Simple preparation of in-situ oxidized titanium carbide Mxene for photocatalytic degradation of catechol

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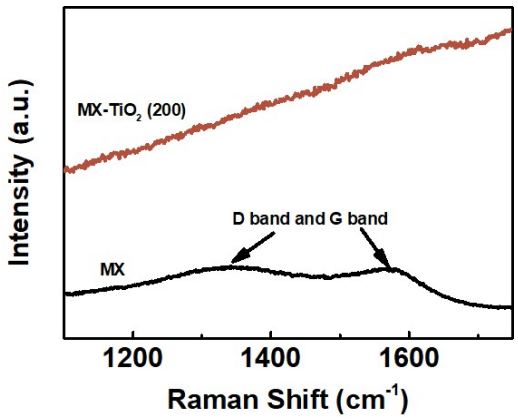

Fig.S1 Raman spectra of as-prepared MX and MX-TiO_2(200) powder

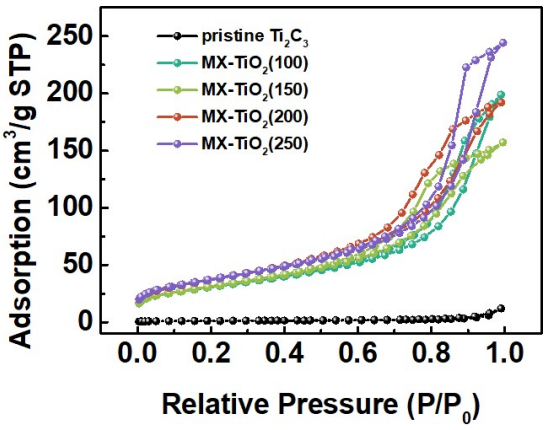

Fig.S2 Nitrogen adsorption-desorption isotherms for as-prepared and H_2O_2 treated MX.

Table S1 The BET surface area of the as prepared MX and H_2O_2 treated MX

Photocatalyst	BET Surface Area (m^2/g)
MX	4.18
MX-TiO_2(100)	109.78
MX-TiO_2(150)	113.59
MX-TiO_2(200)	135.30
MX-TiO_2(250)	139.45

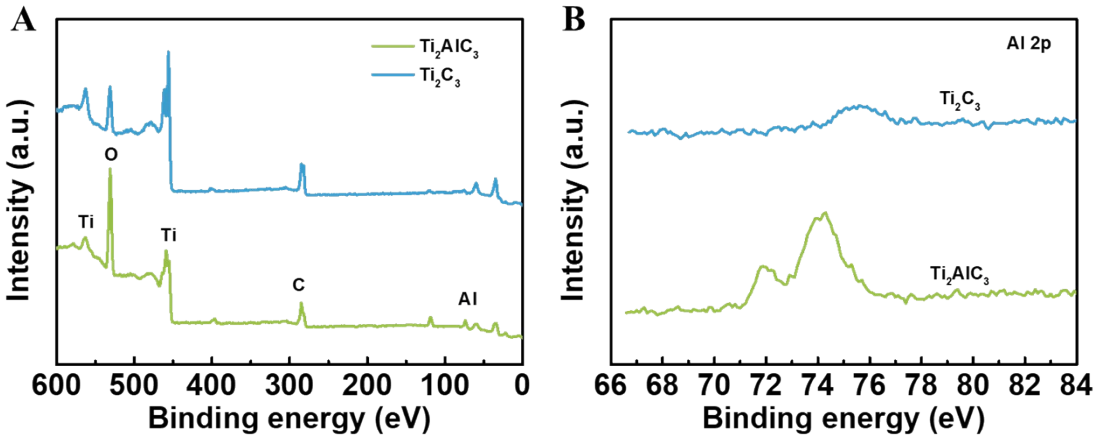

Figure S3 XPS survey spectra (A) and high-resolution XPS spectra of Al 2p (B) for Ti_3AlC_2 and Ti_3C_2.

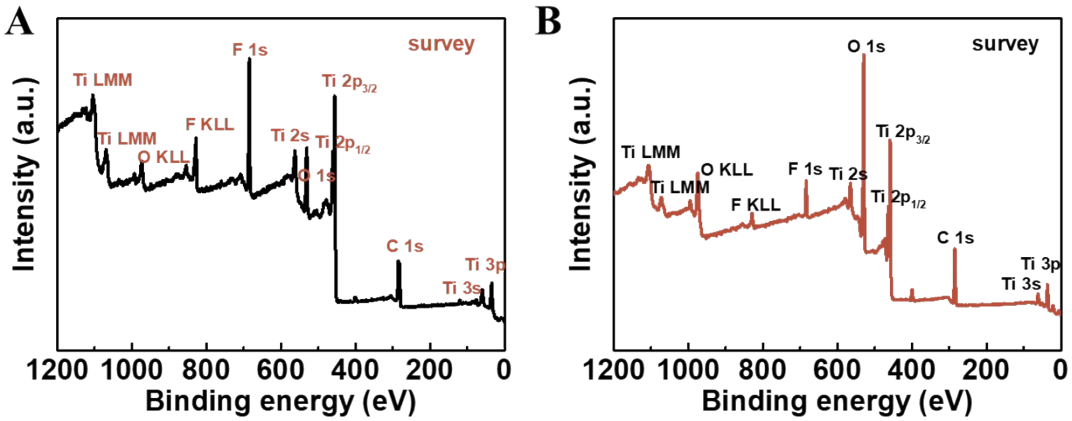

Fig.S4 XPS survey spectra: (A) as-prepared MX; (B) H_2O_2 treated MX-TiO_2(200).

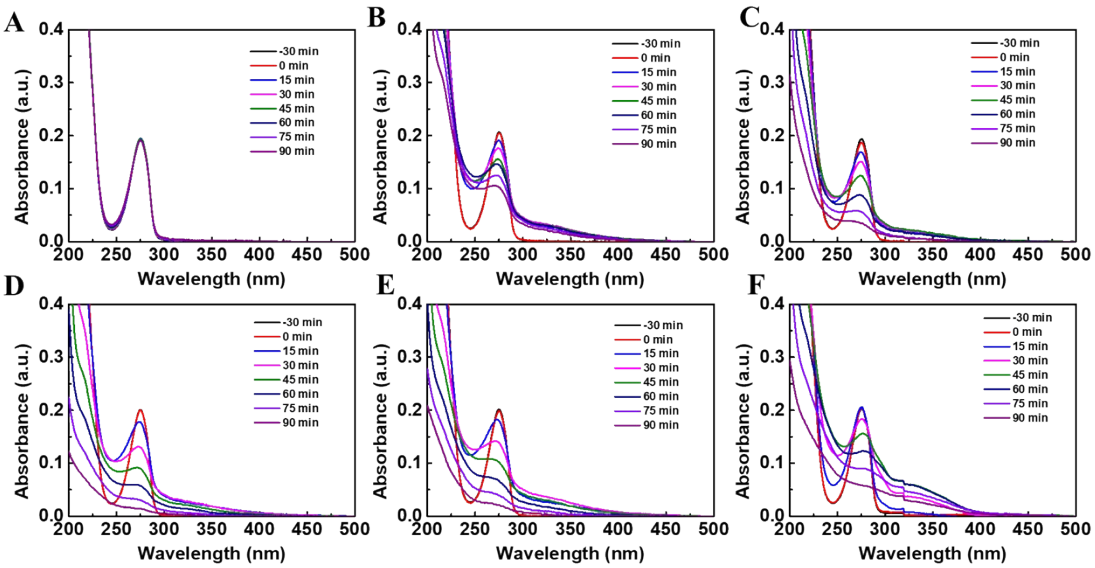

Fig.S5 The as-prepared photocatalysts (A) pristine MX, (B) MX-TiO_2(100), (C) MX-TiO_2(150), (D) MX-TiO_2(200), (E) MX-TiO_2(250), and (F) TiO_2 UV-vis absorption spectra of the degradation process of CC.

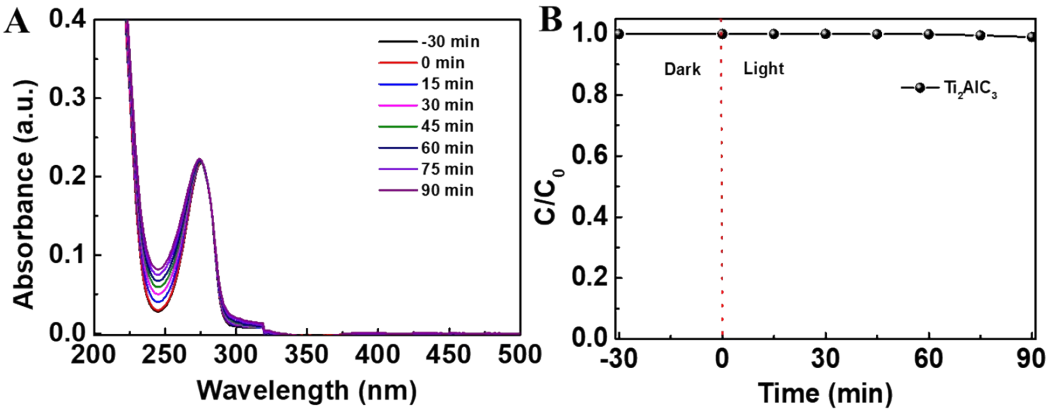

Fig.S6 The as-prepared Ti_2AlC_3 (A) UV-vis absorption spectra of the degradation process of CC (B) photocatalytic degradation efficiency of CC.

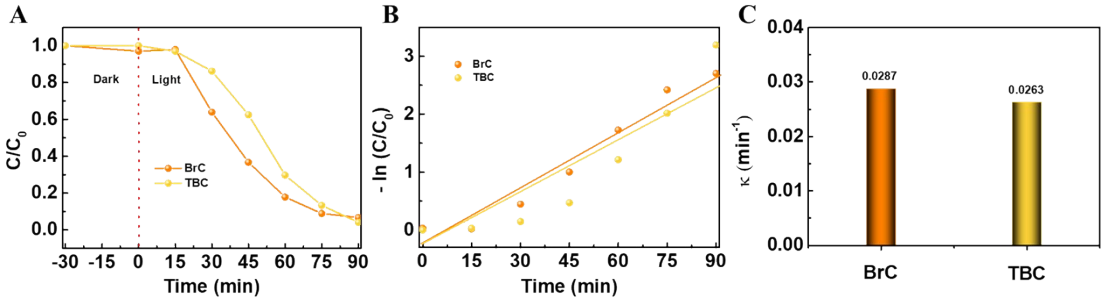

Fig.S7 The MX-TiO_2(200) (A) photocatalytic degradation efficiency of BrC and TBC; (B) the first-order kinetics of BrC and TBC degradation; (C) the degradation rate constant of BrC and TBC.

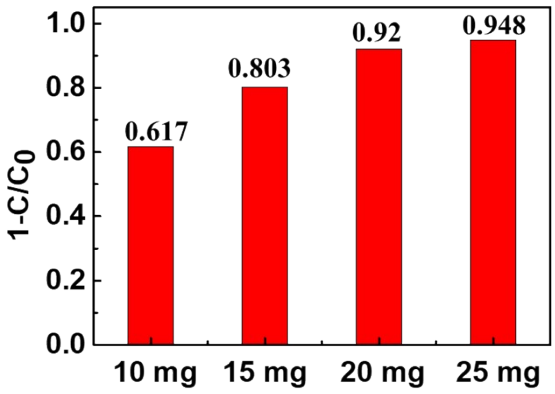

Fig. S8 Different dosage as-prepared photocatalysts photocatalytic degradation of CC.

Table S2 The calculated degradation rate and Pseudo-first-order kinetic model for catalysts

Photocatalyst	Degradation percentage	Rate constants (k; min^{-1})	R^2
MX-TiO_2(100)	49.7	0.0068	0.99
MX-TiO_2(150)	81.3	0.0152	0.94
MX-TiO_2(200)	92.1	0.0243	0.97
MX-TiO_2(250)	89.6	0.0214	0.97
TiO_2	71.5	0.0108	0.92

Table S3 Summary of the CC photocatalytic efficiencies of previous compared to this research

photocatalysts	Catalyst mass (mg)	Irradiation time (min)	Degradation efficiency (%)	Ref.
BiOCl	100	120	65	1[1]
ZnO	20	98	69.8	2[2]
TiO_2	50	180	40	3[3]
Ti_3C_2-TiO_2	20	90	92	This work

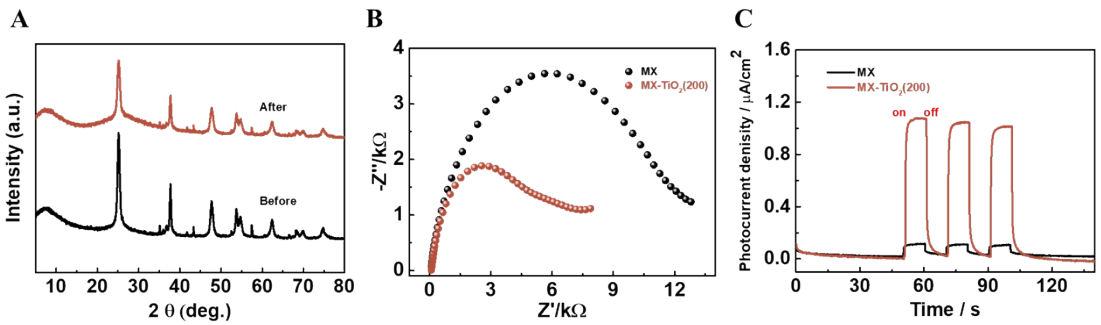

Fig. S9 (A) XRD patterns of before and after used MX-TiO_2(200) (B) EIS spectra and (C) Photocurrent curves of MX and MX-TiO_2 (200).

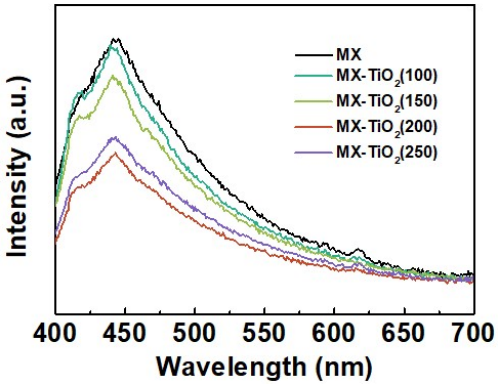

Fig. S10 PL spectra of as prepared and H_2O_2 treated MX.

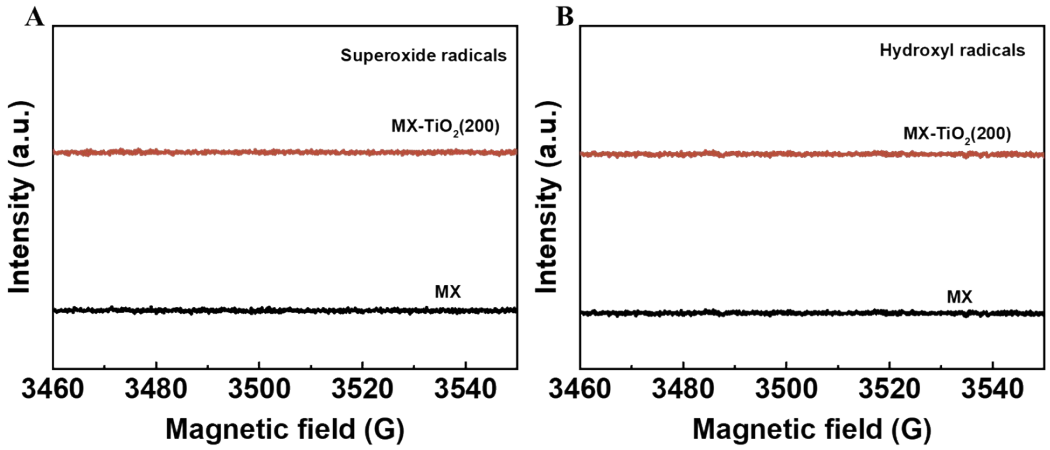

Fig. S11 ESR spectra of radicals trapped by DMPO in the presence of MX and MX-TiO_2(200) in the dark: DMPO-•O_2^-(A), DMPO-•OH (B).

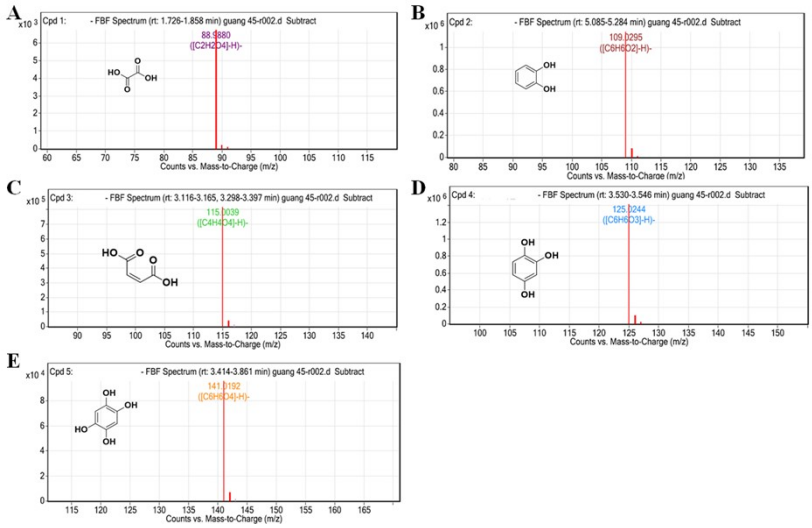

Fig. S12 Fragment chart photocatalytic main intermediate of the 45 min photocatalytic products by HPLC/MS.

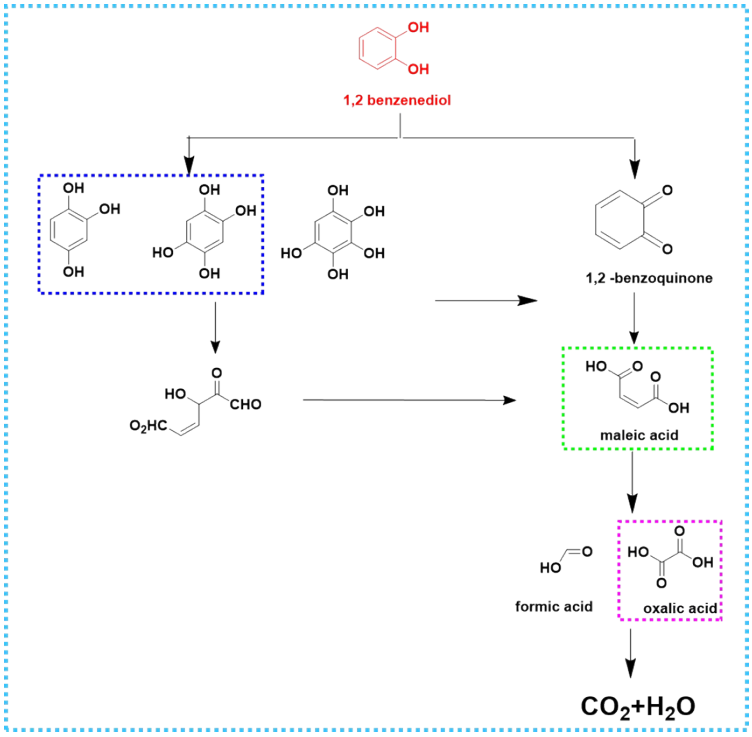

Fig.S13 Proposed photocatalytic degradation pathway of CC under simulated sunlight irradiation (MX-TiO_2(200)).

References

1. M. Li, Y. Jin, J. Su and J. Shen, *J. Adv. Oxid. Technol.*, 2017, **20**, 20160193.
2. E. Bazrafshan, T. J. Al-Musawi, M. F. Silva, A. H. Panahi, M. Havangi and F. K. Mostafapur, *Microchem. J.*, 2019, **147**, 643-653.
3. A. Sobczynski and L. Duczmal, *React. Kinet. Catal. Lett.*, 2004, **82**, 213-218.