

Supporting Information

Ce-/S-codoped TiO₂/sulfonated graphene for efficiently photocatalytic degradation of organic dyes

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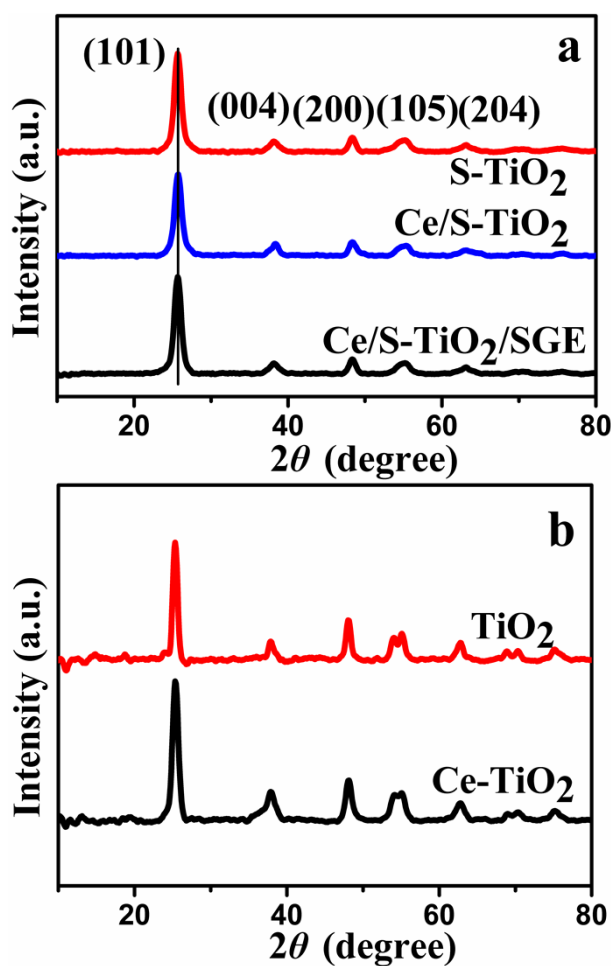


Fig. S1 (a) XRD patterns of S-TiO₂, Ce/S-TiO₂, Ce/S-TiO₂/SGE. (b) XRD patterns of pristine TiO₂, Ce-TiO₂.

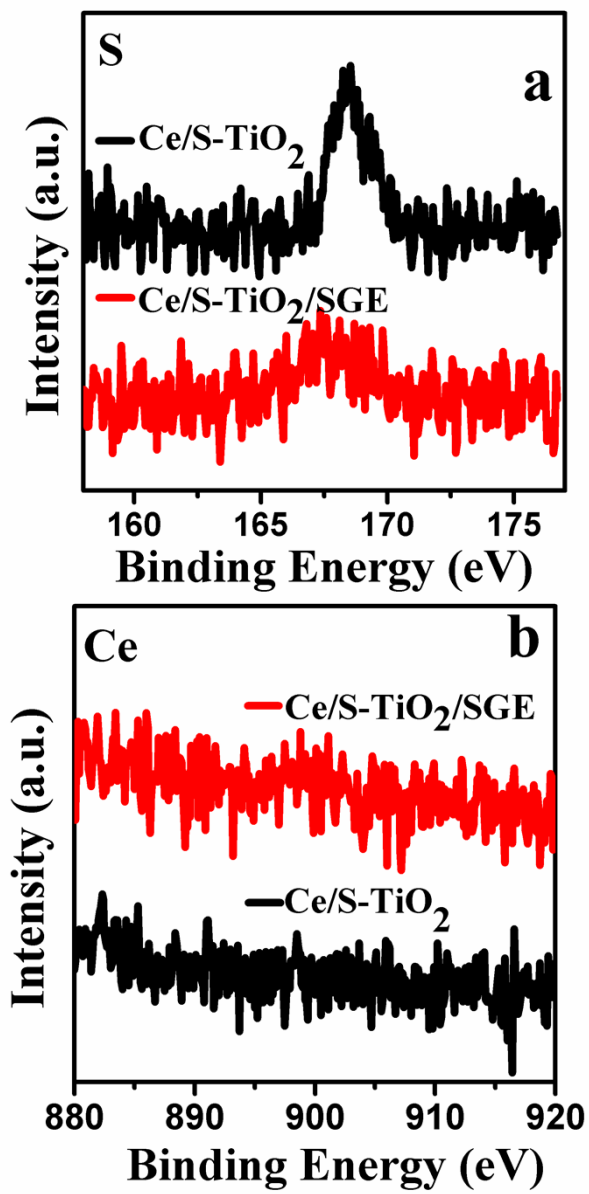


Fig. S2 (a) XPS spectra of S 2p. (b) XPS spectra of Ce 3d.

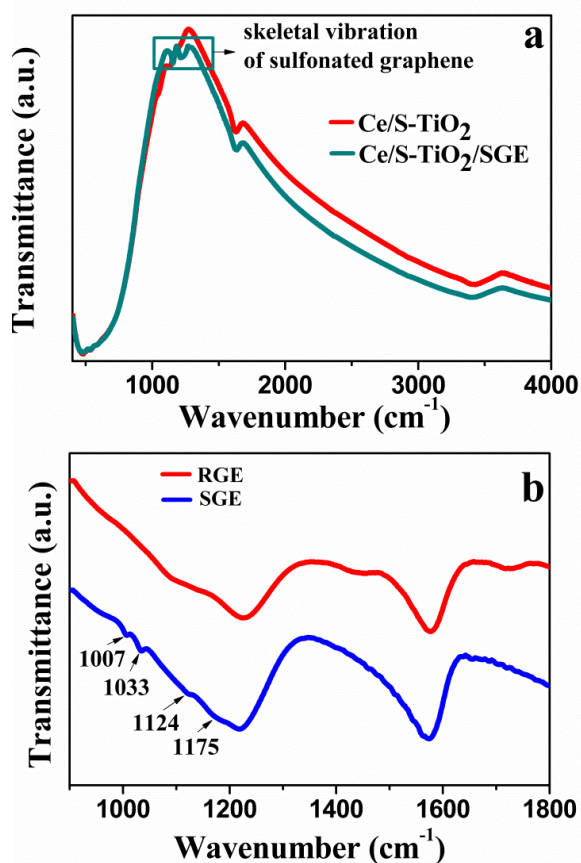


Fig. S3 (a) FTIR spectra of Ce/S-TiO₂ and Ce/S-TiO₂/SGE; (b) FTIR spectra of sulfonated graphene (SGE) and chemical reduced graphene oxide (RGE).

Fig. S3a shows the FTIR spectra of Ce/S-TiO₂ and Ce/S-TiO₂/SGE prepared by depositing Ce/S-TiO₂ NPs on SGE. The broad absorption for samples at low frequency (below 1000 cm⁻¹) is due to the stretching vibrations of Ti-O-Ti bonds in Ce/S-TiO₂ NPs. The peaks at ca. 3430 and 1629 cm⁻¹ are ascribed to the bending vibrations and the stretching of O-H from surface-absorbed water molecules and the surface-bound hydroxyl groups. From Fig. S3a, it can be observed that the surface of Ce/S-TiO₂/SGE would absorb the larger number of water molecules and hydroxyl groups. The reason could be attributed to two aspects. One is that the existence of sulfonic groups (-SO₃H) attaching to SGE can build hydrogen bonds with water molecules and hydroxyl groups.¹ Another is that as the S doped in Ce/S-TiO₂ nanoparticles, there are sulfur oxides presenting on the surface and make the circumstance acidic, so that more hydroxyl groups and hydrones are inclined to gathering to it.^{2, 3} Peaks at ca. 1000-1500 cm⁻¹ are the response of the skeletal vibration of sulfonated graphene whose properties can be also explained in Fig. S3b with comparison to chemical reduced graphene oxide. As shown in Fig. S3b, FTIR spectra were performed to confirm the presence of -SO₃H groups with the peaks displayed at 1033, 1124 and 1175 cm⁻¹, which stand for the bending vibrations and the stretching of S-phenyl and S-O groups. In addition, the characteristic vibrations of the p-disubstituted phenyl group (ν_{C-H} in-plane bending) show their peak at 1007 cm⁻¹.

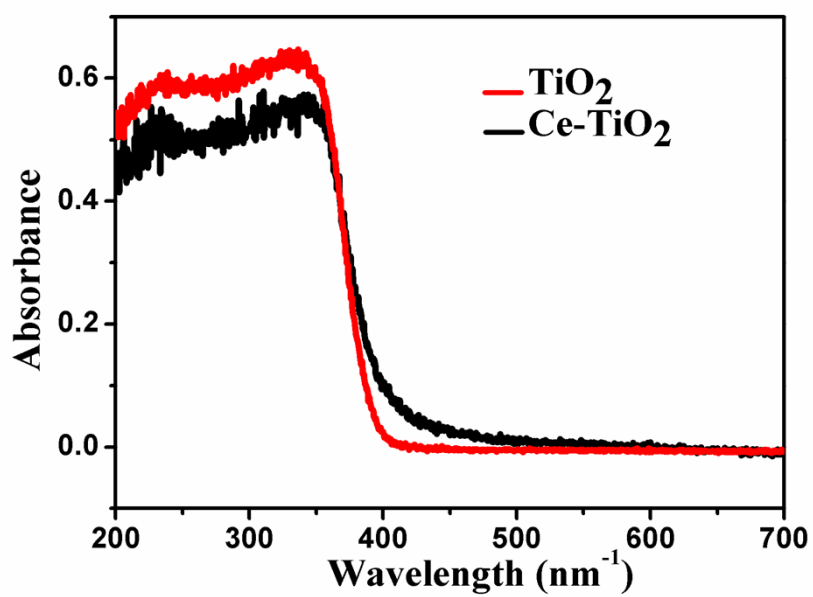


Fig. S4 UV-Vis diffuse reflectance spectra of Ce-TiO_2 and TiO_2 .

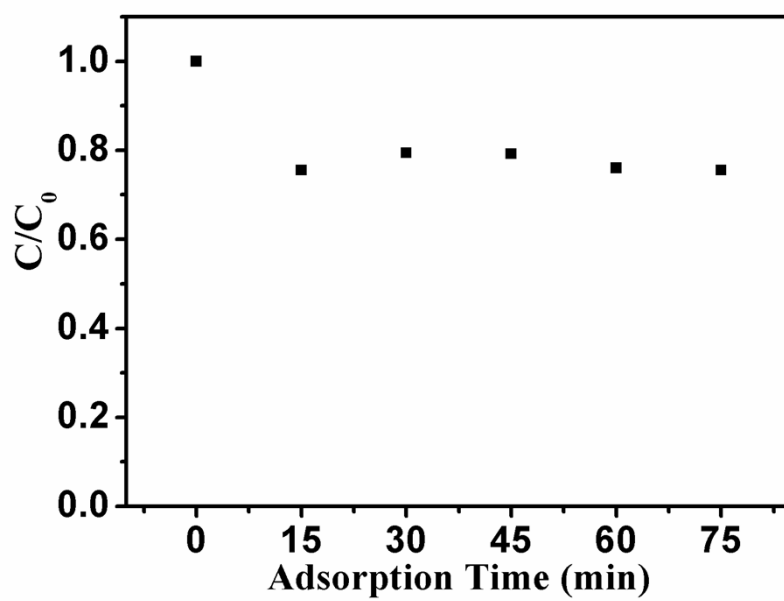


Fig. S5 Adsorption capacity of MO by the sample of $\text{Ce/S-TiO}_2/\text{SGE}$.

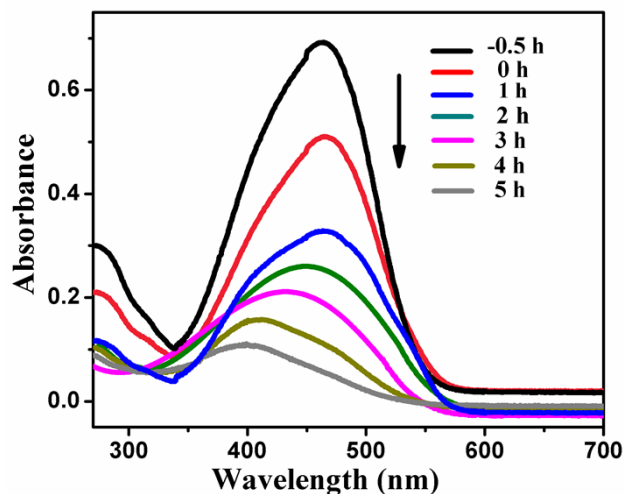


Fig. S6 Typical real-time absorption spectra of MO dye during the photodegradation process over Ce/S-TiO₂/SGE under visible irradiation ($\lambda > 420$ nm). The curves marked as (a) to (g) are the adsorption spectra of MO in the irradiation time.

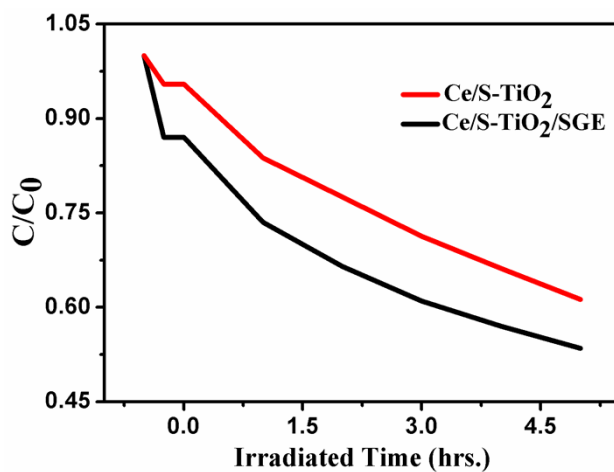


Fig. S7 Photodegradation dynamic curves of MO (50 mL, 20 mg L⁻¹) over Ce/S-TiO₂ (50 mg) and Ce/S-TiO₂/SGE (50 mg).

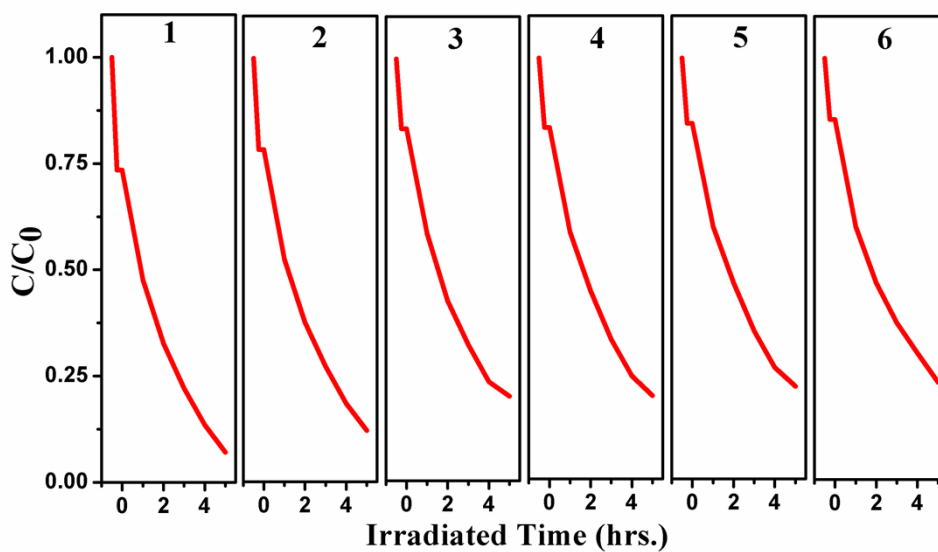


Fig. S8 Six successive photodegradation dynamic curves of MO over Ce/S-TiO₂/SGE.

References

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2. M. Nasir, Z. Xi, M. Xing, J. Zhang, F. Chen, B. Tian and S. Bagwasi, *The Journal of Physical Chemistry C*, 2013, **117**, 9520-9528.
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