Supporting Information

A Facile and Versatile Method for Preparation of Colored TiO₂ with Enhanced Solar-Driven Photocatalytic Activity

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Figure S1. Full XPS survey of P25 TiO₂ and CIOMP-8 on conductive tape.



Figure S2. (a) The diffuse reflectance UV-Vis spectra of colored anatase; (b) Photographs of colored anatase and pristine anatase.



Figure S3. XRD pattern of anatase and colored TiO₂@TiO_{2-x} samples.



Figure S4. (a) The diffuse reflectance UV-Vis spectra of colored rutile; (b) Photographs of colored rutile and pristine rutile.



Figure S5. XRD pattern of rutile and colored TiO₂@TiO_{2-x} samples.



Figure S6. (a) The diffuse reflectance UV-Vis spectra of black TiO_2 (fresh and stored for a year); (b) optical image of black TiO_2 (fresh and stored for a year).



Figure S7. The SEM of pristine P25 (a) and CIOMP-8 (b).



Figure S8. The N_2 adsorption–desorption of P25 (a) and CIOMP-8 (b).



Figure S9. The HRTEM of pristine P25 (a) and TiO_{2-x} sample after NaBH₄ treatment under Ar atmosphere 400 °C 10 h (b).



Figure S10. XRD pattern of P25 and TiO_{2-x} sample after NaBH₄ treatment under Ar atmosphere 400 °C 10 h.



Figure S11. Raman spectra of P25 Degussa and CIOMP samples.



Figure S12. Ti XPS of P25 (a), CIOMP-2 (b), CIOMP-4 (c), CIOMP-6 (d), CIOMP-8 (e), TiO (f).



Figure S13. The IR spectra of P25 and CIOMP-8. Both materials show similar absorption features from 400 cm⁻¹ to 4000 cm⁻¹. The characteristic absorptions at ≈ 500 cm⁻¹ were attributed to the stretching vibrations of the Ti–O bonds of the TiO₄ tetrahedra.^[1] And the peaks at 1630 cm⁻¹ and 3422 cm⁻¹ region could be assigned to the absorption bands of OH. In region of 3600-3800 cm⁻¹, there was no new peaks at 3710 cm⁻¹ that might be caused by hydrogenation^[2] observed, which indicated the hydrogenation of TiO₂ has ignorable contribution on the structure of colored TiO₂ after NaBH₄ treatment.



Figure S14. The photoluminescent spectra of colored TiO_2 and P25. The PL peak intensity of the colored $TiO_2@TiO_{2-x}$ samples reveals a significant decrease compared with pristine TiO_2 , which reveal that these colored $TiO_2@TiO_{2-x}$ samples have relative low radiative recombination rate of photo-generate electrons and holes.^[2]



Figure S15. UV-Vis photocatalytic degradation of methylene orange using CIOMP-6 as photocatalyst.

References

- [1] V. A. Zeitler, C. A. Brown, J. Phys. Chem. 1957, 61, 1174
- [2] Z. Wang, C. Yang, T. Lin, H. Yin, P. Chen, D. Wan, F. Xu, F. Huang, J. Lin, X. Xie, M.
- Jiang, Adv. Funct. Mater. 2013, 23, 5444.