Supporting Information

A Multifunctional Biocide/Sporocide and Photocatalyst Based on Titanium Dioxide (TiO_2) Co-Doped with Silver, Carbon, Sulfur

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EDX measurement. Scanning Electron Microscope (S-3500N) and adsorbed Electron Detector (S-6542) (Hitachi Science Systems, Ltd.) were used to measure the EDX spectrum and to determine the surface composition of the annealed samples under conditions of 20 keV and 4000x magnification.

Specific surface area, pore volume and pore diameter measurement. Nitrogen adsorption-desorption isotherms of TiO_2–P25 and Ag/(C, S)-TiO_2 (Ag = 0, 0.5, 1, 2, 10 and 20 mol %) were recorded at 77 K on a NOVA-1200 Instrument from Quantachrome Corporation. The Brunnauer-Emmett-Teller (BET) and Barrett-Joyner-Halenda (BJH) methods were used to determine the specific surface area, pore-volume and pore-diameter of samples.

*FT-IR measurement***.** Nicolet NEXUS 670 FTIR was used to record transmittance IR spectra of samples by pelletizing with KBr as reference.

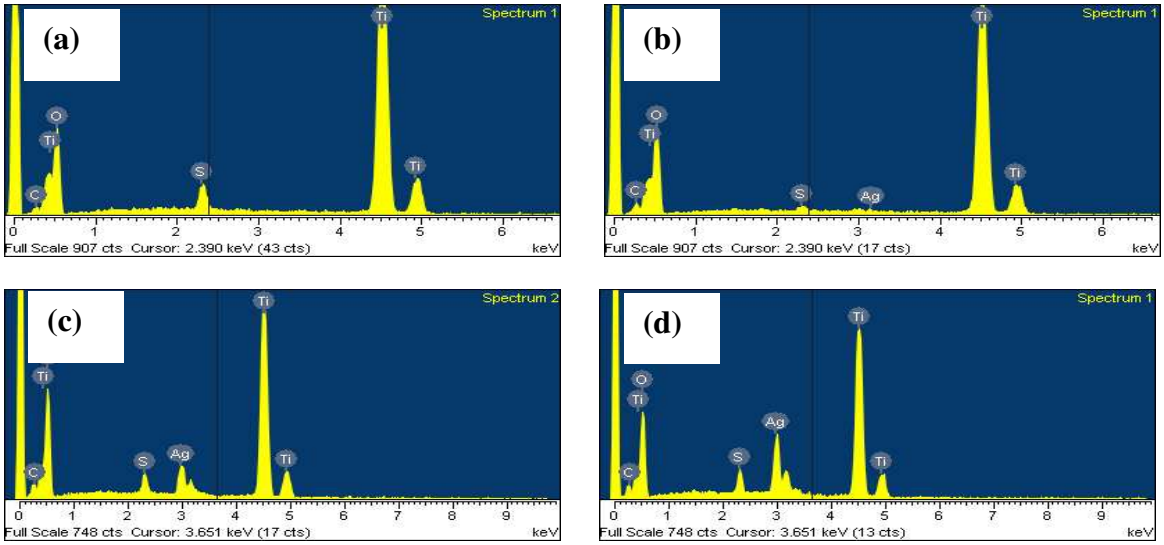

Figure S1**.** EDX spectrum of Ag/(C, S)-TiO_2 sample with initial silver doping (a) 0, (b) 1, (c) 10 and (d) 20 mol%.

Table S1. Amount of carbon and sulfur codoped with silver in TiO_2 samples after heat treatment at 500 °C for 2h in air.

Ag^+ loading (mol %)	C (at. %)	S (at. %)
0	4.8	1.8
1	5.8	1.6
10	10	1.4
20	9.9	1.7

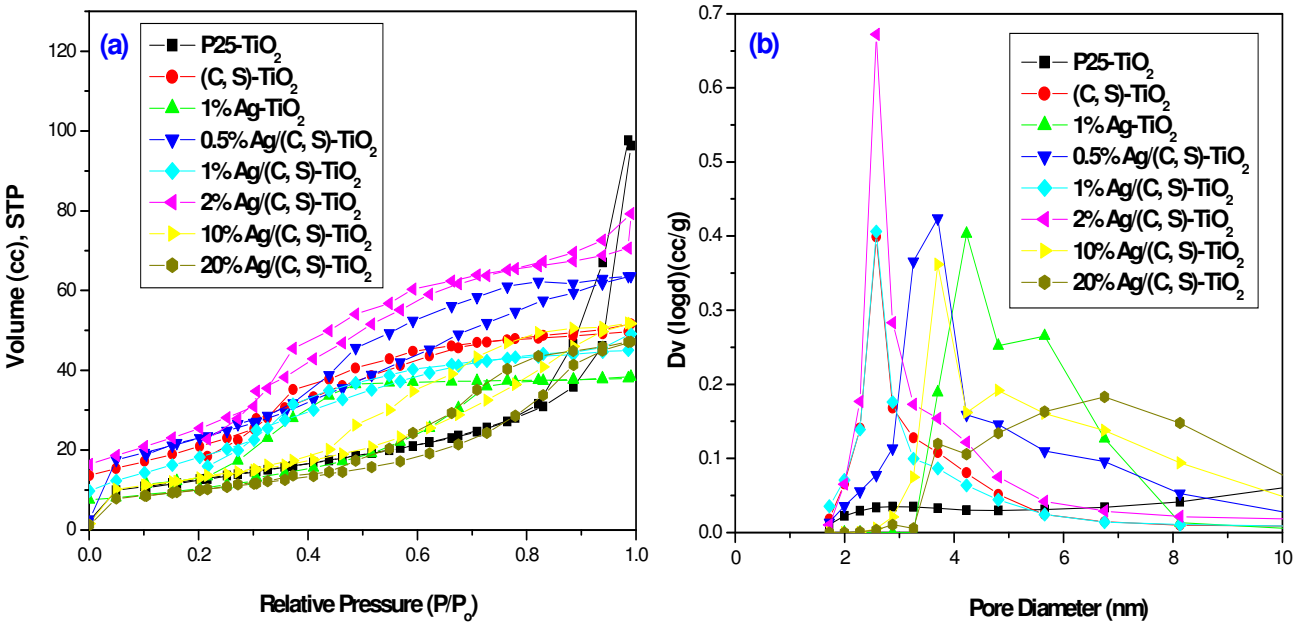

Figure S2. (a) Nitrogen adsorption-desorption isotherms and (b) pore-size distribution of the doped and undoped TiO_2 samples.

Table S2. Specific surface area, pore volume and pore diameter of the samples.

Samples Ag/(C, S)-TiO_2	BET Area (m^2/g)	Pore Volume (cc/g)	Pore Diameter (nm)
TiO_2-P25	45	0.15	2.3
(C, S)-TiO_2	70	0.09	3.4
1% Ag-TiO_2	34	0.07	3.8
0.5% Ag/(C, S)-TiO_2	83	0.1	3.7
1% Ag/(C, S)-TiO_2	68	0.06	3.4
2% Ag/(C, S)-TiO_2	92	0.13	3.4
10% Ag/(C, S)-TiO_2	46	0.09	3.7
20% Ag/(C, S)-TiO_2	36	0.08	3.7

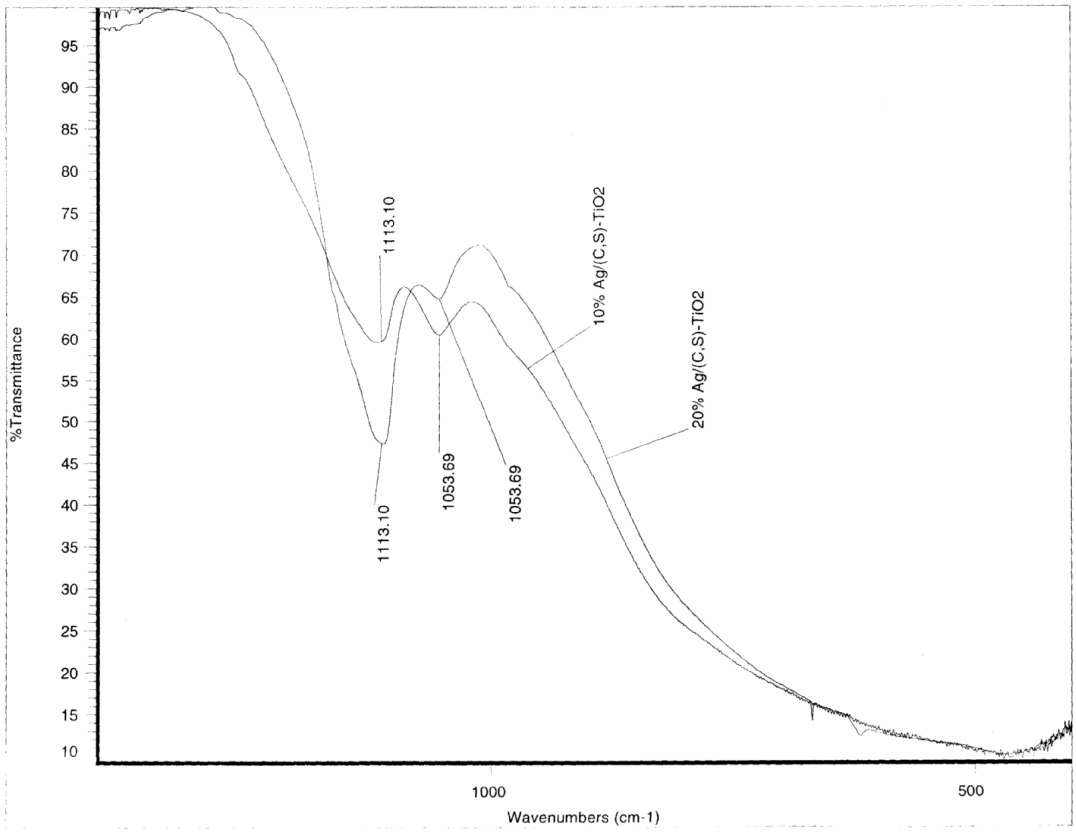

Figure S3. FT-IR spectrum of sulfate species present in 10 and 20 mol% silver doped (C, S)-TiO_2 samples obtained with KBr reference.

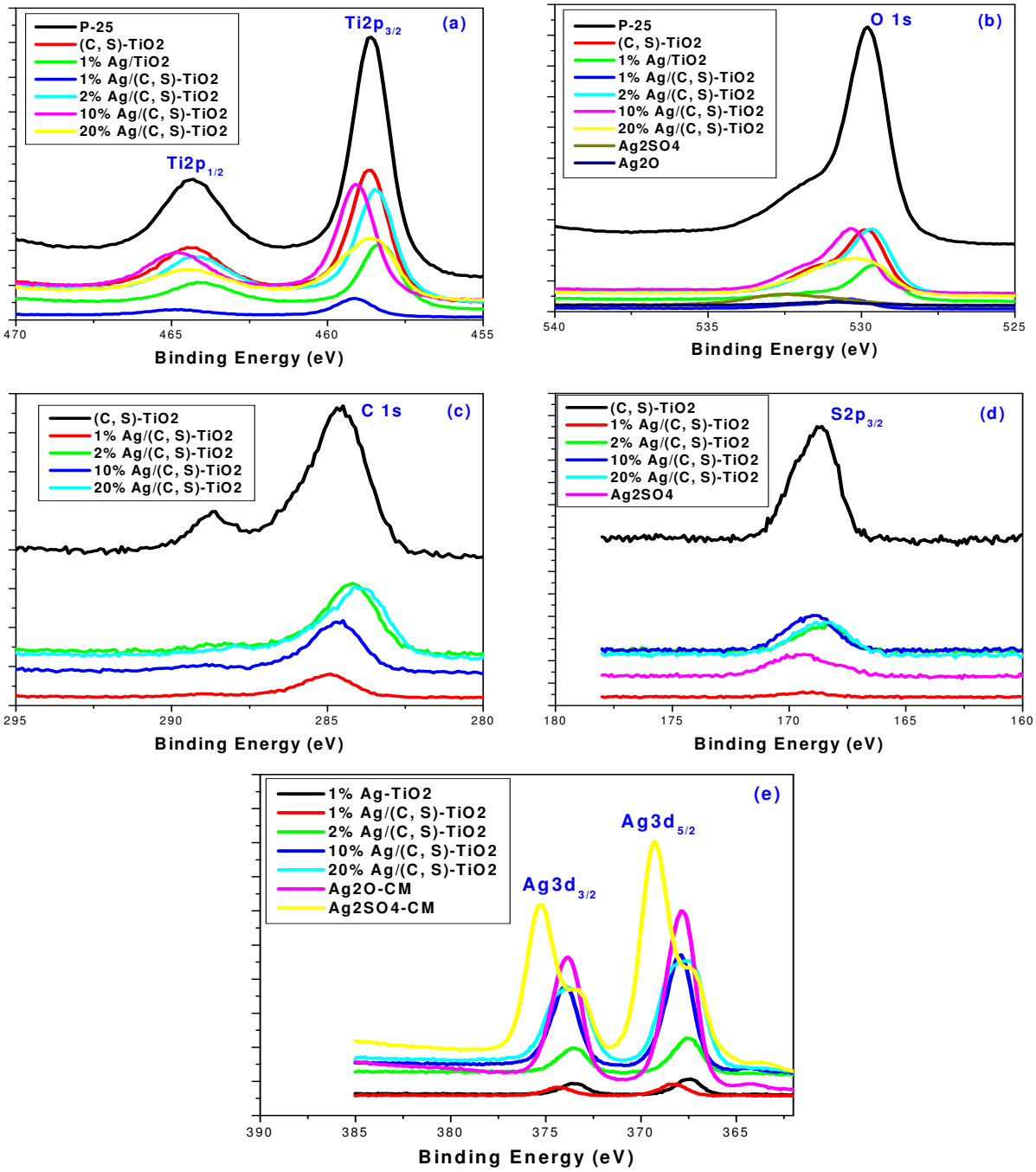

Figure S4. XPS spectra of (a) Ti2p, (b) O1s, (c) C1s, (d) S2p and (e) Ag3d present in various samples.

Table S3**.** Zeta potentials of the doped and undoped TiO_2 samples measured at pH = 3.

Sample	Zeta potential (mV)
P25-TiO_2	+31.4
(C, S)-TiO_2	+0.611
1% Ag-TiO_2	-2.76
0.5% Ag/(C, S)-TiO_2	+1.27
1% Ag/(C, S)-TiO_2	-2.13
2% Ag/(C, S)-TiO_2	+1.17
10% Ag/(C, S)-TiO_2	-5.52
20% Ag/(C, S)-TiO_2	-3.75