Supporting information

Boosting Hydrogen Peroxide Production of Brookite TiO_2 under UV Light through Au and MXene Co-catalysis

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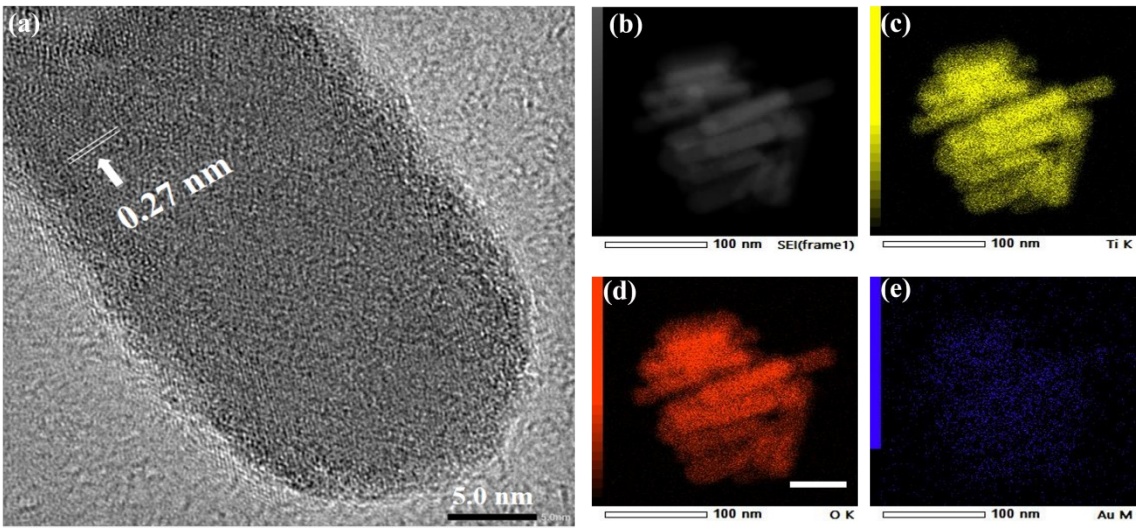

Figure S1. (a) HR TEM image of pure brookite TiO_2;(b)-(e) TEM EDS mapping pictures of TiO_2/Au

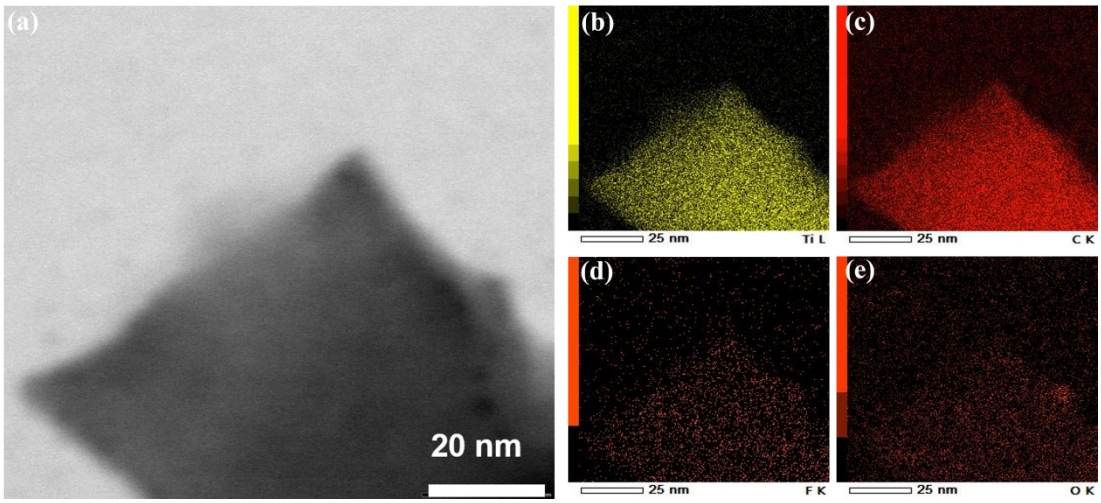

Figure S2. (a)-(f) EDS mapping pictures of MXene

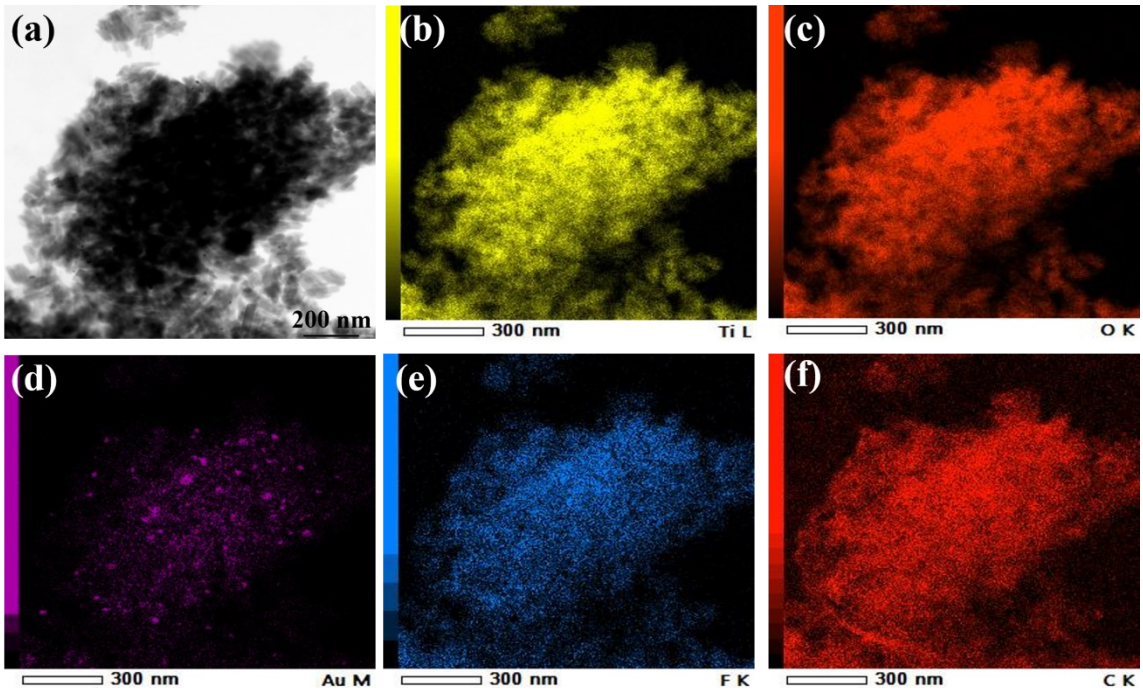

Figure S3. (a)-(f) EDS mapping pictures of TiO_2/Au/MXene;

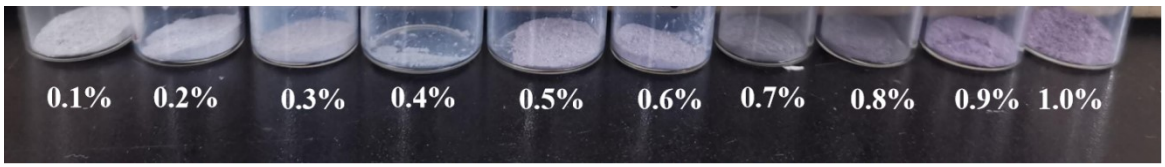

Figure S4. The photos of TiO_2/Au with 0.1 %-1.0 % Au content.

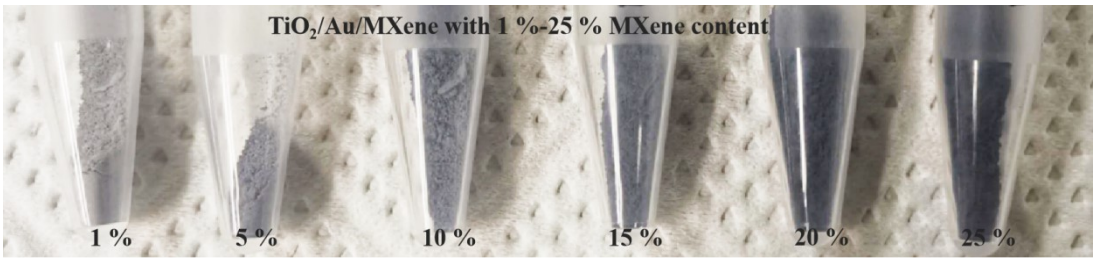

Figure S5. The photos of TiO_2/Au/MXene with 1 %-25 % MXene content.

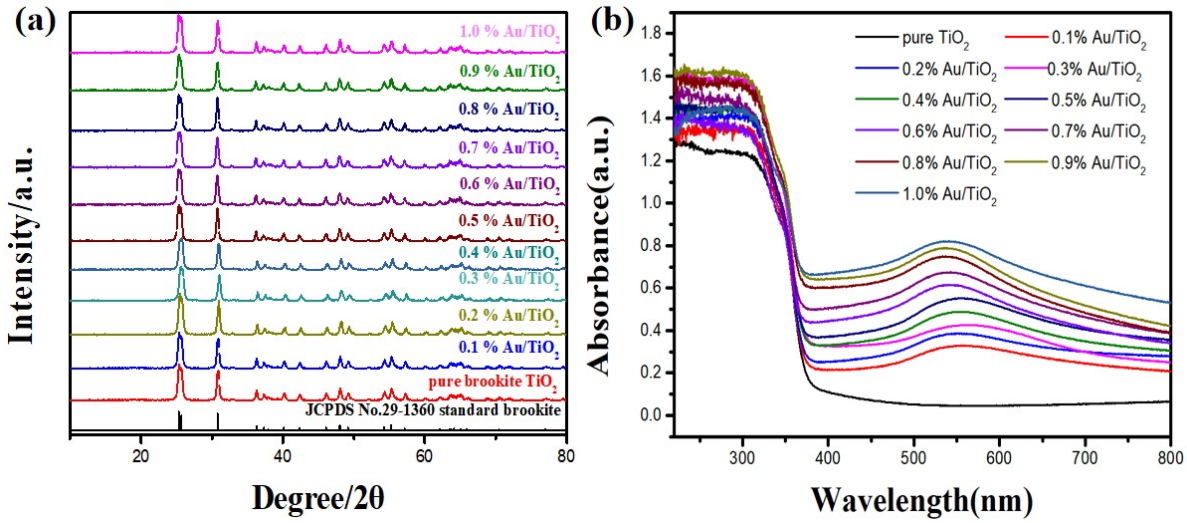

Figure S6. (a) XRD data of brookite TiO_2 and TiO_2/Au with different Au content; (b) Uv-vis of brookite TiO_2 and TiO_2/Au with 0.1%-1.0% Au content.

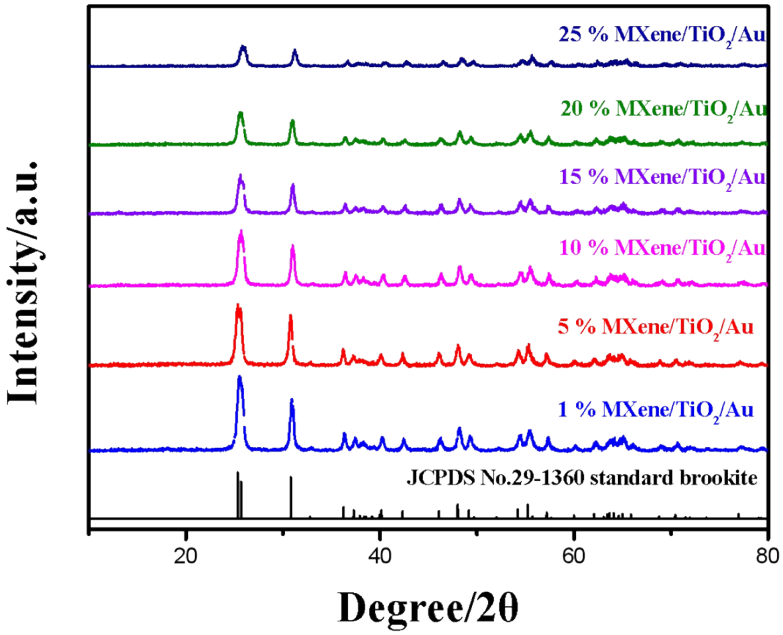

Figure S7. XRD data of TiO_2/Au/MXene with different MXene content.

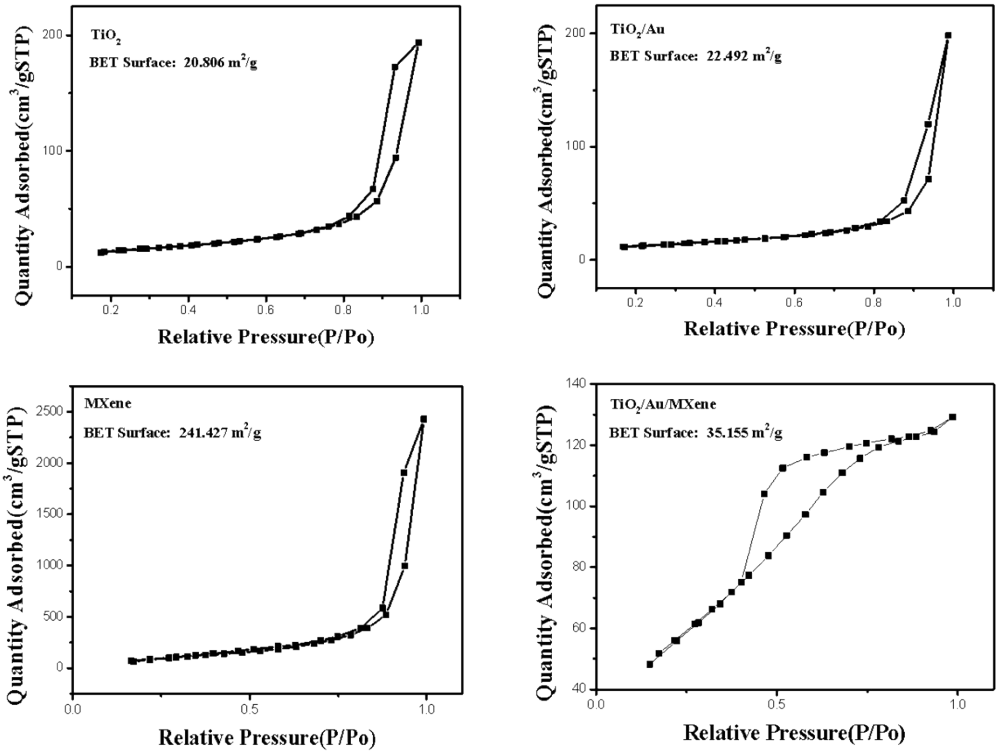

Figure S8. Nitrogen adsorption-desorption isotherms of TiO_2, MXene, TiO_2/Au and TiO_2/Au/MXene.

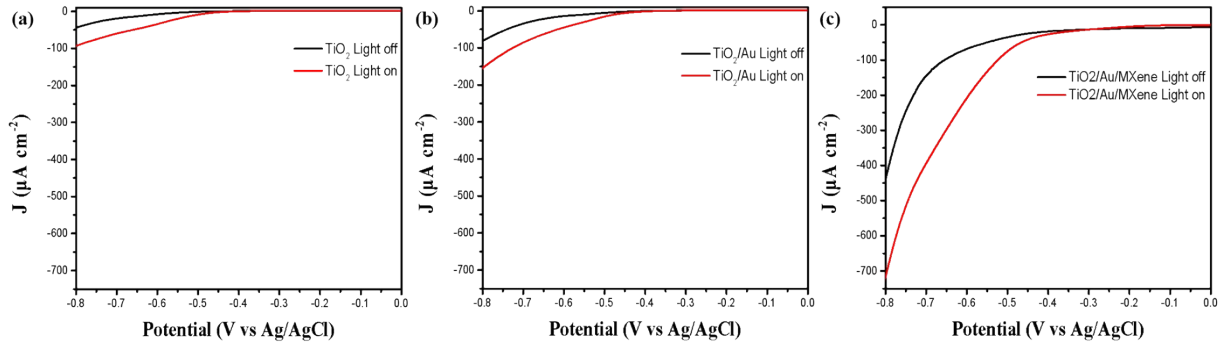

Figure S9. LSV data of (a)Brookite TiO_2; (b)TiO_2/Au and (c)TiO_2/Au/MXene at ph=6.09.

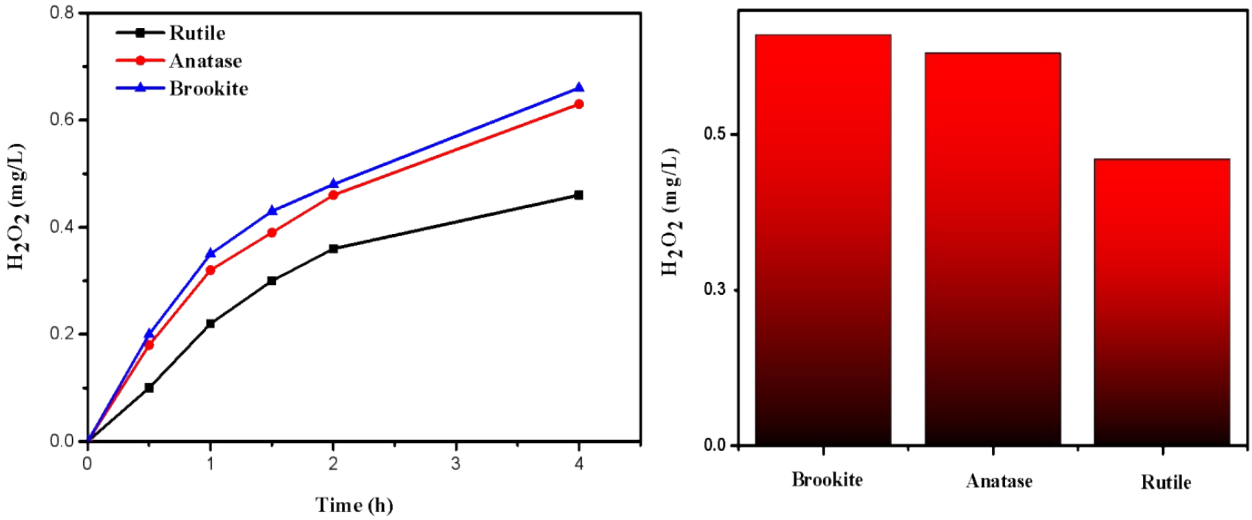

Figure S10.(a) Amounts of H_2O_2 production from Rutile, Anatase and Brookite TiO_2; (b) Amounts of H_2O_2 production from Rutile, Anatase and Brookite TiO_2 after 4 hours.

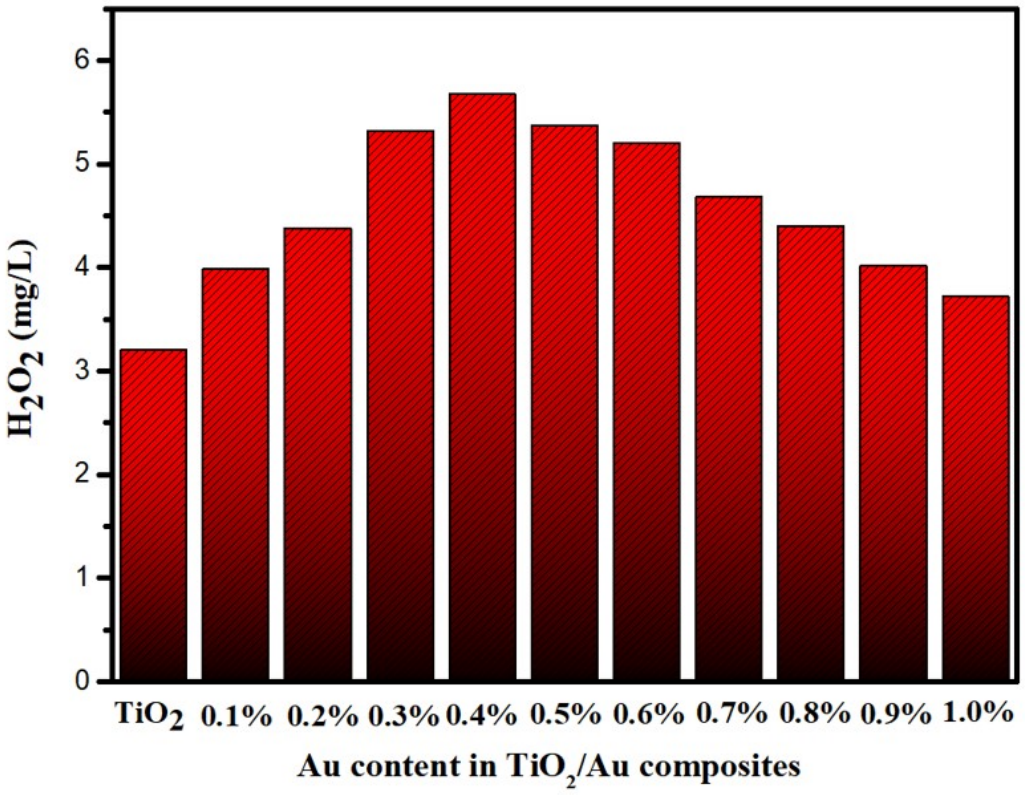

Figure S11. Amounts of H_2O_2 production from TiO_2/Au with different MXene content after 4 hours under the condition of pH=7 with UV light .

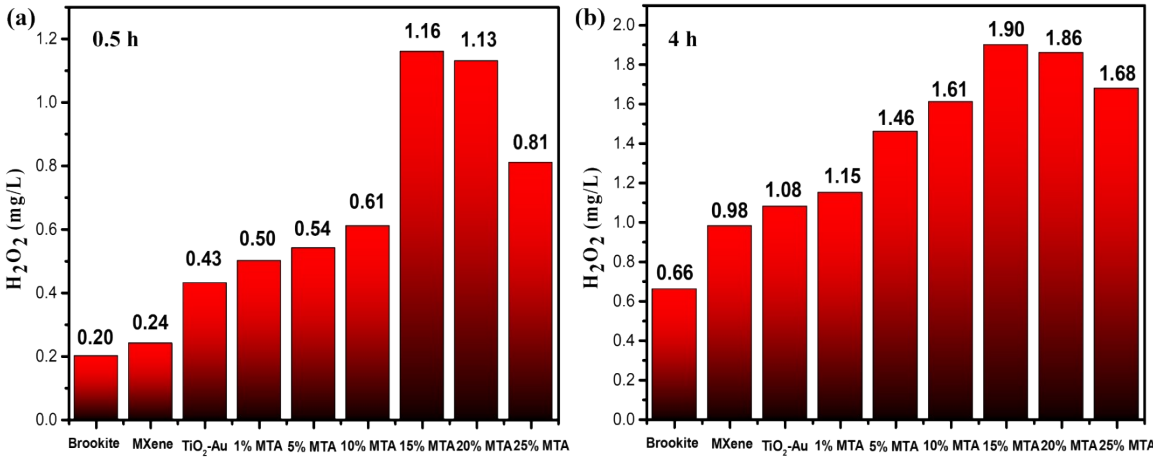

Figure S12. Amounts of H_2O_2 production from TiO_2/Au/MXene with different MXene content after 0.5 and 4 hours under the condition of pH=7 with UV light .

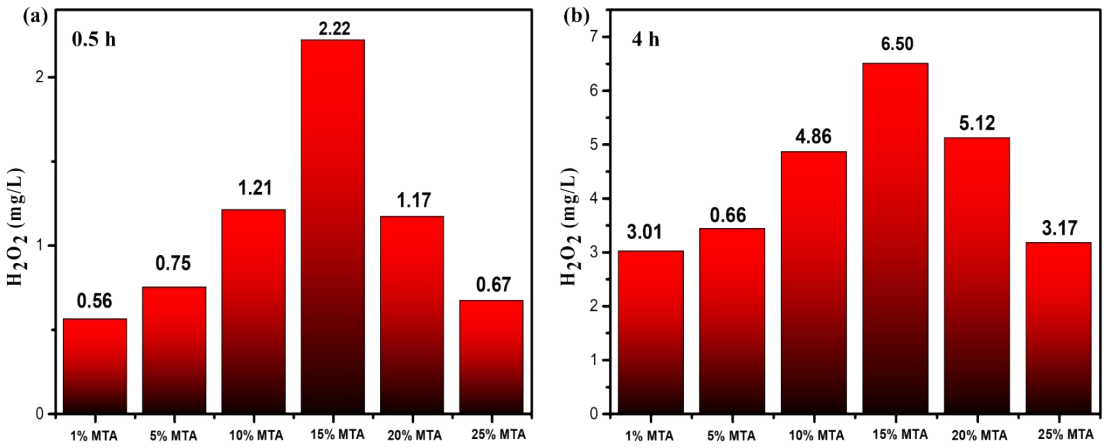

Figure S13. Amounts of H_2O_2 production from TiO_2/Au/MXene with different MXene content 0.5 and after 4 hours under the condition of pH=3 with UV light.

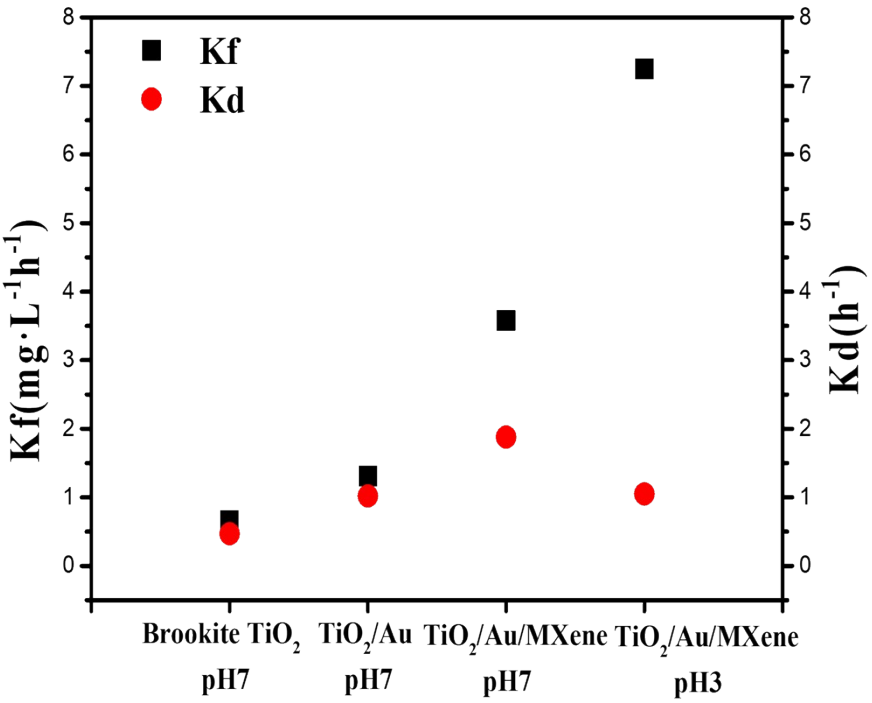

Figure S14. Formation rate constant (Kf) and decomposition rate constant (Kd) for H_2O_2 production.

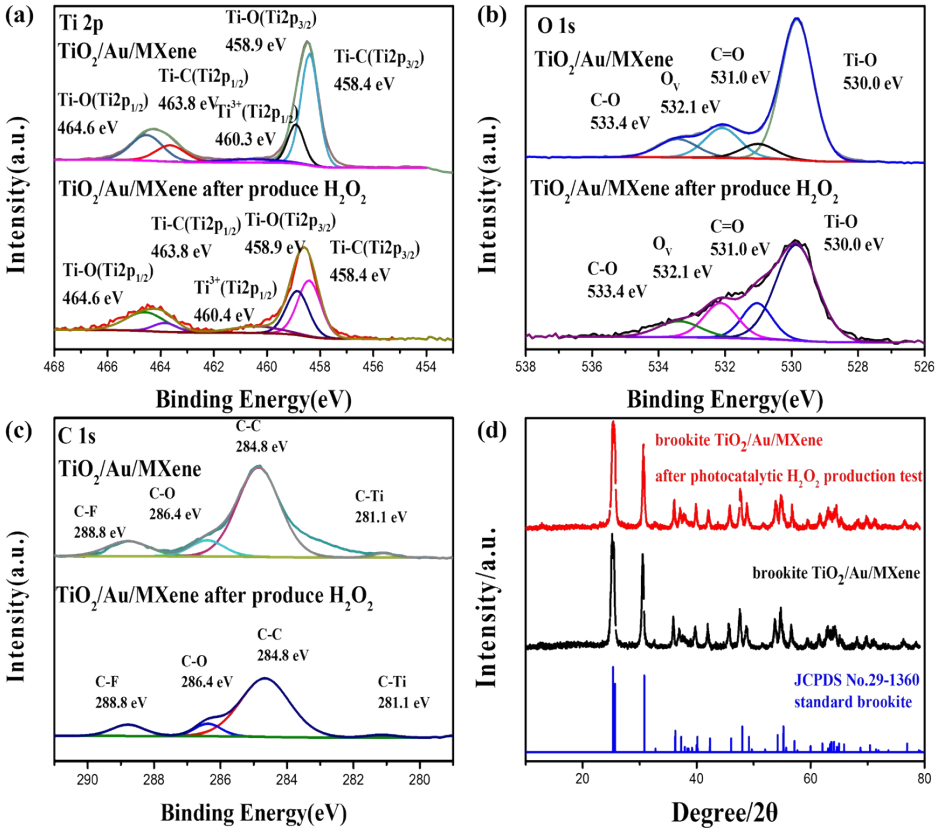

Figure S15. XPS and XRD of TiO_2/Au/MXene before and after H_2O_2 production.

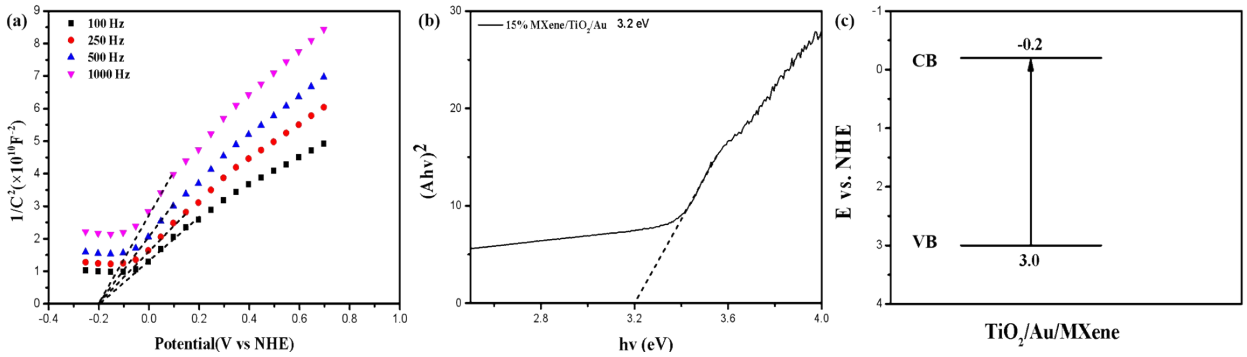

Figure S16. Motto-Schottky plots of TiO_2/Au/MXene.

Table S1. Comparison with other photocatalysts based on TiO_2 for H_2O_2 production.

Photocatalysts	Concentration of photocatalyst ($g\ L^{-1}$)	Light source	H_2O_2 yields ($\mu mol\ g^{-1}\ h^{-1}$)	References

		300 W Xe lamp (λ > 420		
Ti_3C_2/g-C_3N_4	1.0	nm)	131.71	[2]
Pd/APTMS/TiO_2	-	-	150	[5]
Ti_3C_2/TiO_2	1.0	5 W lamp (λ = 365 nm)	179.71	[19]
		500 W Hg lamp (λ = 300-		
Cu^{2+}/TiO_2	100	400 nm)	0.96	[41]
		450 W Hg lamp (λ = 280-		
Au-Ag/TiO_2	1.0	400 nm)	150	[42]
		125 W Hg Lamp (λ < 320		
Zn^{2+}/TiO_2	0.5	nm)	146.67	[43]
Au/TiO_2	1.0	Hg lamp (λ > 320 nm)	243.33	[44]
Au/SnO_2-TiO_2	1.0	300 W Xe lamp (UV light)	600	[45]
		300 W Xe lamp (360		
TiO_2/Au/MXene	0.5	nm<λ<380 nm)	**331.76**	This work