Supporting Information

g-C_3N_4/TiO_2 Mesocrystals Composite for H_2 Evolution under Visible Light Irradiation and Its Charge Carriers Dynamics

*Ossama Elbanna, Mamoru Fujitsuka, and Tetsuro Majima**

†The Institute of Scientific and Industrial Research (SANKEN), Osaka University, Mihogaoka 8-1, Ibaraki, Osaka 567-0047, Japan.

*Author to whom correspondence should be addressed. E-MAIL: majima@sanken.osaka-u.ac.jp (T.M.)

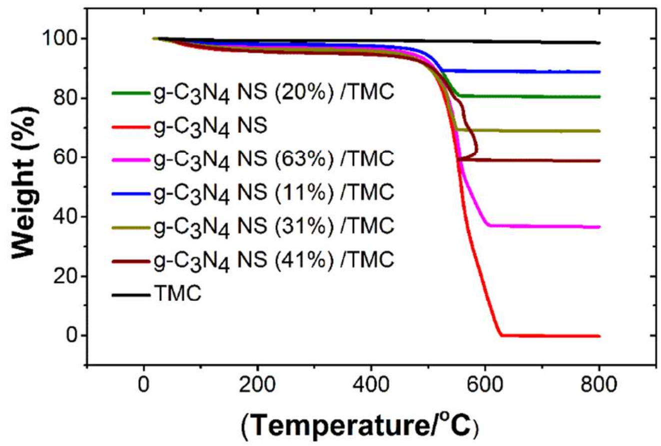


Figure S1. TGA curves of pure g-C_3N_4 NS and g-C_3N_4 NS/TMC composite with different wt%.

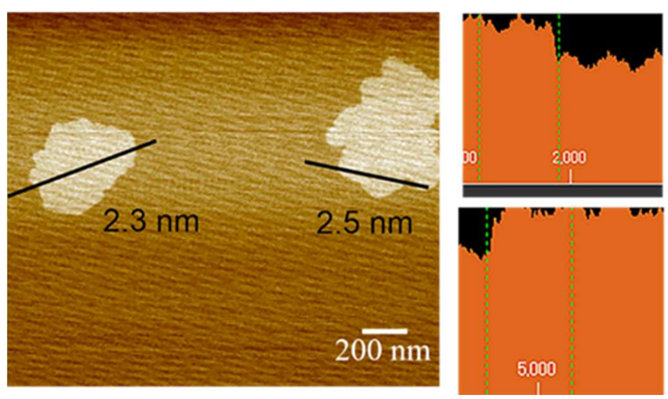


Figure S2. AFM image of g-C_3N_4 NS.

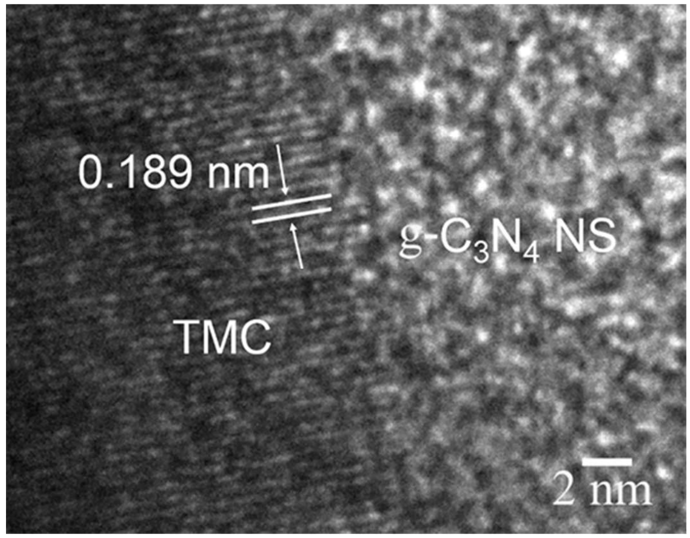


Figure S3. HRTEM image of g-C_3N_4 NS (31 wt%)/TMC.

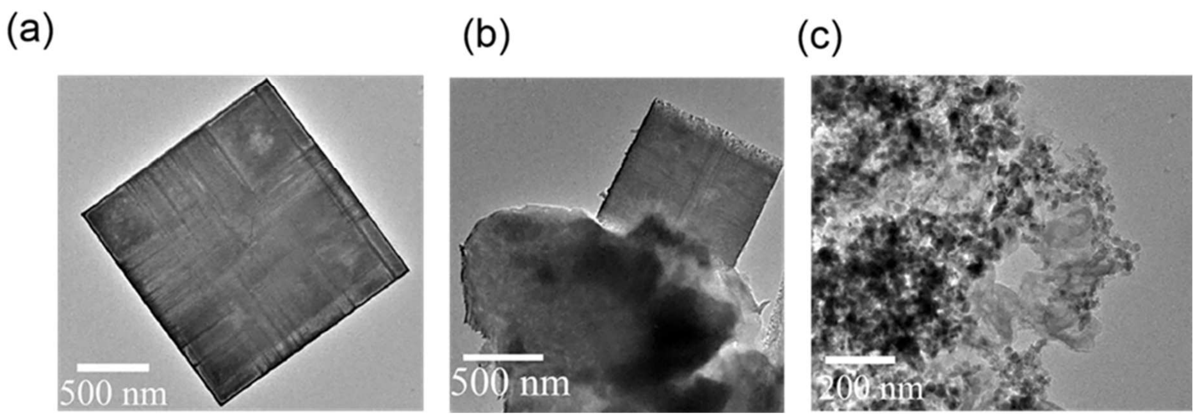


Figure S4. TEM images of TMC (a), bulk g-C_3N_4 (31 wt%)/TMC (b), and g-C_3N_4 NS (31 wt%) /P25 (c).

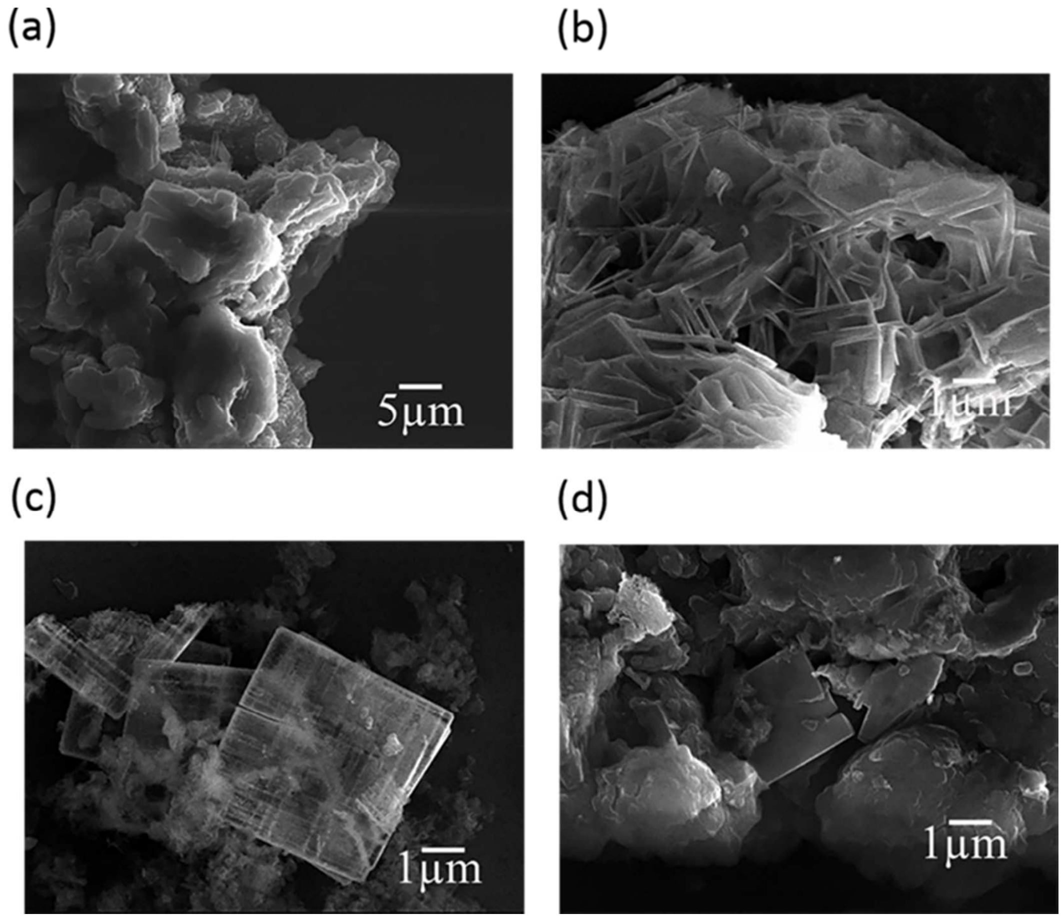


Figure S5. SEM images of bulk g-C_3N_4 (a), g-C_3N_4 NS (b), g-C_3N_4 NS (31 wt%)/TMC (c), and bulk g-C_3N_4 (31 wt%)/TMC (d).

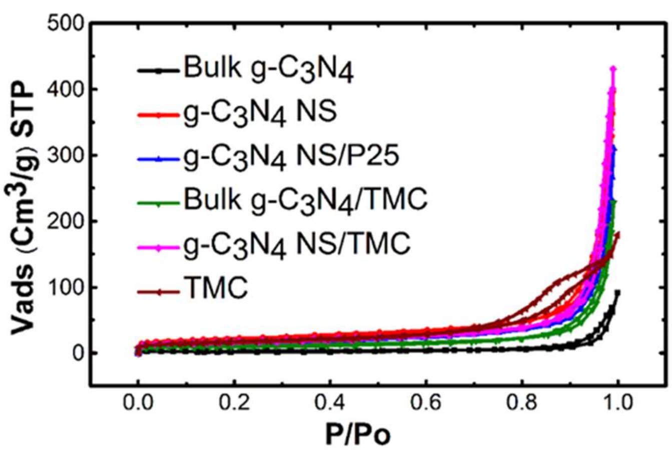


Figure S6. N_2 adsorption-desorption isotherm of the prepared samples.

Mott-Schottky (MS) measurement. The MS plots were measured with a frequency of 200 Hz and amplitude of 10 mV. The electrodes were immersed in 0.1 M Na_2SO_4 aqueous solution.

$1/C_{sc}^2 = [2/e\varepsilon_o\varepsilon N_d A^2]\,[(E-E_{fb}) - (K_bT/e]$

where C_{sc} is the space charge capacitance (F cm^{-2}), A is the area, N_d is the donor density, e is the elementary charge (1.62×10^{-19} C), ε is the relative dielectric constant of the semiconductor, ε_o is the permittivity of vacuum (8.85×10^{-14} F cm^{-1}), E is the applied potential (V), K_b is the Boltzmann constant (1.38×10^{-23} J K^{-1}) and T is the temperature. According to the equation, three curves can be drawn using E against $1/C_{sc}^2$, and E_{fb} of the corresponding electrode is ascertained by the x-intercept

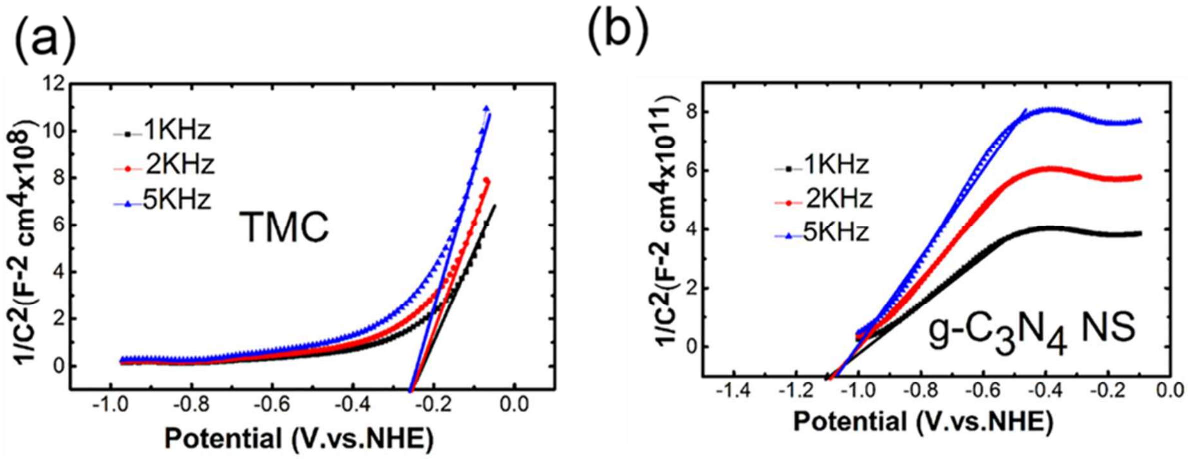


Figure S7. Mott-Schottky plot of TMC (a) and g-C_3N4 NS (b).

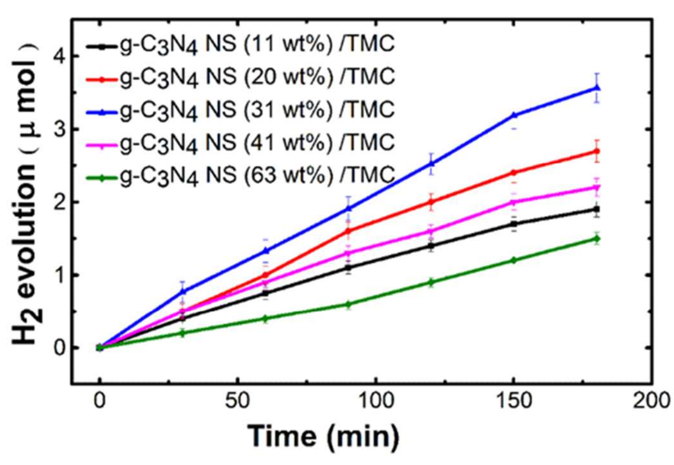


Figure S8. Visible-light photocatalytic activities for H_2 evolution (λ> 420 nm) of g-C_3N_4 NS /TMC with different wt% of g-C_3N_4 NS.

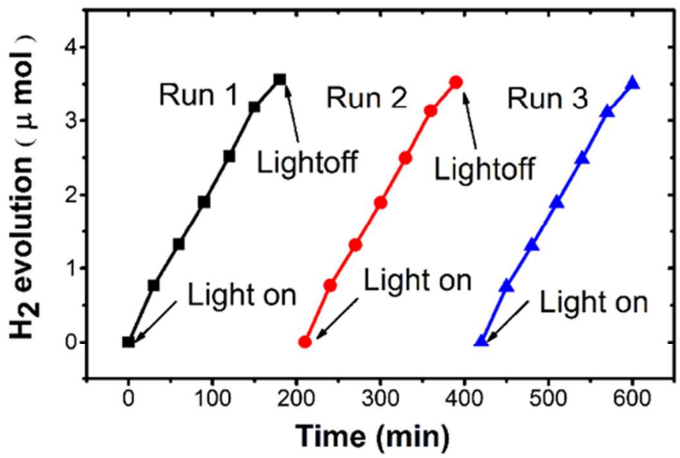


Figure S9. Stability test of g-C_3N_4 NS (31 wt%)/TMC under visible light irradiation (λ> 420 nm).

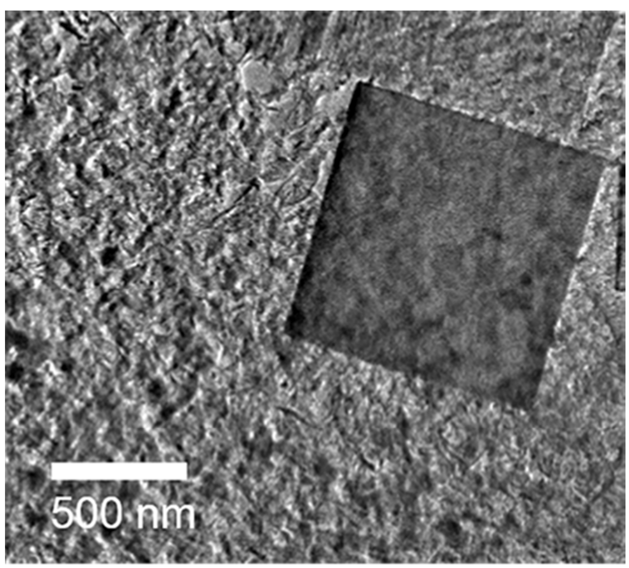


Figure S10. TEM image of g-C_3N_4 NS (31 wt%)/TMC after photocatalytic H_2 evolution under visible light irradiation (λ> 420 nm).

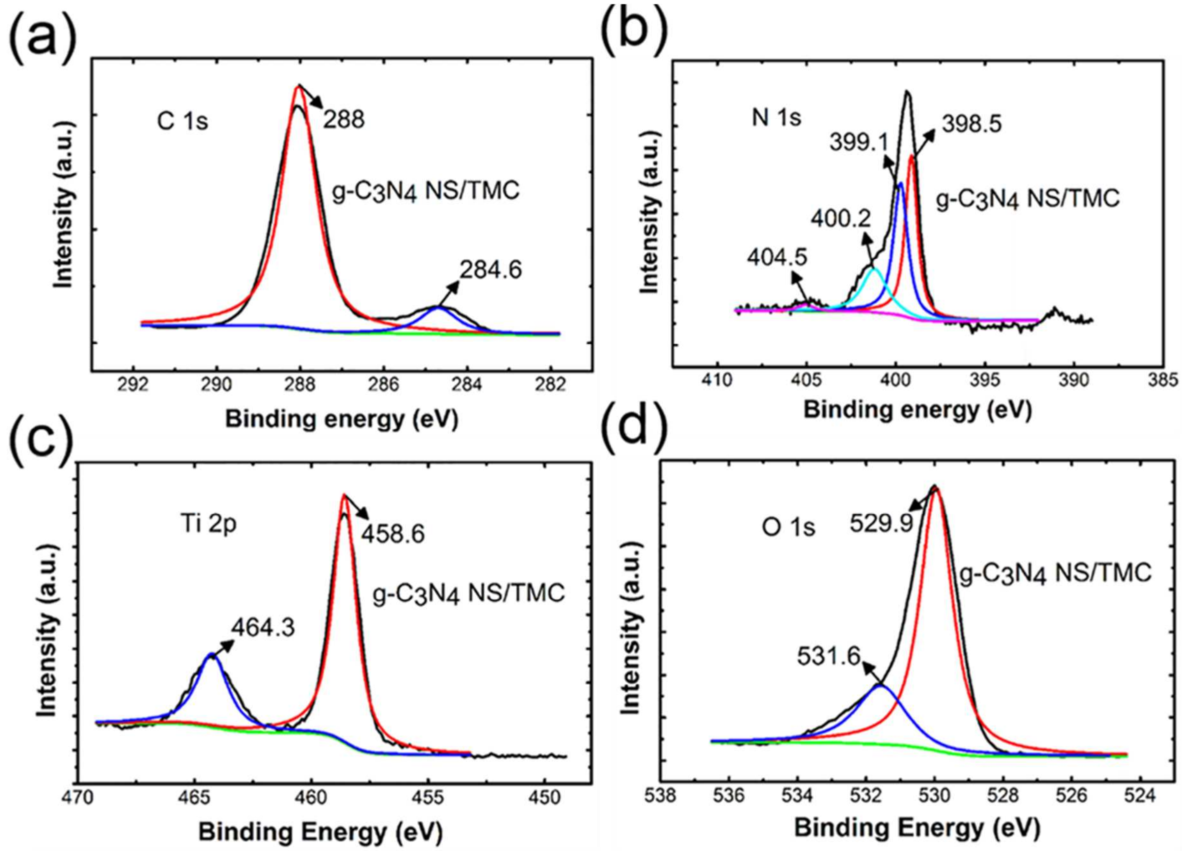


Figure S11. High resolution XPS spectra of C 1s (a), N 1s (b), Ti 2p (c), and O 1s (d) of g-C_3N_4 NS (31 wt%)/TMC after photocatalytic H_2 evolution under visible light irradiation (λ> 420 nm).

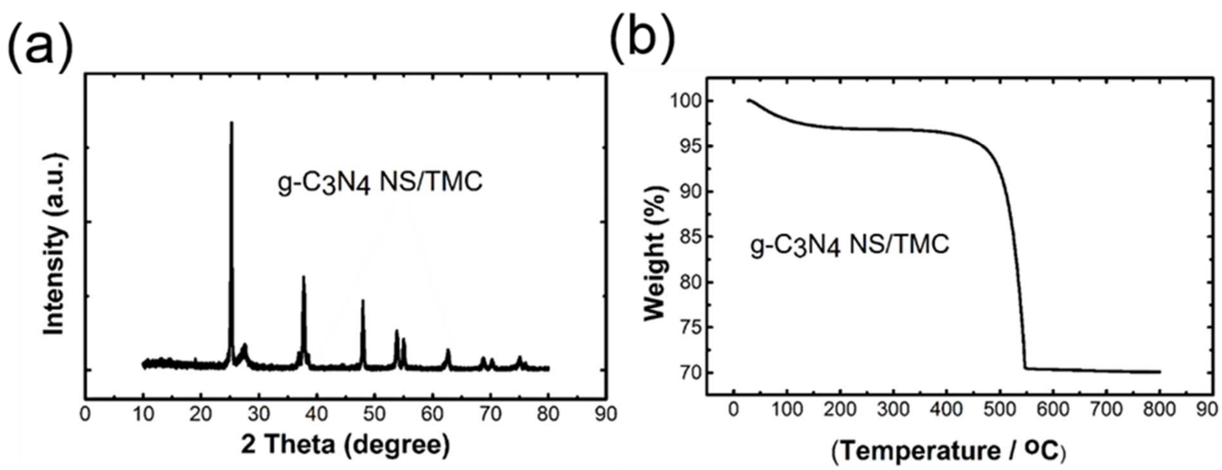


Figure S12. (a) XRD and (b) TGA curve of g-C_3N_4 NS (31 wt%)/TMC after photocatalytic H_2 evolution under visible light irradiation (λ> 420 nm).

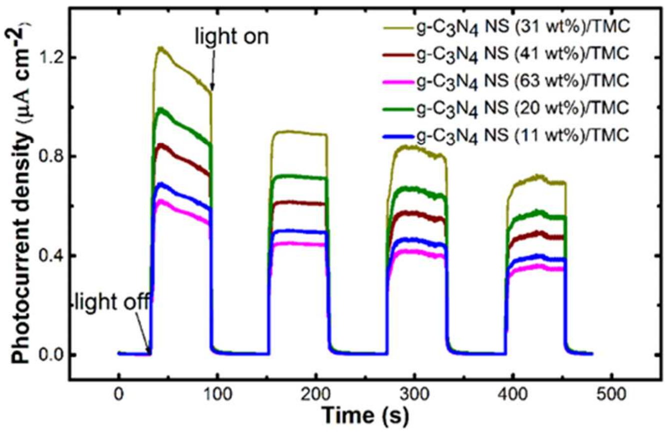


Figure S13. Photocurrent response of g-C_3N_4 NS/TMC with different wt% of g-C_3N_4 NS**.**

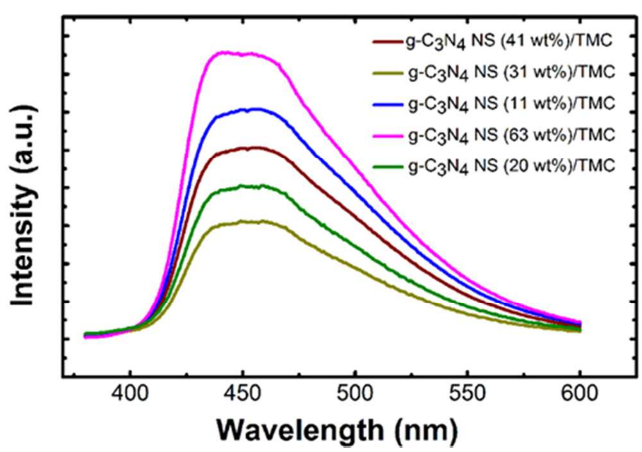


Figure S14. Room-temperature PL emission spectra of g-C_3N_4 NS/TMC with different wt% of g-C_3N_4 NS.

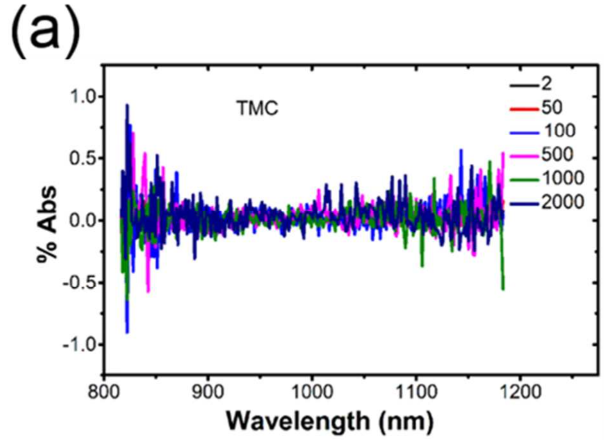
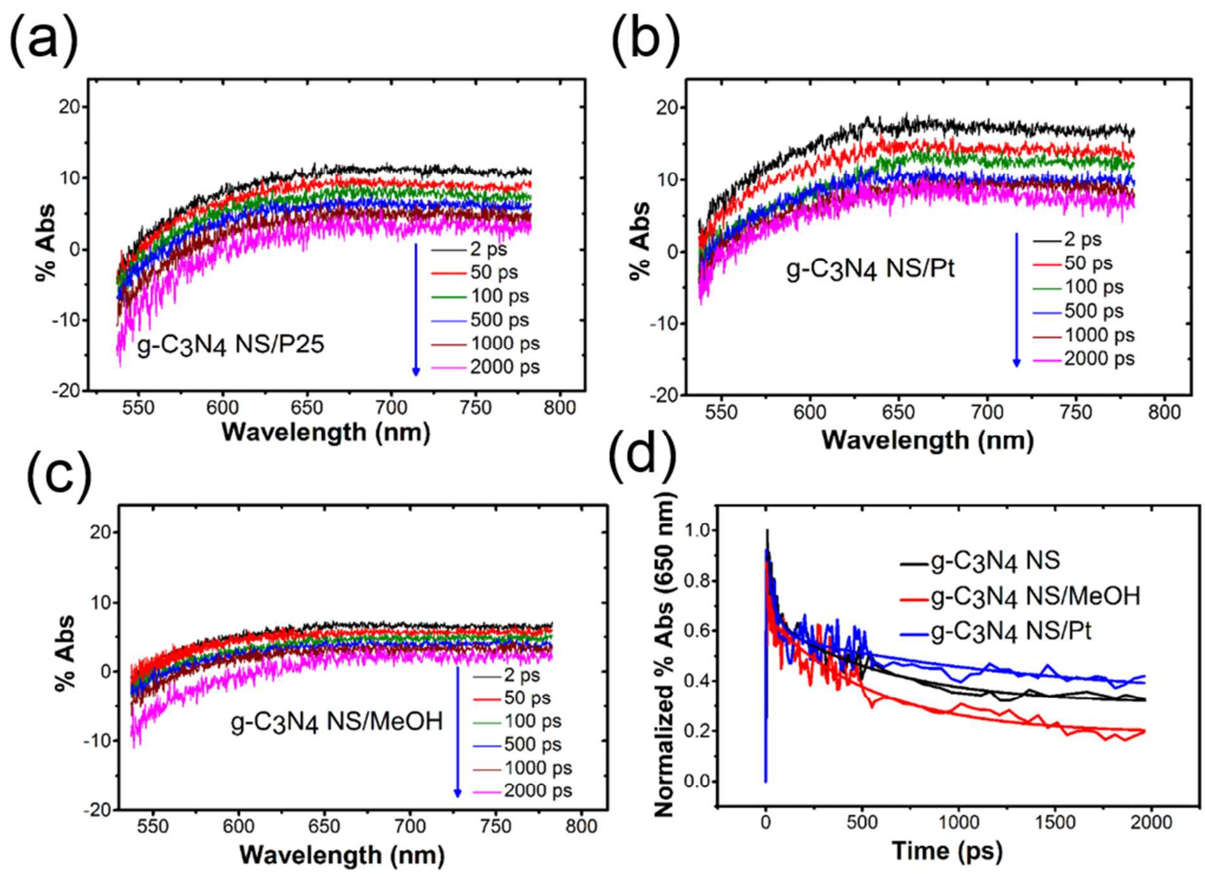


Figure S15. Time-resolved diffuse reflectance spectra of TMC (a) and g-C_3N_4 NS (31 wt%)/P25



(b).

Figure S16. Time-resolved diffuse reflectance spectra of g-C_3N_4 NS (31 wt%)/P25 (a), g-C_3N_4 NS/Pt (b), g-C_3N_4 NS/MeOH (c), and time decay profile observed at 650 nm for g-C_3N_4 NS, g-C_3N_4 NS/MeOH, and g-C_3N_4 NS/Pt (d).

Table S1. Elemental analysis of g-C_3N_4 NS and g-C_3N_4 NS /TMC with different wt%.

Sample	C%	N%	C/N molar ratio
g-C_3N_4 NS	35.6	62.1	0.67
g-C_3N_4 NS (11 wt%)/TMC	3.9	6.9	0.67
g-C_3N_4 NS (21 wt%)/TMC	7.2	12.7	0.66
g-C_3N_4 NS (31 wt%)/TMC	11.3	19.5	0.67
g-C_3N_4 NS (41 wt%)/TMC	15	26.3	0.67
g-C3N4 NS (63 wt%)/TMC	22.8	39.7	0.67

Table S2. The structural characteristics of TMC, g-C_3N_4, and g-C_3N_4/TMC composite.

Sample	Surface area (m^2 g^{-1})	Pore volume (cm^3 g^{-1})	Pore size (nm)
bulk g-C_3N_4	8.4	0.09	24.3
g-C_3N_4 NS	72.2	0.55	14
g-C_3N_4 NS (31 wt%)/P25	52.3	0.45	16.5
bulk g-C_3N_4 (31 wt%)/TMC	34.2	0.33	19
g-C_3N_4 NS (31 wt%)/TMC	57.4	0.66	15.5

Table S3. The fitted parameters of fluorescence lifetime for different samples.

Samples	A_1	τ_1 (ns)	A_2	τ_2 (ns)
bulk g-C_3N_4	0.46	0.5	0.54	2.2
g-C_3N_4 NS	0.43	0.74	0.57	3.0
g-C_3N_4 NS (31 wt%)/P25	0.41	0.9	0.59	3.3
bulk g-C_3N_4 (31 wt%)/TMC	0.40	0.9	0.60	3.5
g-C_3N_4 NS (31 wt%)/TMC	0.35	1.1	0.65	4.8