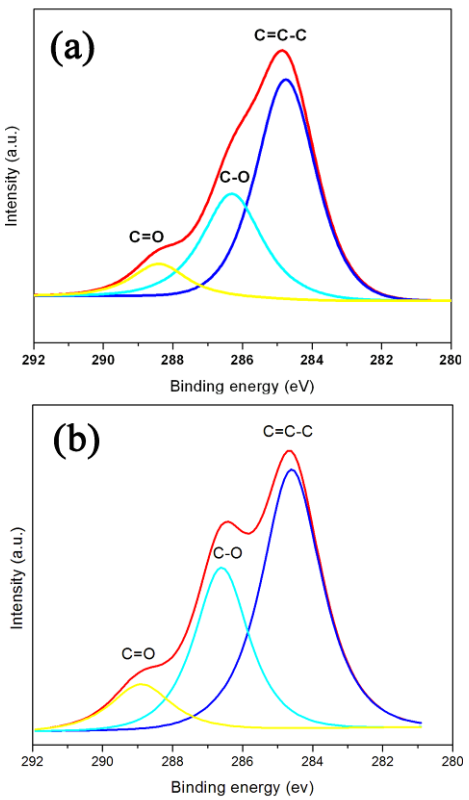

Fig. s3 The C (1s) XPS core level of CdS nanoparticles/ RGO composites fabricated from thioacetamide (a) and thiourea(b).

3. Time-resolved fluorescence decays of products

The luminescence decay measurements following 375 nm laser pulse excitation is studied in Fig. s4. After the introduction of RGO, the PL lifetime of CdS nanorods is significantly shortened from 8 ns to 5.2 ns. It further confirms the inhibited recombination of charge carrier and the possibly promoted interfacial electron transfer.[2,3]

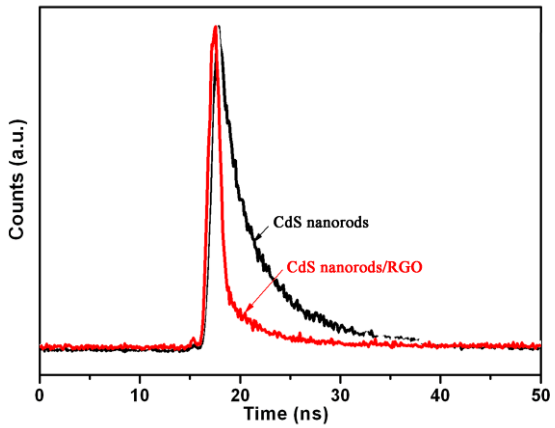

Fig. s4 Time-resolved fluorescence decays of CdS nanorods and CdS nanorods/ RGO composites.

4. Transient photocurrent response of products

Photocurrent response is used to evaluate the charge separation efficiency of products, which is given in Fig. s5. Under visible-light irradiation, both CdS nanorods and CdS nanorods/ RGO composites show reproducible responses to on–off light cycles. It is found that the photocurrent of CdS nanorods/ RGO composites is much higher than that of CdS nanorods. It is well known that the photocurrent is formed mainly by the diffusion of the photogenerated electrons to the back contact.[4] The enhanced photocurrent indicates a more efficient separation of the photoexcited electron-hole pairs as compared with blank CdS nanorods.

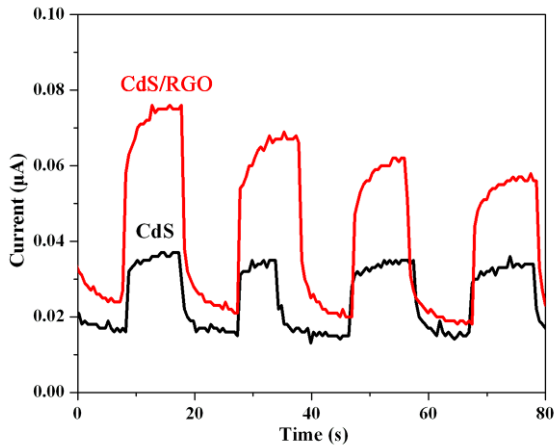

Fig. s5 Transient photocurrent response of CdS nanorods and CdS nanorods/ RGO composites.

5. Electrocatalytic activity of pure CdS and CdS nanoparticles/RGO composites

To investigate the effect of structure on the performance of enzyme-free H_2O_2 sensor, we further studied amperometric responses of pure CdS nanorods and CdS nanoparticles/ RGO composites fabricated from thioacetamide. In Fig. s6, the peak potential for reduction of hydrogen peroxide at pure CdS nanorods and CdS nanoparticles/ RGO composites is -1.1 V and -1.06 V, respectively, which is more negative than that at CdS nanorods/ RGO composites. For the response to 10 mM H_2O_2, the reductive current is 55 and 31 μA, respectively, which is much smaller than that of CdS nanorods/ RGO composites electrode (80 μA). The more positive reductive potential and the higher reductive current of CdS nanorods/ RGO composites indicate their higher electrocatalytic activity than that of pure CdS nanorods and CdS nanoparticles/ RGO composites.[5] Furthermore, the linear response ranges of pure CdS nanorods and CdS nanoparticles/ RGO composites are 1.0×10^{-4}~1.0×10^{-2} M and 1.0×10^{-4}~7×10^{-3} M, and the detection limits are both 3.3×10-5 M, respectively. That is to say, CdS nanorods/ RGO composite exhibits a more stable signal, a wider LRR and a relatively lower LOD, suggesting the superiority of biosensor based on CdS nanorods/ RGO composites.

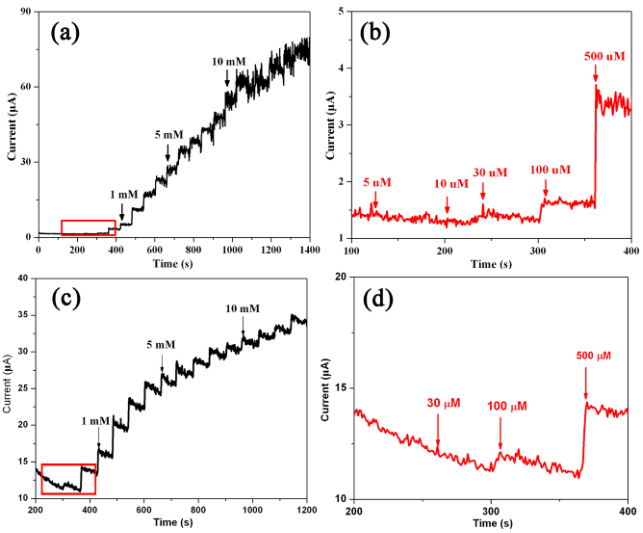

Fig. s6 (a) Typical amperometric responses of the pure CdS nanorods modified electrode to successive addition of H_2O_2; (b) Local images corresponding to the rectangular area of (a); (c) Typical amperometric responses of the CdS nanoparticles/ RGO modified electrode to successive addition of H_2O_2; (d) Local images corresponding to the rectangular area of (c).

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