

HYDROTHERMAL SYNTHESIS OF rGO-TiO₂ COMPOSITES AS HIGH-PERFORMANCE UV PHOTOCATALYSTS FOR ETHYL PARABEN DEGRADATION

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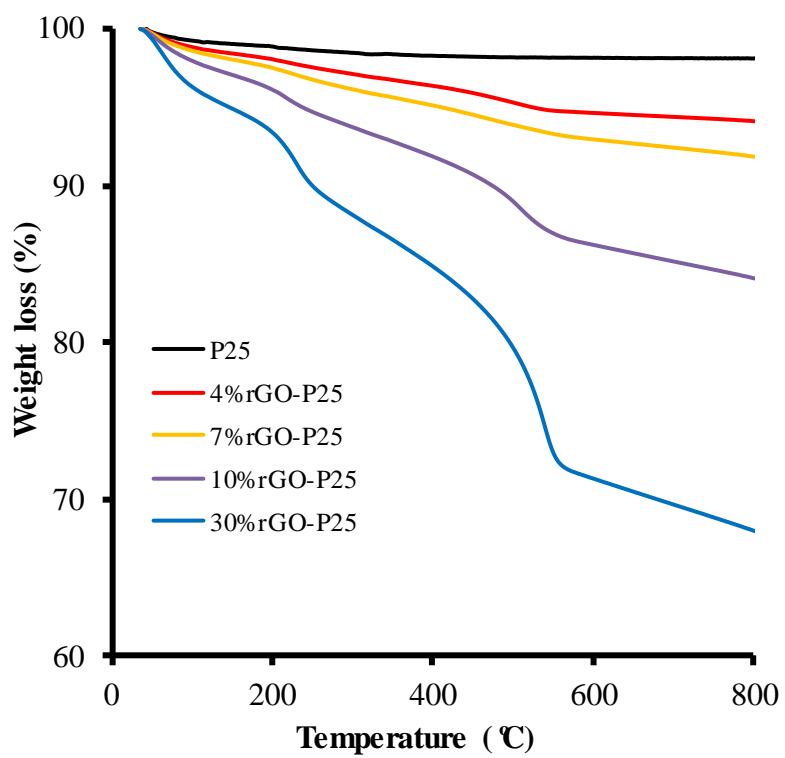


Figure S1. Thermogravimetric analysis curves for P25 and x%rGO-P25.

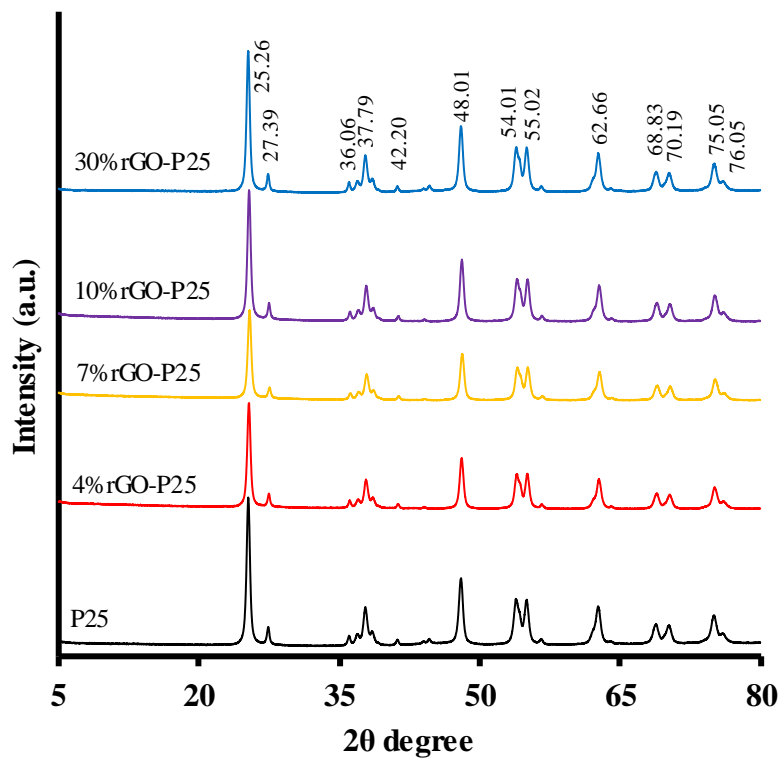


Figure S2. XRD patterns for rGO-P25 composites.

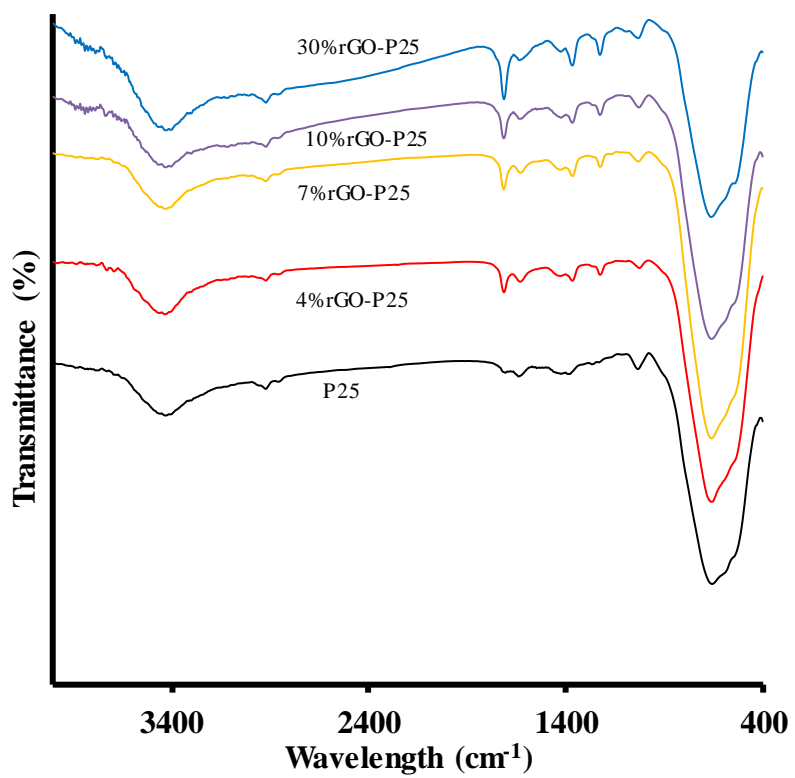


Figure S3. FTIR spectra of P25 and rGO-P25 composites.

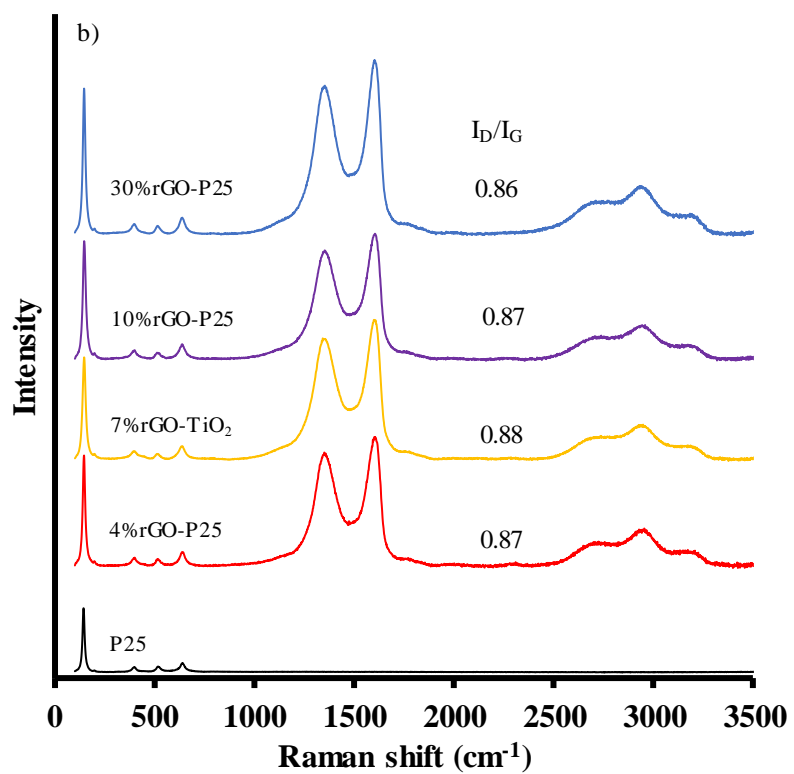


Figure S4. Raman spectra of P25 and rGO-P25 composites.

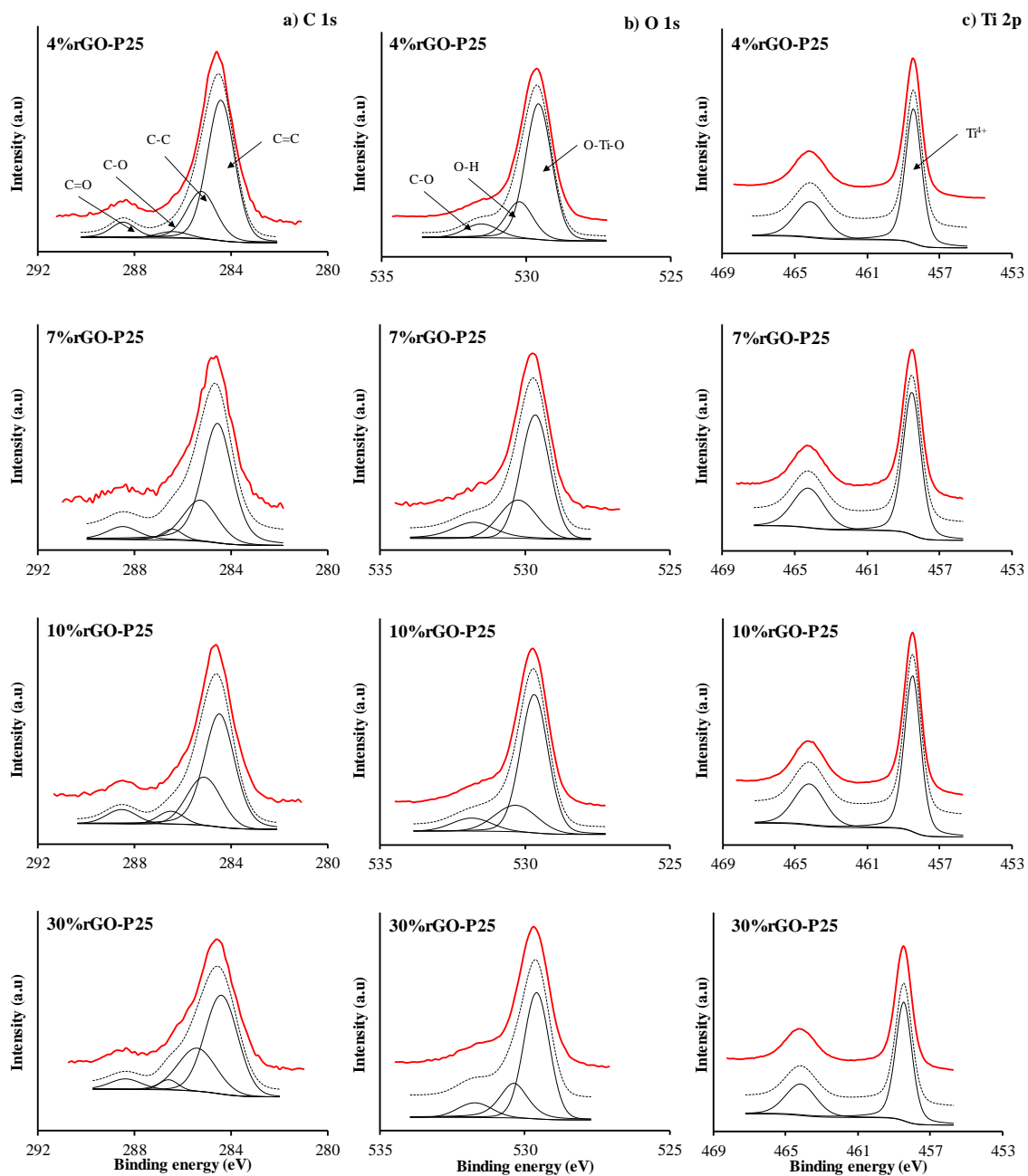


Figure S5. XPS profiles of rGO-P25 composites: a) C 1s spectra; b) O 1s spectra and c) Ti 2p spectra. Continuous red line: experimental profile; discontinuous black line: fitted profile.

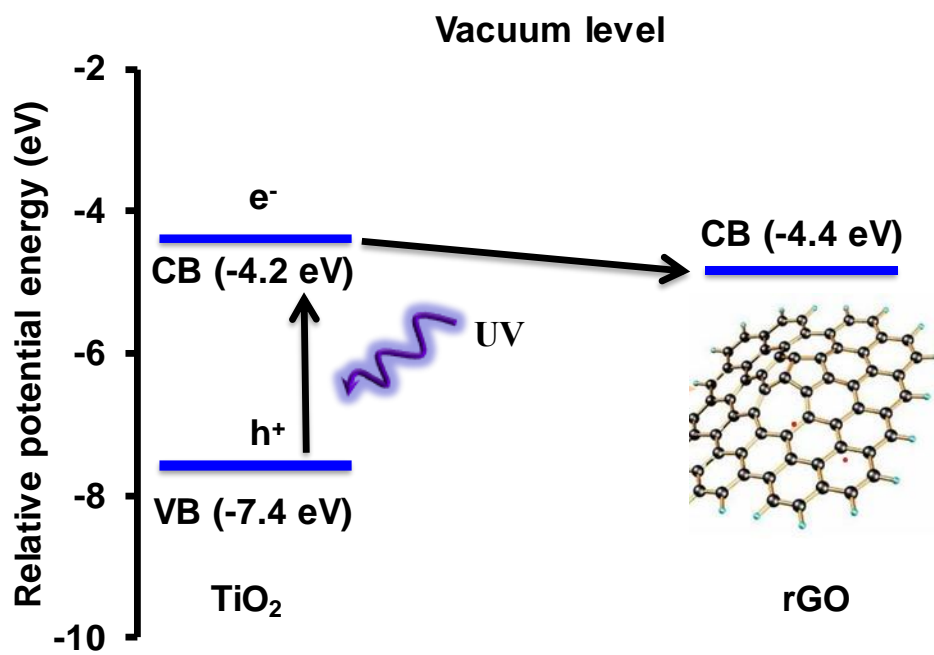


Figure S6. Schematic diagram of the energy levels for rGO and TiO₂

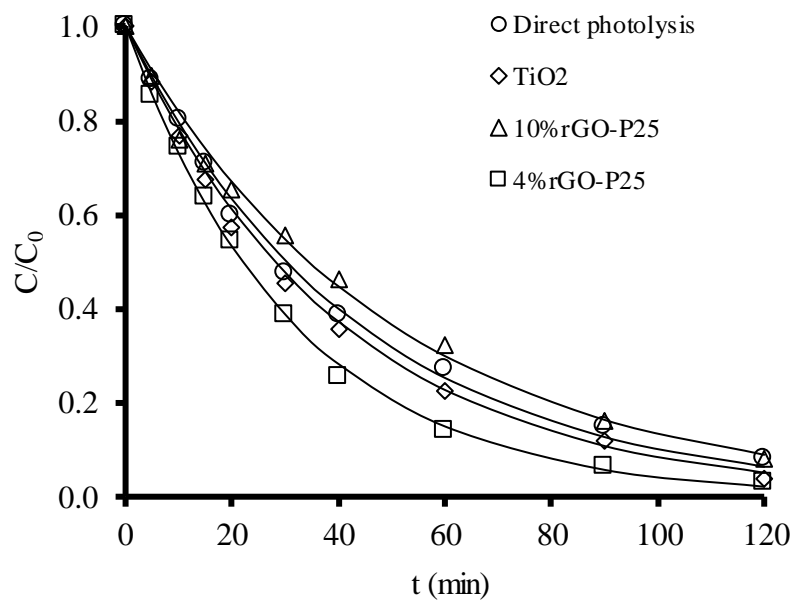


Figure S7. Photodegradation kinetics of EtP under UV radiation in the presence of rGO-P25 composites as a function of treatment time. $[\text{EtP}]_0 = 0.30 \times 10^{-3} \text{ mol/L}$, $[\text{catalyst}]_0 = 0.7 \text{ g/L}$.

Table S1. Parameters obtained from XR diffractograms: diffraction peak position (2θ), full-width at half maximum (FWHM), and crystal size (D_{101}).

Composite	2θ (°)	FWHM (°)	D_{101} (nm)	% rutile
P25	25.27	0.396	20.6	14.1
4%rGO-P25	25.33	0.390	20.9	14.4
7%rGO-P25	25.40	0.410	19.9	13.9
10%rGO-P25	25.35	0.385	21.2	14.0
30%rGO-P25	25.26	0.384	21.2	13.2

Table S2. Parameters obtained from Raman spectra for P25 and rGO-P25 composites.

Sample	Mode E_g cm⁻¹	Band D cm⁻¹	Band G cm⁻¹	I_D/I_G	L_a nm	I_G/I_{Eg}
P25	144	-	-			
4%rGO- P25	146	1355	1595	0.87	19.3	1.14
7%rGO- P25	146	1354	1594	0.88	19.1	1.31
10%rGO- P25	147	1355	1595	0.87	19.3	1.01
30%rGO- P25	147	1354	1595	0.86	19.4	0.46

Tabla S3. Ti/C, A_{C-O}/A_{C-C} ratios, species percentages, and bond energies (in brackets, eV) obtained by XPS analysis.

Muestra	Ti/C	A_{C-O}/A_{C-C}	C 1s (%)			
			C=C	C-C	C-O	C=O
4%rGO-P25	0.65	0.11	65.9(284.4)	23.9(285.2)	3.2(286.4)	7.0(288.5)
7%rGO-P25	0.74	0.12	64.5(284.6)	25.0(285.3)	3.8(286.4)	6.6(288.5)
10%rGO-P25	0.56	0.14	61.7(284.5)	26.3(285.1)	5.2(286.5)	6.8(288.5)
30%rGO-P25	0.56	0.11	59.4(284.4)	30.8(285.4)	3.4(286.6)	6.4(288.4)

Table S4. Results of the application of different photocatalysts for the removal of parabens from water.

Photocatalysts	Conditions	Observations	Reference
TiO ₂	[MetP] = 10 mg/L [TiO ₂] = 2 g/L pH= 6; t = 120 HP Hg lamp	Total removal of MetP was 95% after 120 min of irradiation	[26]
ZnO	[EtP] = 20 mg/L [ZnO] = 1 g/L Simulated solar radiation 100 W Xe lamp	ZnO is capable of degrading completely EtP after 240 min, while P25 gives only 55% conversion	[29]
Bi ₄ O ₅ I ₂ /Bi ₅ O ₇ I	[ProP] = 10 mg/L [Catalyst] = 1 g/L UV-Vis 1000 W Xe lamp	Removal of ProP was 95% after 120 min of irradiation. Rate constant was 0.021 min ⁻¹	[30]
N-TiO ₂	[EtP] = 300 µg/L [N-TiO ₂] = 750 mg/L pH= 6.5; t = 120 min Simulated solar radiation Xe lamp 100 W	Removal of EtP was 96% after 60 min of irradiation. Rate constant was 0.060 min ⁻¹	[28]
Ag ₃ PO ₄	[EtP] = 500 µg/L [Ag ₃ PO ₄] = 500 mg/L pH=9 Simulated solar radiation 100 W Xe lamp	Removal of EtP was 73.3% after 30 min of irradiation	[32]
I-Bi ₄ O ₅ Br ₂	[ProP] = 10 mg/L [Catalyst] = 1 g/L 1000 W Xe lamp	Removal of ProP was 95% after 120 min of irradiation. Rate constant was 0.021 min ⁻¹	[36]
CoO _x /BiVO ₄	[ProP] = 200 µg/L [Catalyst] = 1 g/L Simulated solar radiation 100 W Xe lamp	Removal of ProP with 0.5% CoO _x /BiVO ₄ was 97% after 120 min of irradiation. Rate constant was 0.026 min ⁻¹	[31]
AgCl/Ag ₃ PO ₄	[EtP] = 20 mg/L [Catalyst] = 500 mg/L 300 W Xe lamp	The degree of degradation of EtP was 98% after 40 min of irradiation	[88]
Fe-doped-WO ₃	[MetP] = 10 mg/L [Catalyst] = 30 mg/L pH= 3 Xe lamp (1000 W/m ²)	Removal of EtP was 40% after 60 min of irradiation	[34]