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Supplementary Information

Vanadium doped $CaTiO_3$ cuboids: Role of vanadium in improving the photocatalytic activity

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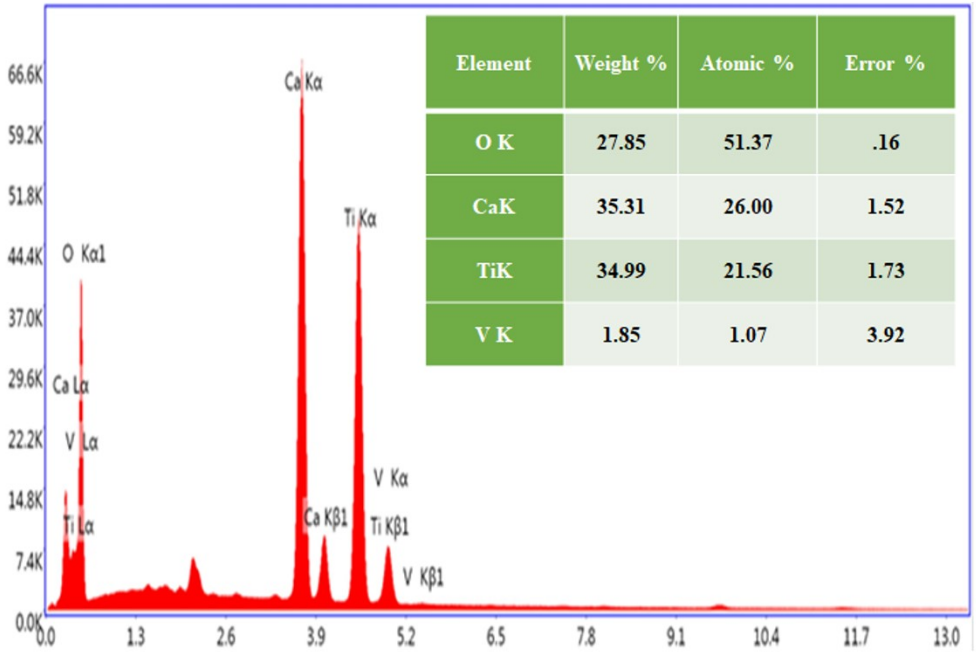
Characterization

The crystal structure and phase purity of the synthesized materials were analysed by using an X-ray diffractometer (XRD, Rigaku Miniflex 600) equipped with monochromatic Cu K_α radiation (λ = 0.154 nm) at a scan rate of 2° per minute in the 2θ range of 20°-80°. The surface morphology of the synthesized semiconductor samples was analysed using field emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM) and high-resolution transmission electron microscopy (HRTEM) (JEOL/JEM 2100). X-ray photoelectron spectrum (XPS) was recorded using Kratos XSAM 800 spectrometer equipped with an Al K_α source. The specific surface area was determined using the Brunauer-Emmett-Teller (BET) method (BEL SORP II, JAPAN). The diffuse reflectance (DR) spectra were recorded using a UV-visible spectrometer (DRS, DR SPECORD S600 Analytic Jena). The photoluminescence (PL) spectra were recorded at room temperature using a fluorescence spectrometer (LS-55, PerkinElmer).



Element	Weight %	Atomic %	Error %
O K	27.85	51.37	.16
CaK	35.31	26.00	1.52
TiK	34.99	21.56	1.73
V K	1.85	1.07	3.92

Figure S1. EDX spectrum of 1.0 V. Inset shows the elemental percentage.

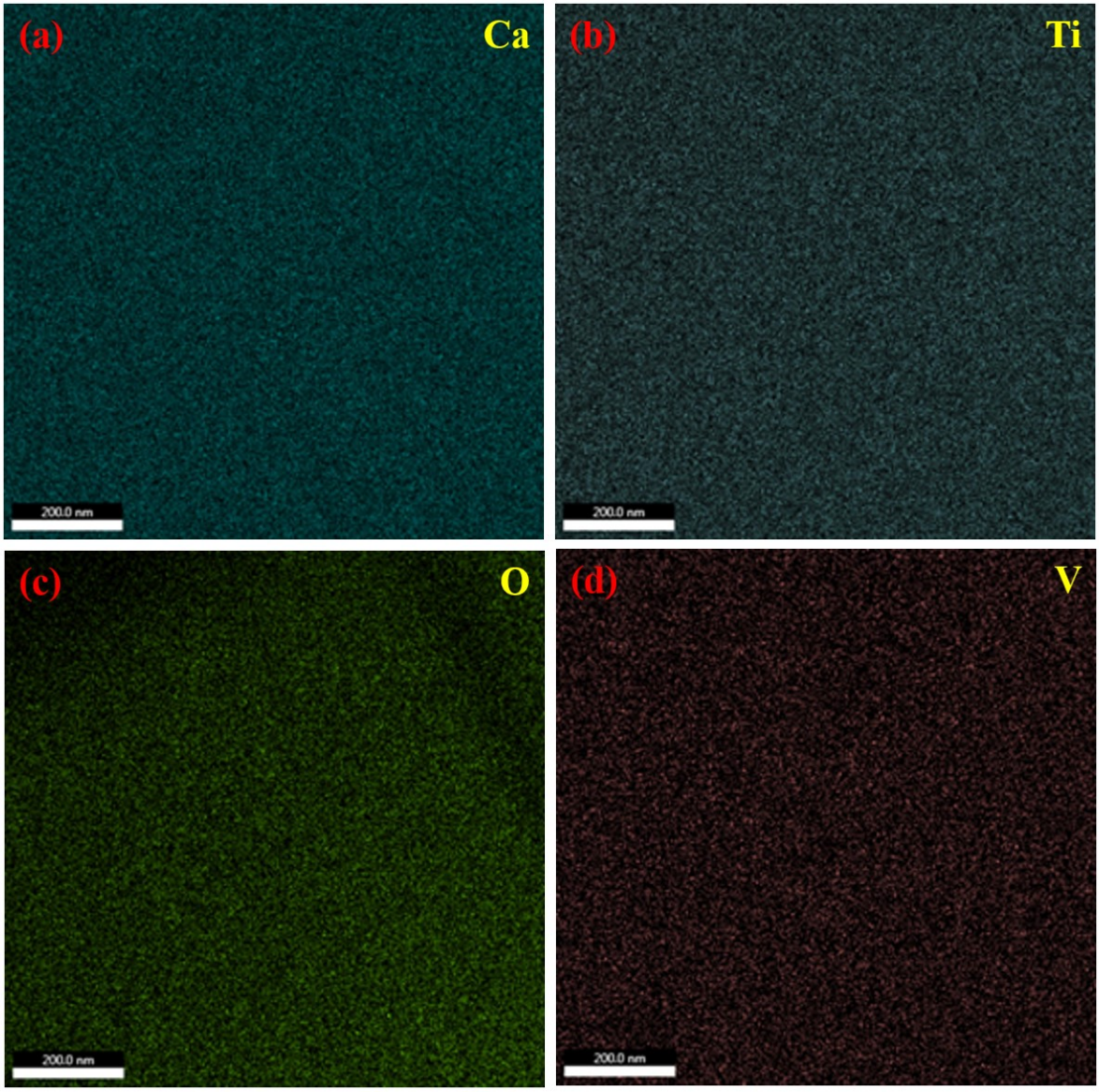


Figure S2. Elemental mapping of a) Ca; b) Ti; c) O; d) V.

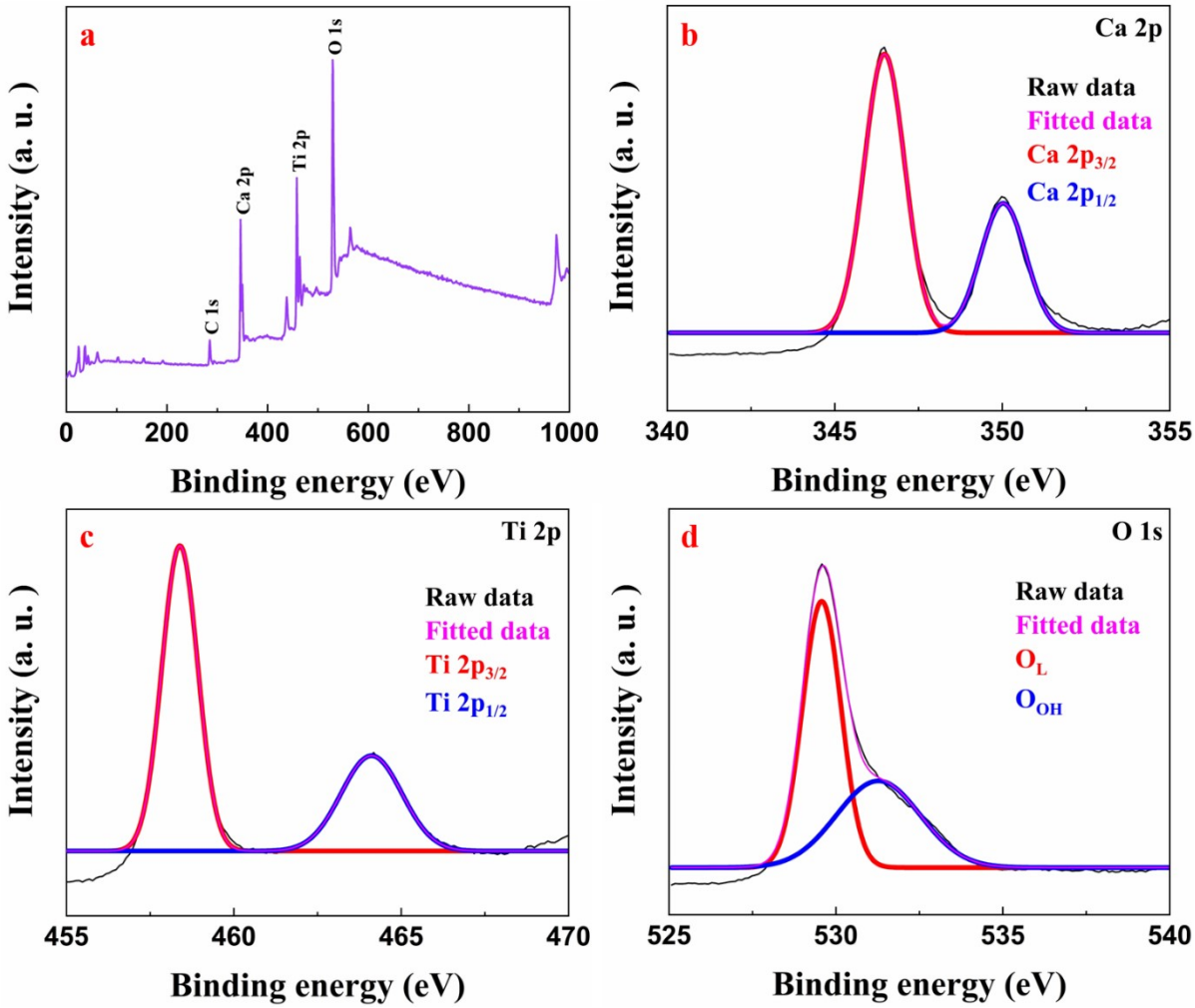


Figure S3. a) XPS survey spectrum of $CaTiO_3$; High resolution XPS spectrum of b) Ca 2p; c) Ti 2p; d) O 1s in $CaTiO_3$.

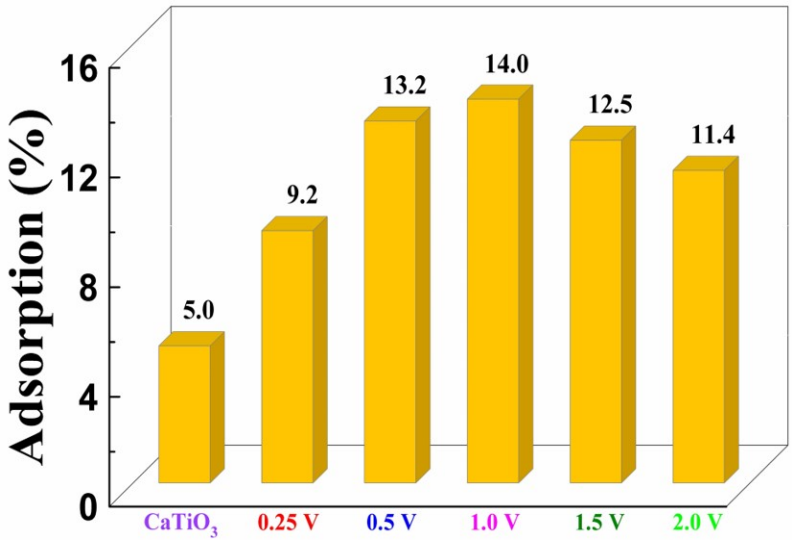


Figure S4. Adsorption percentage of MB on $CaTiO_3$ and V doped $CaTiO_3$ determined by experiments carried out in dark.

Table S1. Comparison of photocatalytic activity of 1.0 V sample with reported literatures.

Photocatalysts	**Light source**	**Test sample**	**Degradation extent and Time**	**Reference**
1.0 V	Visible light source (High pressure 250 W Hg vapor lamp)	Methylene blue	94.2 %, 120 min ($k = 0.0234\ min^{-1}$)	This work
Fe-doped $CaTiO_3$	UV light source (500 W Hg lamp with a wavelength of 365 nm)	Methylene blue	100 %, 180 min	Yang et al. 2014 [1]
Er^{3+}- doped $CaTiO_3$	UV-visible-NIR source (300 W Hg-Xe lamp)	Methylene blue	$k = 11.90\times10^{-5}\ s^{-1}$	Lozano-Sánchez et al. 2015 [2]
Substitutional and interstitial N in $CaTiO_3$	500 W Xe lamp	Methylene blue	$k = 0.0035\ min^{-1}$	Han et al. 2016 [3]
N-doped $CaTiO_3$/RGO composite	Visible light source	Methylene blue	95 %, 180 min	Kumar et al. 2017 [4]
Surface disorder-engineered $CaTiO_3$ nanocuboids	Solar simulator	Rhodamine B	94.7 %, 180 min	Yan et al. 2018 [5]
Rh doped $SrTiO_3$ (1.0 Rh)	Visible light source (High pressure 250 W Hg vapor lamp)	Methylene blue	72.9 %, 120 min ($k = 0.0108\ min^{-1}$)	Shenoy et al. 2018 [6]
Au@$CaTiO_3$ composite	Solar simulator (200 W Xe lamp with wavelength range from 300-2500 nm)	Rhodamine B	99.6 %, 120 min	Yan et al. 2019 [7]
2D/1D g-C_3N_4/$CaTiO_3$ composite	Solar simulator (300 W Xe lamp)	Crystal violet	99.76 %, 180 min	Chen et al. 2020 [8]
Na^+ co-doped $CaTiO_3$:Eu^{3+} powder	UV light source (35 W Hg lamp with a	Methylene blue	96.62 %, 300 min	Chen et al. 2020 [9]

	wavelength of 253.7 nm)			
$MoS_2/CaTiO_3$ heterostructure	300 W Xe lamp	Tetracycline	71.7 %, 60 min	Jiang et al. 2020 [10]
V doped $SrTiO_3$ (1.0 V)	Visible light source (High pressure 250 W Hg vapor lamp)	Methylene blue	83 %, 120 min ($k = 0.0124\ min^{-1}$)	Bantawal et al. 2020 [11]
Rh doped $BaTiO_3$ (0.5 Rh)	Visible light source (High pressure 250 W Hg vapor lamp)	Methylene blue	96 %, 120 min ($k = 0.0245\ min^{-1}$)	Bhat et al. 2020 [12]

References

1. H. Yang, C. Han and X. Xue, Photocatalytic Activity of Fe-Doped $CaTiO_3$ Under UV–Visible Light, *J. Environ. Sci.*, 2014, **26**, 1489-1495.
2. L. M. Lozano-Sánchez, S. Obregón, L. A. Díaz-Torres, S. W. Lee and V. Rodríguez-González, Visible and Near-Infrared Light-Driven Photocatalytic Activity of Erbium-Doped $CaTiO_3$ System, *J. Mol. Catal.*, 2015, **410**, 19-25.
3. C. Han, J. Liu, W. Yang, Q. Wu, H. Yang and X. Xue, Enhancement of Photocatalytic Activity of $CaTiO_3$ through HNO_3 Acidification, *J. Photochem. Photobiol.*, 2016, **322**, 1-9.
4. A. Kumar, S. Kumar, A. Bahuguna, A. Kumar, V. Sharma and V. Krishnan, Recyclable, Bifunctional Composites of Perovskite Type N-$CaTiO_3$ and Reduced Graphene Oxide as an Efficient Adsorptive Photocatalyst for Environmental Remediation, *Mater. Chem. Front.*, 2017, **1**, 2391-2404.
5. Y. Yan, H. Yang, X. Zhao, R. Li and X. Wang, Enhanced Photocatalytic Activity of Surface Disorder-Engineered $CaTiO_3$, *Mater. Res. Bull.*, 2018, **105**, 286-290.
6. U. S. Shenoy, H. Bantawal and D. K. Bhat, Band Engineering of $SrTiO_3$: Effect of Synthetic Technique and Site Occupancy of Doped Rhodium, *J. Phys. Chem. C*, 2018, **122**, 27567-27574.
7. Y. Yan, H. Yang, Z. Yi, R. Li and X. Wang, Enhanced Photocatalytic Performance and Mechanism of Au@$CaTiO_3$ Composites with Au Nanoparticles Assembled on $CaTiO_3$ Nanocuboids, *Micromachines*, 2019, **10**, 254.
8. X. Chen, X. He, X. Yang, Z. Wu and Y. Li, Construction of Novel 2D/1D g-C_3N_4/$CaTiO_3$ Heterojunction with Face-to-Face Contact for Boosting Photodegradation of Triphenylmethane Dyes Under Simulated Sunlight*, J. Taiwan Inst. Chem. Eng.*, 2020, **107**, 98-109.
9. M. Chen, Q. Xiong, Z. Liu, K. Qiu and X. Xiao, Synthesis and Photocatalytic Activity of Na^+ Co-Doped $CaTiO_3$: Eu^{3+} Photocatalysts for Methylene Blue Degradation, *Ceram. Int.*, 2020, **46**, 12111-12119.
10. E. Jiang, N. Song, G. Che, C. Liu, H. Dong and L. Yang, Construction of a Z-scheme MoS_2/$CaTiO_3$ Heterostructure by the Morphology-Controlled Strategy towards Enhancing Photocatalytic Activity, *Chem. Eng. J.*, 2020, **399**, 125721.
11. H. Bantawal, U. S. Shenoy and D. K. Bhat, Vanadium-Doped $SrTiO_3$ Nanocubes: Insight into Role of Vanadium in Improving the Photocatalytic Activity, *Appl. Surf. Sci.*, 2020, **513**, 145858.

12. D. K. Bhat, H. Bantawal and U. S. Shenoy, Rhodium Doping Augments Photocatalytic Activity of Barium Titanate: Effect of Electronic Structure Engineering. *Nanoscale Adv.*, 2020, **2**, 5688-5698.