Enhancing Photocatalytic CO_2 Reduction and Biological Activity Using Silver Nanoparticles Decorated $ZnTiO_3$/Permutit Composite

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Precursors

Permutit (PT) zeolite powder, purchased from Aladdin, was used in this study. Zinc nitrate ($Zn(NO_3)_2.6H_2O$) and potassium titanyl oxalate ($C_4K_2O_9Ti.2H_2O$) were obtained from Sigma Aldrich. Hydrogen peroxide (H_2O_2), ethylene glycol ($(CH_2OH)_2$), nitric acid (HNO_3), trisodium citrate ($Na_3C_6H_5O_7$, 98%), dilute ammonium hydroxide solution (NH_4OH 5% solution), and silver nitrate ($AgNO_3$) were sourced from Merck Co. Gibco in Germany provided Nutrient agar, Nutrient broth, NaCl DMEM low glucose medium culture, streptomycin, Trypsin/EDTA, and penicillin. MTT dye and dimethyl sulfoxide (DMSO) were purchased from Sigma-Aldrich in Munich, Germany.

Characterization method

The crystalline phases were analyzed by XRD spectra (Bruker D8 Advance, Cu Kα radiation). FTIR spectra were acquired using a Bruker Vertex 70 spectrophotometer. Morphology and texture were examined via FESEM (XL30 model with EDX), while XPS spectra were obtained using a Shimadzu-Amics instrument. EPR spectra were measured with a Bruker E500 spectrometer, and electronic bandgaps were determined using a Shimadzu Solidspec-3700 DUV spectrometer.

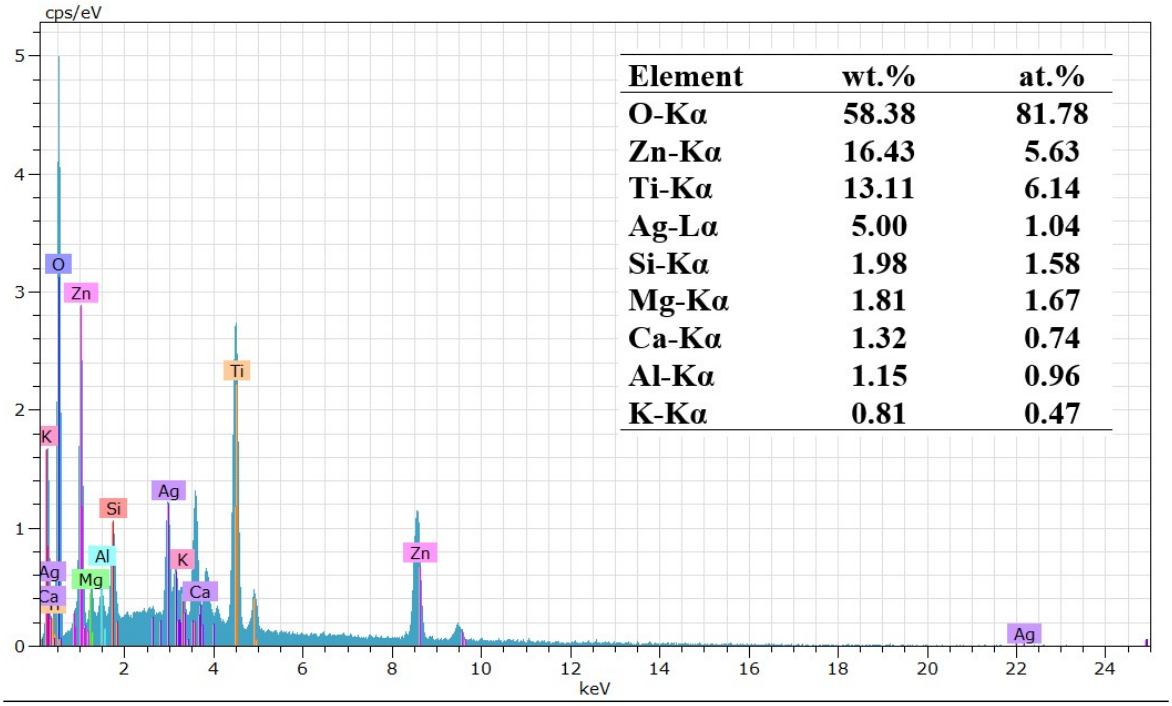

Figure S1. EDX spectrum (inset: weight % and atomic % table) of Ag/$ZnTiO_3$/PT.

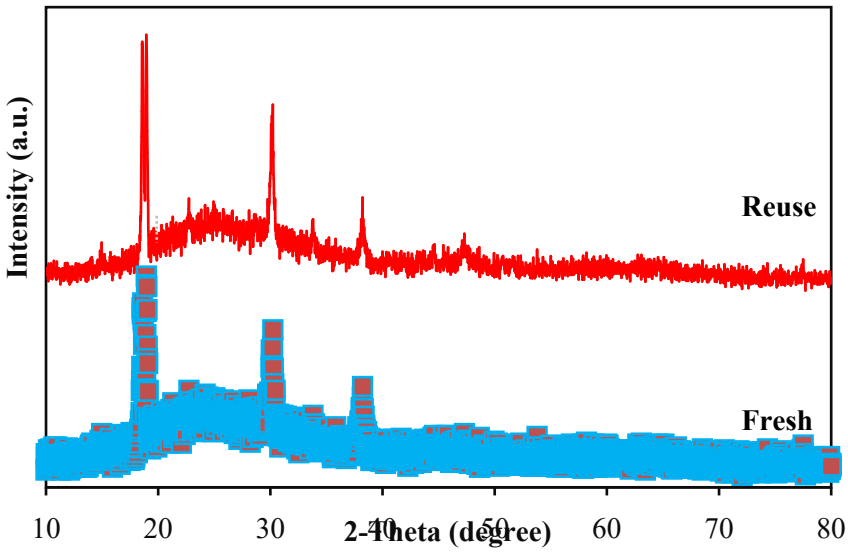

Figure S2. XRD patterns of the Ag/ZnTiO3/PT composite before (Fresh) and after (Reuse) the recycling experiment.

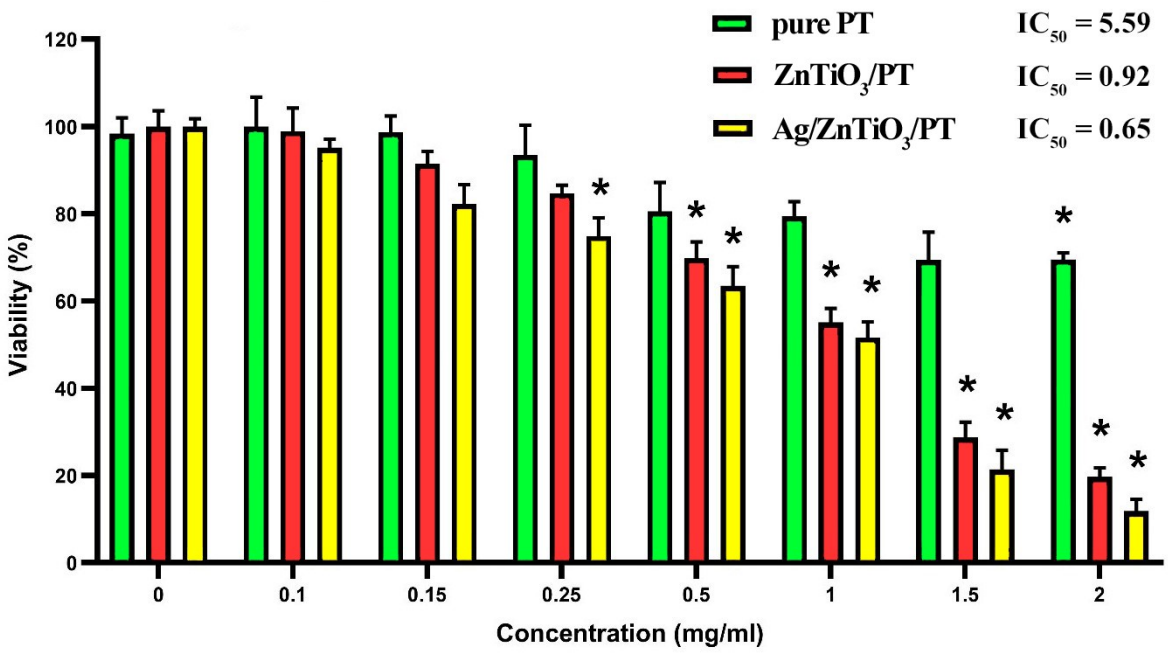

Figure S3. Assessment of $ZnTiO_3$/PT and Ag/$ZnTiO_3$/PT effects on MDA-MB-231 cell viability using the MTT assay after 24 h. Results are mentioned as mean ± SD from at least three independent experiments (* $P \leq 0.05$). 50% inhibitory concentrations were depicted.

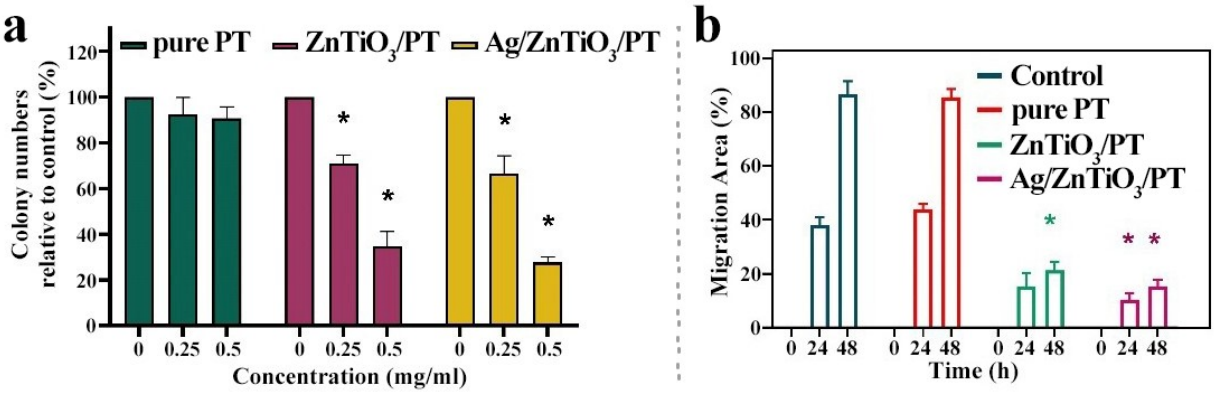

Figure S4. The bar graph (a) shows the colony percentage formed at various concentrations of $ZnTiO_3$/PT and Ag/$ZnTiO_3$/PT. The bar chart (b) represents a quantitative analysis of scratch closure changes. Compared to control, $ZnTiO_3$/PT and Ag/$ZnTiO_3$/PT treatments significantly showed anti-migratory effects on cells. Data are mean ± SD (*$P < 0.05$) of three experiments.

Table S1. The performance of $Ag/ZnTiO_3/PT$ for photocatalytic CO_2RR using water vapor as reducing agent in comparison to previously-reported catalysts.

Sample	Irradiation source	Products	Yields (μmol g^{-1} h^{-1})	CO selectivity	References
Ag-TiO_2/Zeolite TS-1	UV-Vis[a]	CH_4/CO	0.47/3.16	~87%	[1]
TiO_2/ZnO	UV-Vis[a]	CH_4/CO	12.87/2.13	~14%	[2]
$Ag_{3.0\%}/TiO_2$	UV-Vis[a]	CH_4/CO	17.2/44.1	~72%	[3]
Cu NCs/defective TiO_2	UV-Vis[a]	CH_4/CO	19.63/2.0	~9%	[4]
Zeolite HZSM-5	UV[b]	H_2/CO	0.65/3.32	~84%	[5]
$Zn_2Ti_3O_8/ZnTiO_3$	UV[c]	CH_4/CO	0.56/3.68	~87%	[6]
P25 (TiO_2)	Visible[a*]	CH_4/CO	0.16/0.53	~77%	[7]
SnO/CSO	Visible[a*]	CH_4/CO	1.18/10.8	~90%	[8]
$Ag/ZnTiO_3/PT$	Visible[a*]	CH_4/CO	0.73/13.01	~95%	This work

[a] 300 W Xe lamp; [b] fluorescent UV tube; [c] Philips TUV 4W; [*] with a $\lambda \geq 420$ nm cut-off filter.

Table S2. MICs and MBCs for pure PT, $ZnTiO_3$/PT, and Ag/$ZnTiO_3$/PT nanocomposites on *P. aeruginosa* and *S. aureus* in mg/mL.

Sample	*S. aureus*		*P. aeruginosa*	
	MIC	MBC	MIC	MBC
pure PT	2	-	4	-
$ZnTiO_3$/PT	0.5	2	2	4
Ag/$ZnTiO_3$/PT	0.5	1	1	2

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