Supporting Information

Enhanced Photocatalytic CO_2 Reduction to CH_4 Using Novel Ternary Photocatalyst RGO/Au-TNTAs

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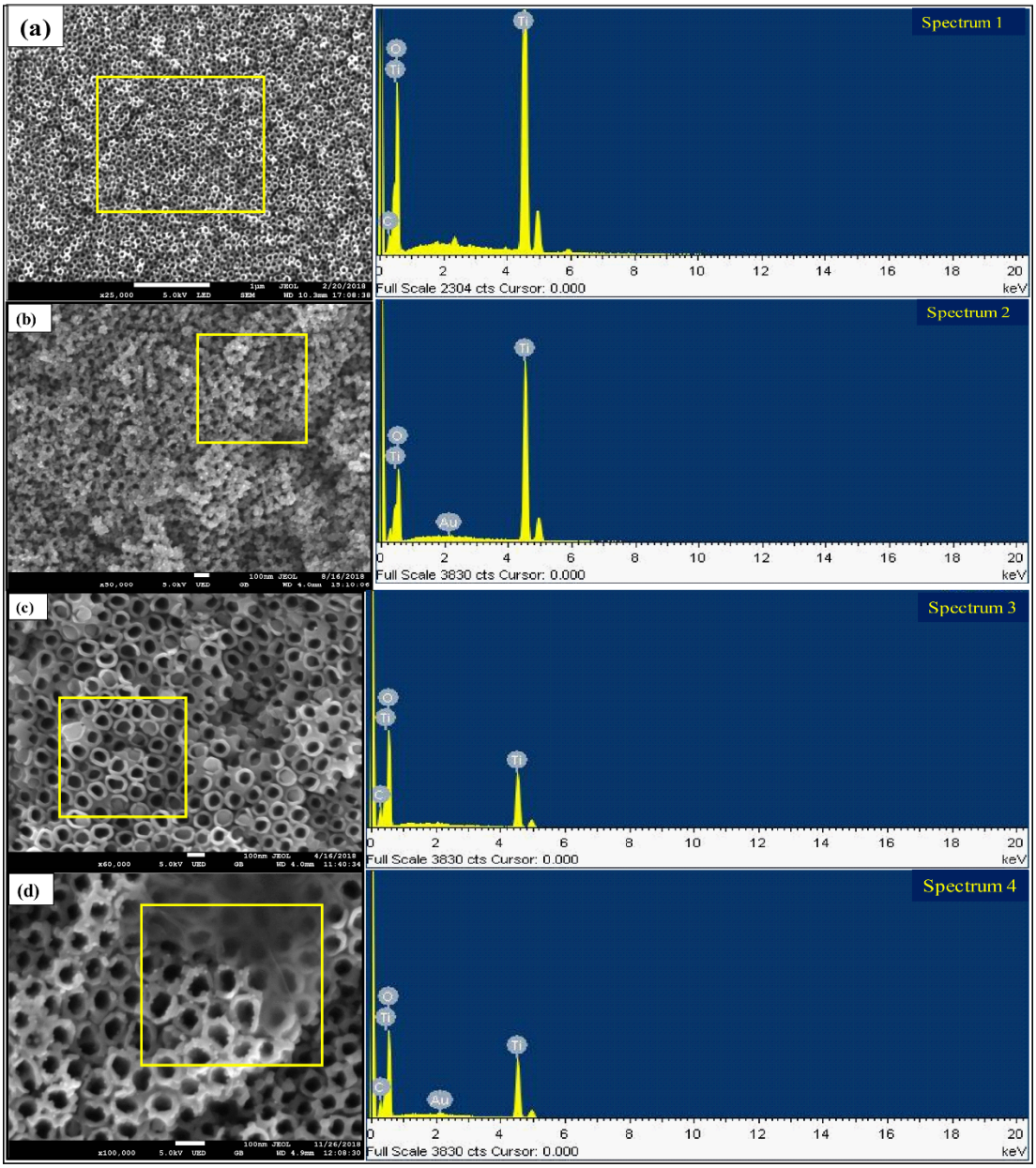

Figure S1. EDX of (a) TNTAs, (b) Au-TNTAs, (c) RGO-TNTAs and (d) RGO/Au-TNTAs.

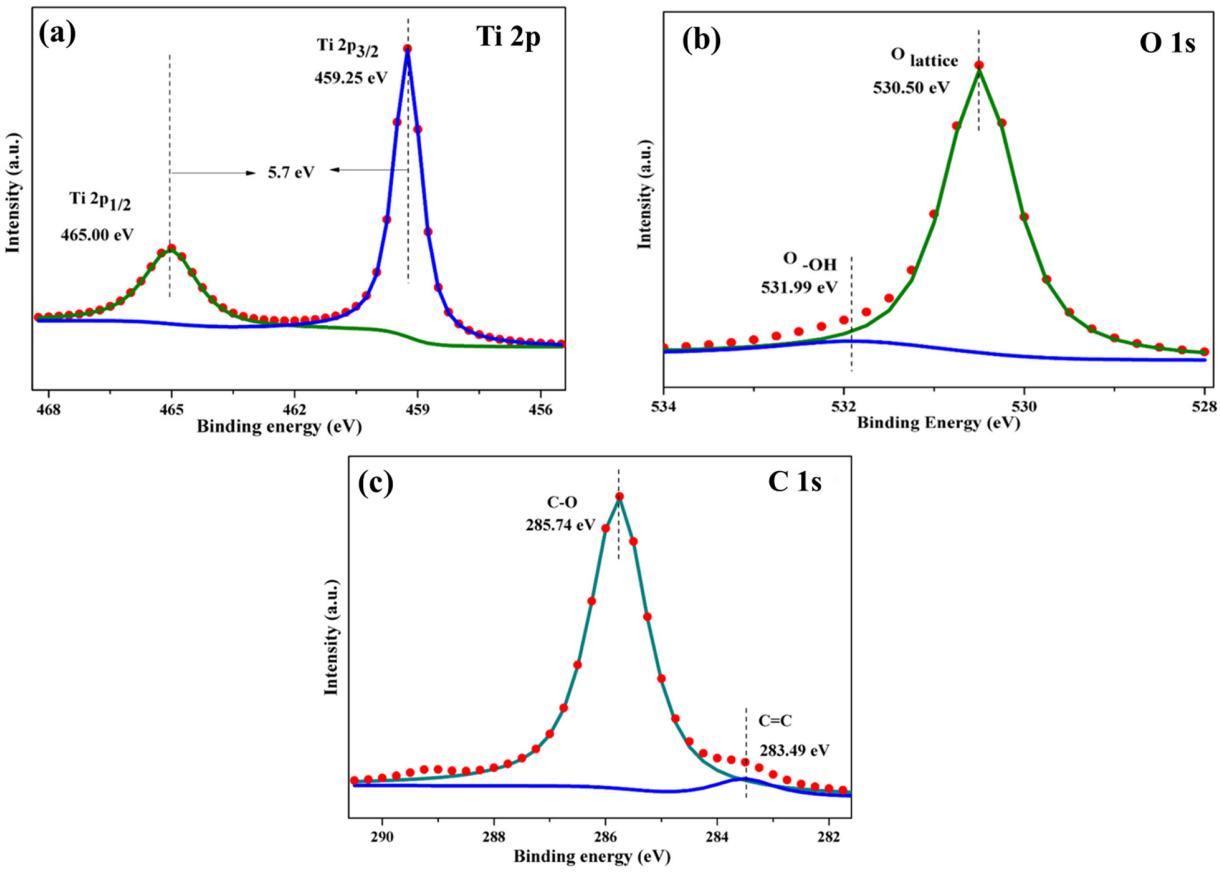

Figure S2. Core level XPS spectra of TNTAs (a) Ti 2p, (b) O 1s and (c) C 1s.

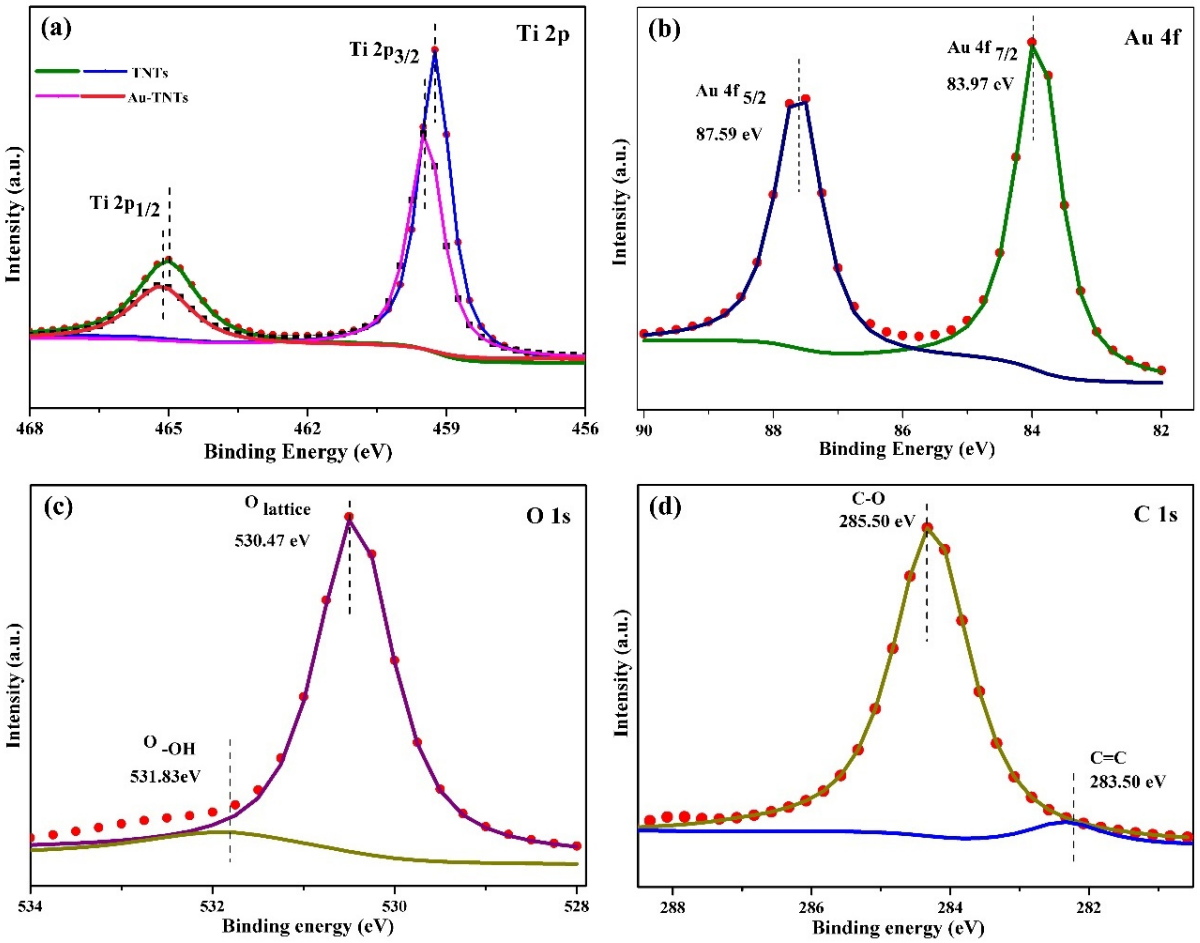

Figure S3. XPS spectra of Au-TNTAs (a) Ti 2p of TNTs and Au-TNTs, (b) Au 4f, (c) O 1s and (d) C 1s.

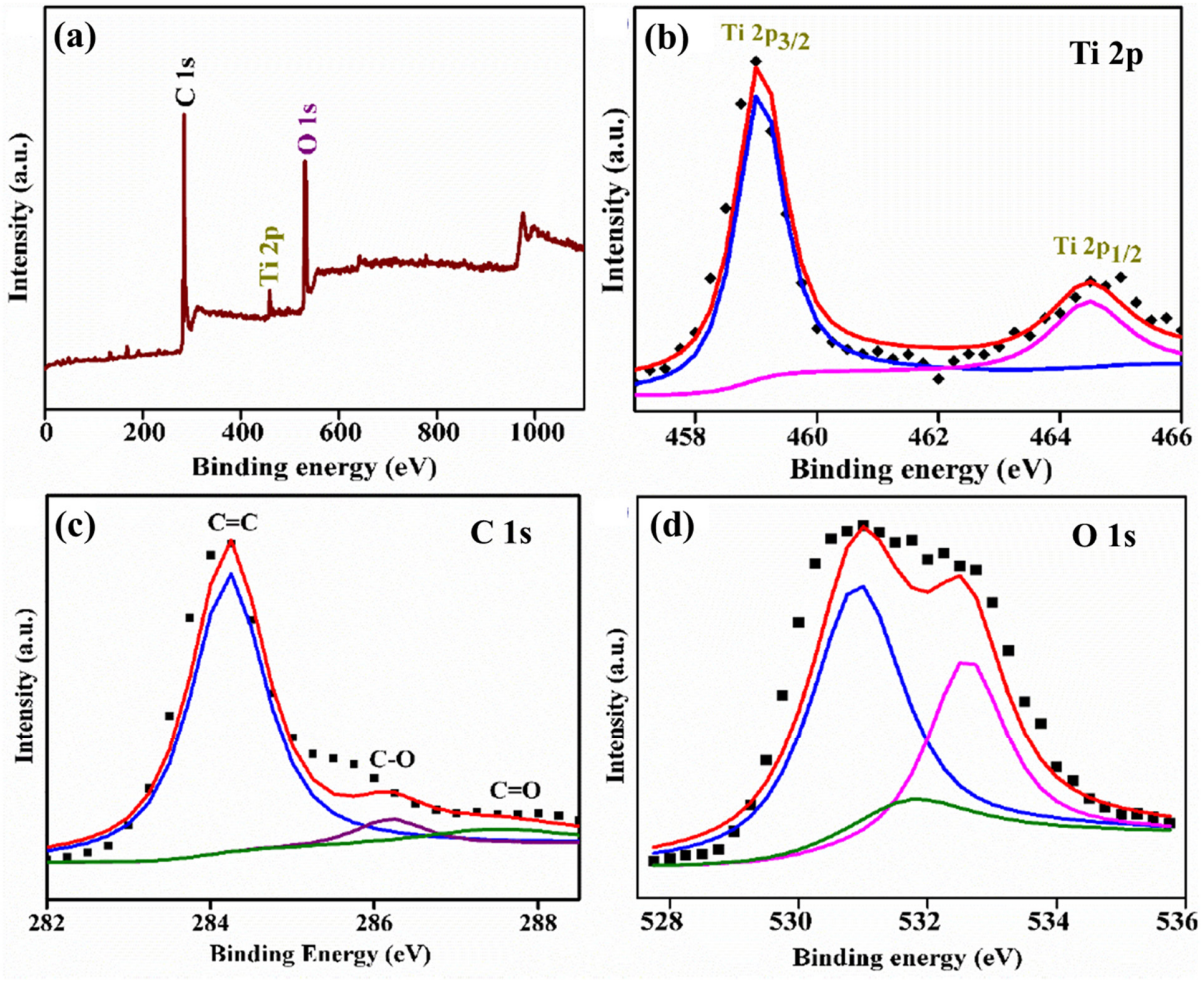

Figure S4. XPS spectra of RGO-TNTAs (a) Fully scanned spectra (b) Ti 2p, (c) C 1s and (d) O 1s.

Quantification of Bandgap of Synthesized Photocatalysts

The bandgap energies were estimated by using the Tauc equation (Equation (S1)).

$$(\alpha h\upsilon)^2 = A\,(h\upsilon - E_g) \qquad \text{(S1)}$$

where α is the absorption coefficient, hυ is the photon energy, A is the absorption constant, and Eg is the energy band gap. By plotting the values of $(\alpha h\upsilon)^2$ versus the photon energy values (hυ) the band gap energies of different synthesized photocatalysts were estimated.

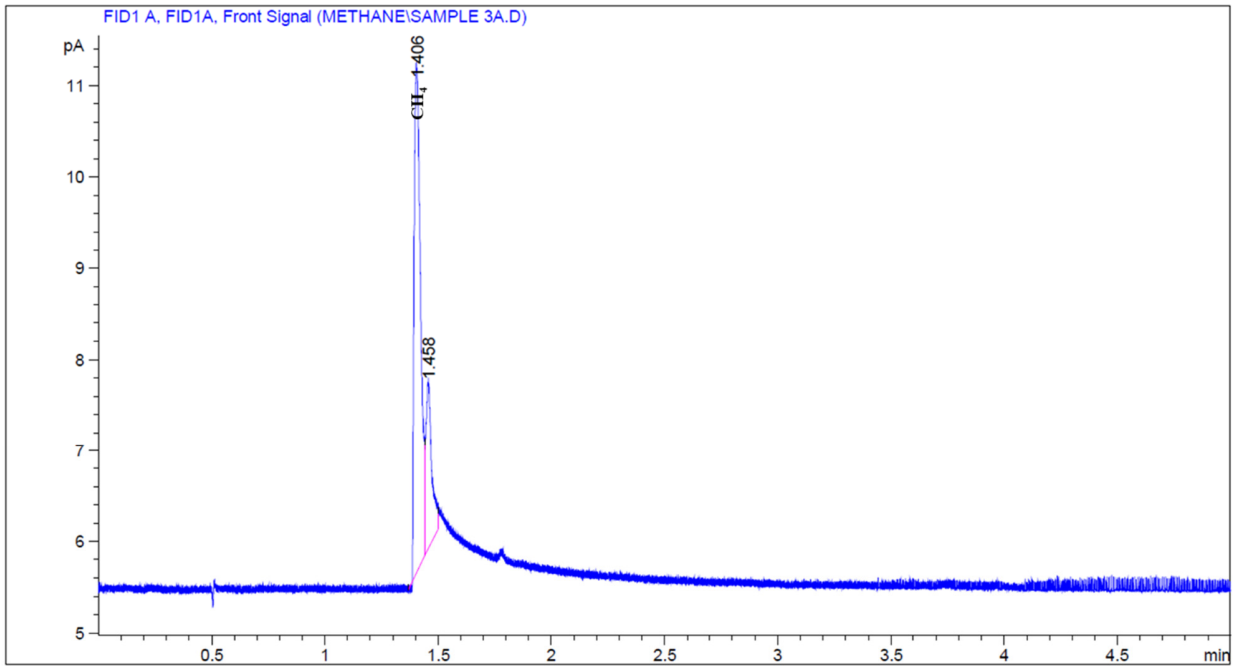

Figure S5. Chromatograms of hydrocarbon fuels generation using RGO/Au-TNTAs as photocatalyst over a period of 4 h of light irradiation. (Detector: FID/Methanizer)

Table S1: Rate of CH_4 production at different irradiation time.

Catalysts	CH_4 production at every 1h irradiation time (ppm cm^{-2} h^{-1})				Total CH_4 production (ppm cm^{-2})
	1h	2h	3h	4h	
TNTAs	0.72 ± 0.37	1.04 ± 0.56	1.24 ± 1.03	1.02 ± 0.67	4.02 ± 1.02
Au-TNTAs	3.42 ± 0.33	4.05 ± 0.55	6.02 ± 0.56	8.15 ± 1.02	21.64 ± 2.34
RGO-TNTAs	1.82 ± 0.32	2.21 ± 0.61	4.41 ± 0.83	4.02 ± 0.72	12.46 ± 3.40
RGO/Au-TNTAs	7.33 ± 0.46	7.92 ± 0.64	9.26 ± 1.06	10.62 ± 0.88	35.13 ± 2.33

Note: Number of of repeated experiments, n = 05