Supporting Information

Enhanced photocatalytic activity of TiO_2 modified with GaI towards environmental application

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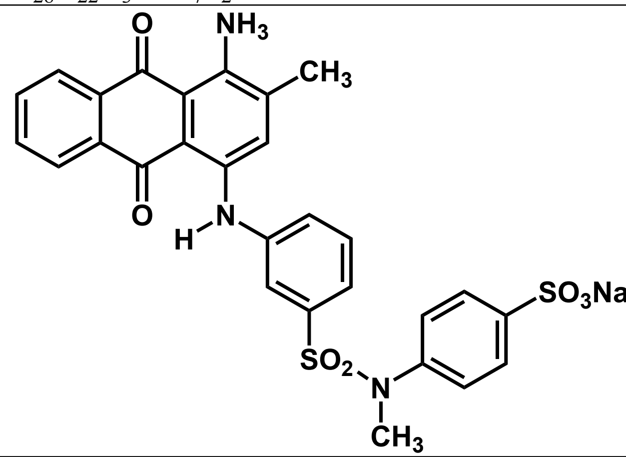
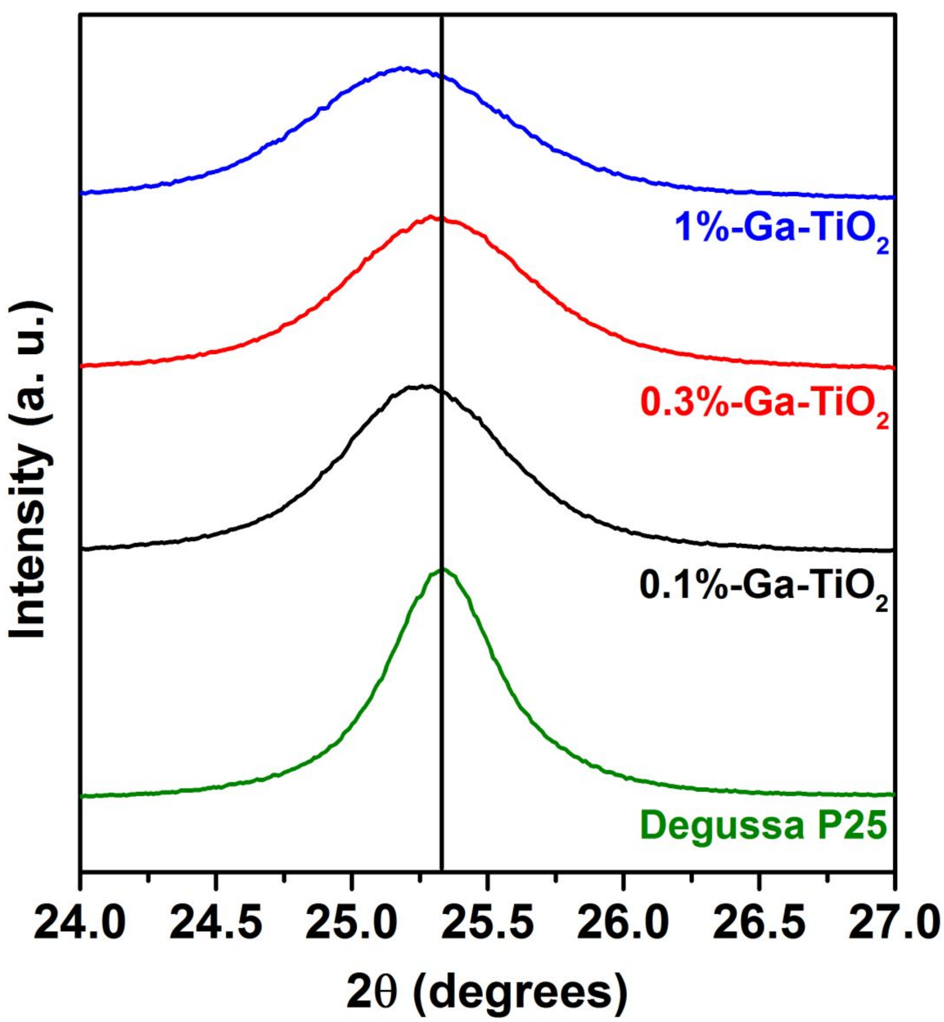
Table S1: Acid Violet 63 (C.I. # 62160) dye chemical property of the industrial dye.

Dye	Acid violet 63
Molecular formula	$C_{28}H_{22}N_3NaO_7S_2$
Molecular structure	
Molecular Weight	599.61 g/mol



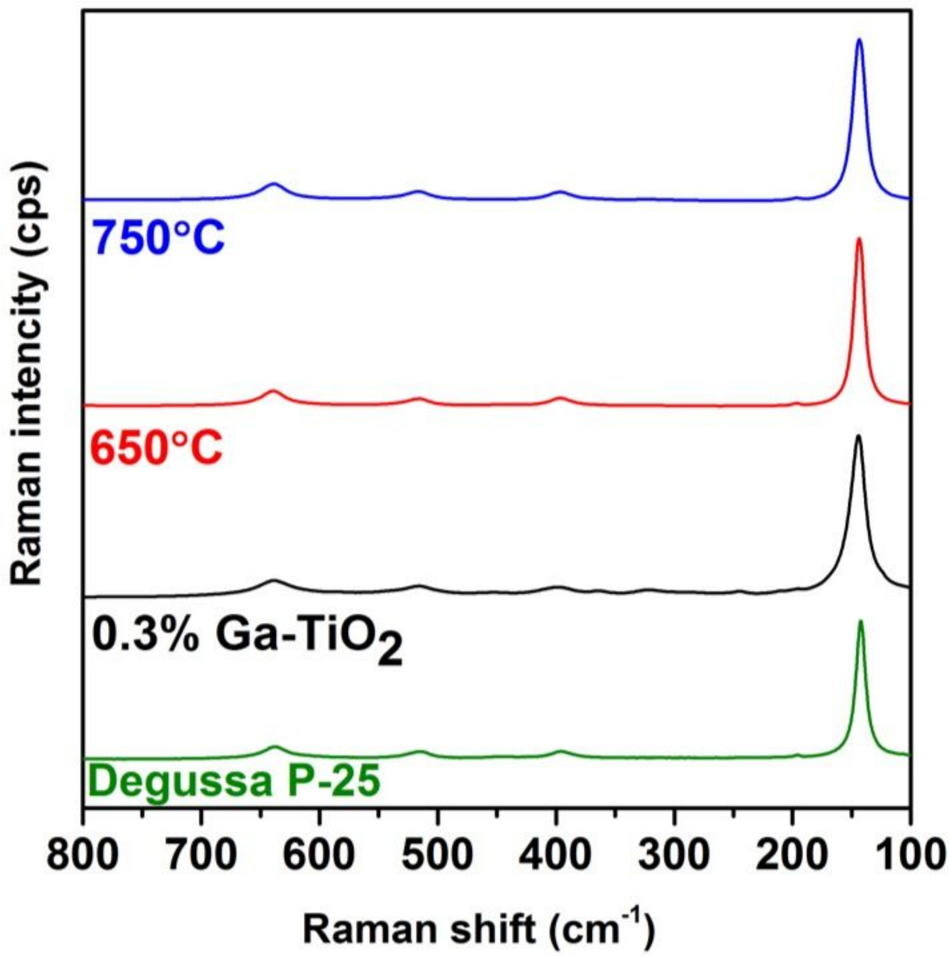


Figure S1:

Magnified PXRD pattern of (101) plane of Ga-TiO_2 (0.1%, 0.3%, 1% Gallium (Ga) ion) nanocomposite and Degussa P25 shows a shift towards lower 2θ with the increase of Gallium ion dopant concentration.

Figure S2: Raman spectra of as-prepared 0.3% Ga-TiO_2 (at 400^{o}C) nanopowder and sintered at 650^{o}C and 750^{o}C.

Table S2: Summarised XPS data of O, Ti and Ga species within Degussa P25 and 0.3% Ga-TiO_2 nanocomposite.

Element	Electronic level	Summarised parameter	0.3% Ga-TiO_2	Degussa P25
O1s	Ti–O	B.E. (e.V.)	529.5	529.8
		FWHM (e.V.)	1.10	1.08
		[a]Area (%)	81	85
	Ti–OH	B.E. (e.V.)	531.2	530.9
		FWHM (e.V.)	2.21	1.94
		[a]Area (%)	18	14.1
Ti2p	Ti^{+4} $2p_{3/4}$	B.E. (e.V.)	458.3	457.4
		FWHM (e.V.)	1.03	0.97
		[b]Area (%)	57.62	53.40
	Ti^{+4} $2p_{1/2}$	B.E. (e.V.)	464.1	463.1
		FWHM (e.V.)	2.09	2.15
		[b]Area (%)	30.89	32.01
	Ti^{+3} $2p_{3/2}$	B.E. (e.V.)	459.9	458.7
		FWHM (e.V.)	4.4	4.02
		[c]Area (%)	11.5	14.57
Ga2p	$Ga2p_{2/3}$	B.E. (e.V.)	1118.16	
		FWHM (e.V.)	1.47	—
		[d]Area (%)	28.68	
	$Ga2p_{1/2}$	B.E. (e.V.)	1145.02	
		FWHM (e.V.)	1.19	—
		[d]Area (%)	11.18	

(a) Concerning all space under the O1s curve.

(b) Concerning all space under the Ti2p curve.

(c) Concerning all areas under the Ti $2p_{3/2}$ curve only.

(d) Concerning all space under the $Ga2p_{2/3}$ and $Ga2p_{1/2}$ curve.

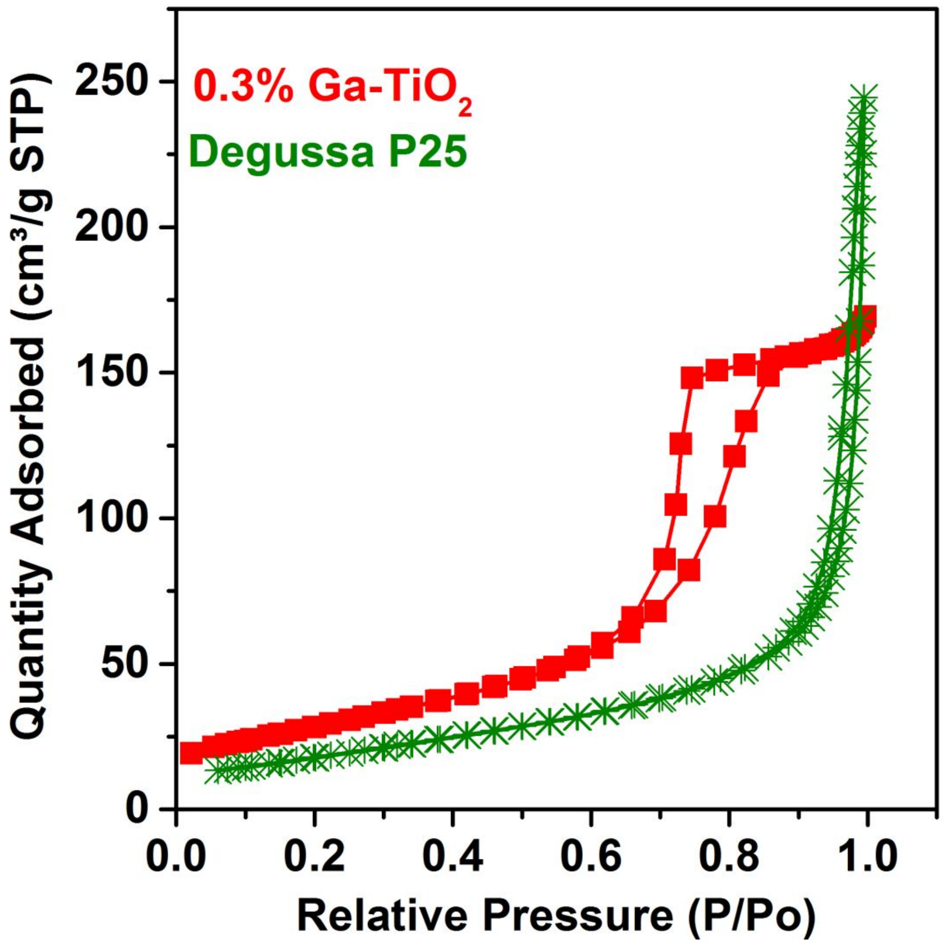


Figure S3: N_2 adsorption and desorption isotherms analyzed from 0.3% Ga-TiO_2 and Degussa P25.

Table S3: Summarized structural properties of Ga-doped TiO_2 nanocomposite and Degussa P25

photocatalyst	Particle size (nm)	Bandgap (e.V.)	BET surface area (m^2/g)	Pore volume (cm^3/g)
Degussa P25	14.17	3.32	52	0.097
0.1%Ga-TiO_2	10.13	3.24	101	0.24
0.3%Ga-TiO_2	9.09	3.19	104	0.39
1%Ga-TiO_2	8.22	3.14	102	0.22

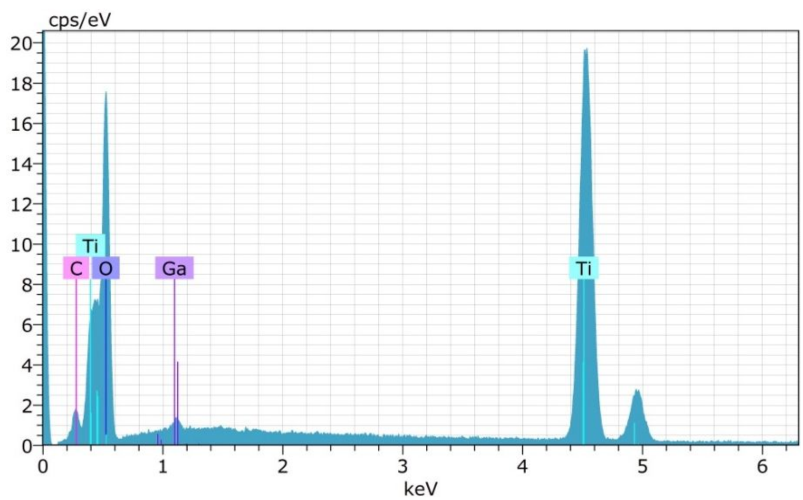
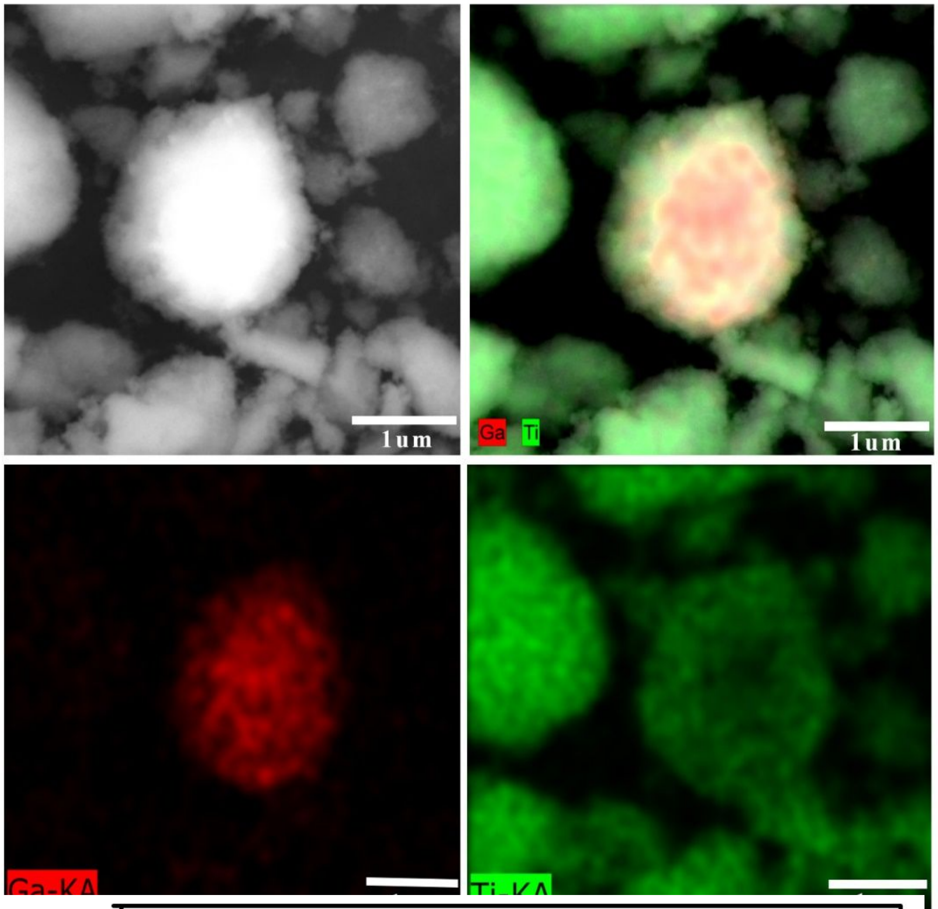


Figure S4: EDX analysis of 0.3% Ga-TiO_2



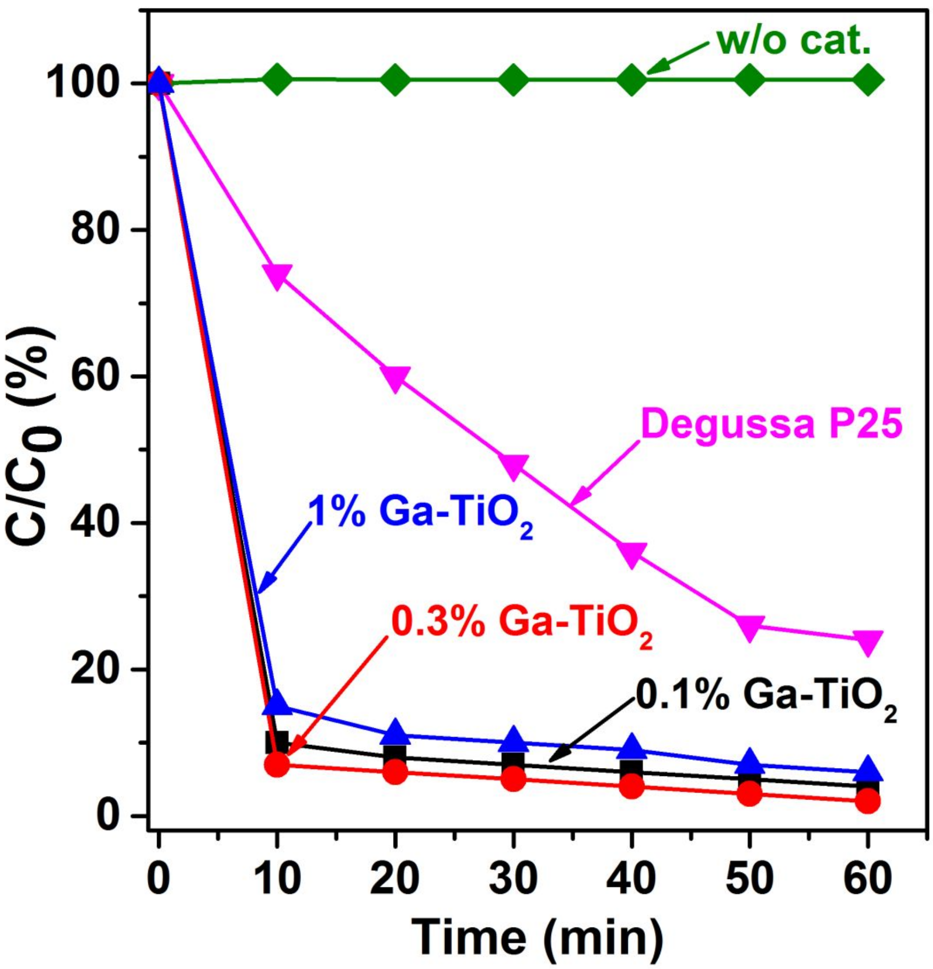


Figure S5: Mapping image of Gallium (Ga-K) and Titanium (Ti-K)

Figure S6: Change in concentration of acid violet 63 by utilizing various Ga-TiO_2 photocatalyst (0.1%, 0.3%, 1% Gallium(Ga) ion) and Degussa P25 under UV-light irradiation.

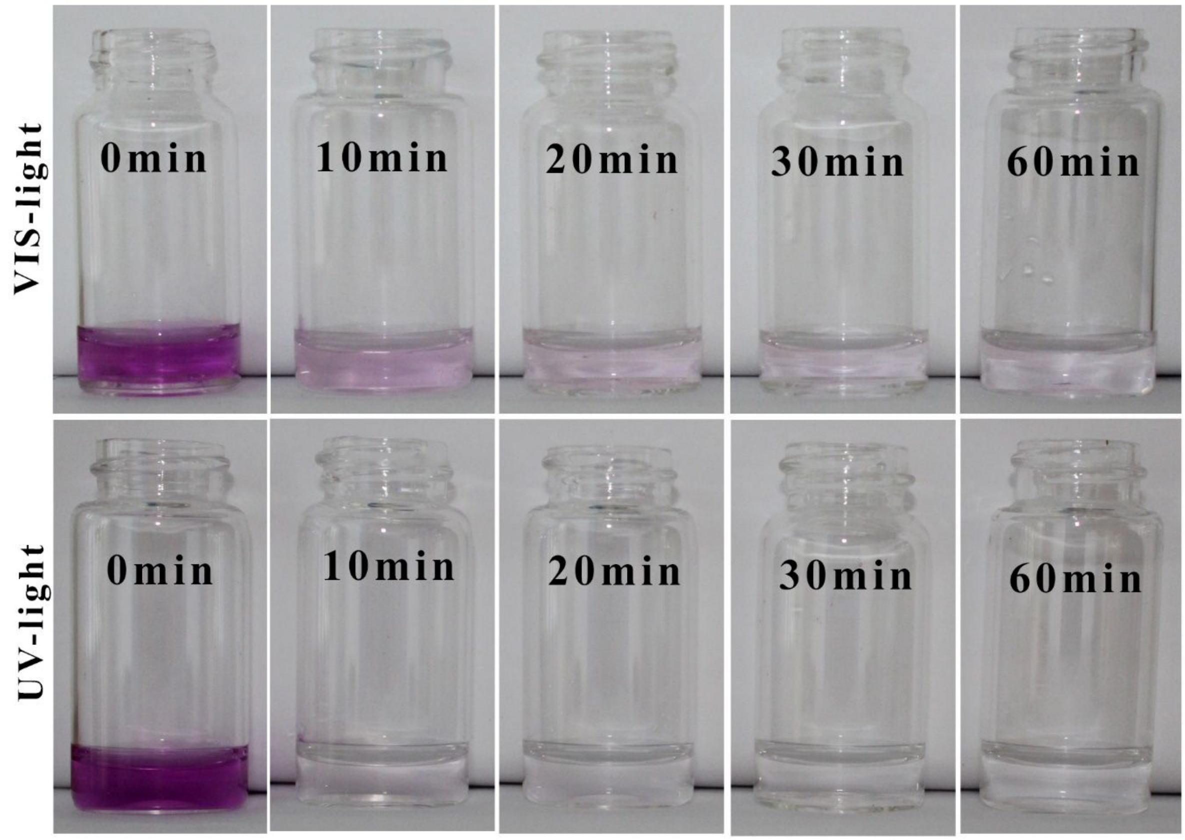


Figure S7: Degradation of acid violet 63 dye solution at the various interval of time under visible and UV- irradiation using 0.3% Ga-TiO_2 nanocomposite.

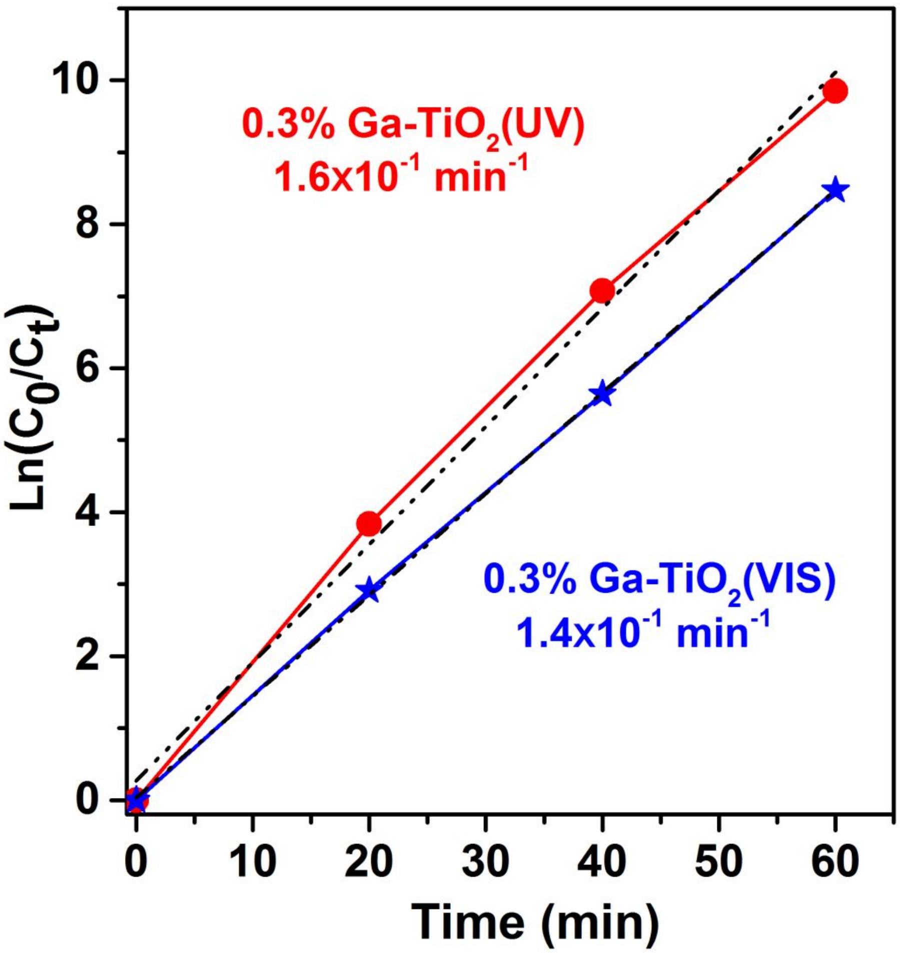


Figure S8: Pseudo 1st order kinetic analysis (Longmuir-Hinshelwood model) and apparent rate constant of acid violet 63 using 0.3% Ga-TiO_2 under UV and visible irradiation.

Table S4: Doping on Titanium oxide (TiO_2) to improve its photocatalytic activity in concern of wastewater treatment

Catalyst	**Amount of catalyst used for photocatalytic activity (g L^{-1})]**	**Dye**	**Dye´s degradation (%)**	**Synthetic method**	**Remarks**	**Ref**
Low valent (GaI) Gallium - TiO_2	0.4g L^{-1}	Acid Violet 63 20 ppm	~95%-0.1% Ga-TiO_2; 97% - 0.3% Ga-TiO_2; 94% - 1% Ga-TiO_2	Sol-gel synthesis	Complete removal of dye withing 60 min and the rate constant value obtained 1.6×10 min^{-1} under UV irrqdiation.	Current Report
Lanthanide (Ln) ions – TiO_2	0.25 g L^{-1}	Direct Blue (DB53): 100 ppm	~91.5%- Gd-TiO_2; 90.0% - Eu-TiO_2; 89.8% - Yb-TiO_2	Sol-gel synthesis		13
(Sm^{3+}, Nd^{3+}, Ce^{3+}, Pr^{3+}) – TiO_2-SiO_2	1g L^{-1}	Reactive Black 5: 10 ppm	>91.2% - Ce-TiO_2-SiO_2; 60–90% - Sm, Nd, Pr-doped TiO_2-SiO_2	Titania and silica composites by sol-gel method with TBT and TEOS as precursors		14
C-N: TiO_2	2.0 g L^{-1}	Methylene blue: $2.7 \times 10{-}5$ mol L−1	96%	Hydrolysis-polymerization	Higher dopant amount not usually increased catalytic activity	16
P-Doped TiO_2	0.2 g L^{-1}	Bisphenol A: 12 ppm	90.3% natural sunlight 98.9% UV irradiation	Sol-gel method	Undoped TiO_2 showed rutile phase at 800 ◦C	17
S-Doped Degussa P25	2.0 g L^{-1}	Orange (II): 10 ppm	100%	Hydrolysis	Activity-dependent on amount doped S Increase of S (>3 times) reduced activity	18