Supporting Information

MXene/SiO_2-CeO_2 Nanoarchitectures for Photothermal-Catalytic Environmental Applications

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- **N_2 adsorption and desorption isotherm at 77 K**

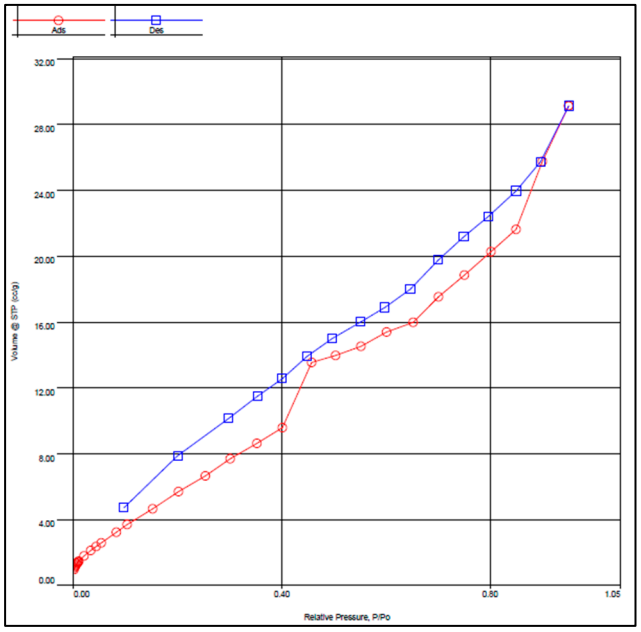


Figure S1 N_2 adsorption and desorption isotherms at 77 K of the MXene sample

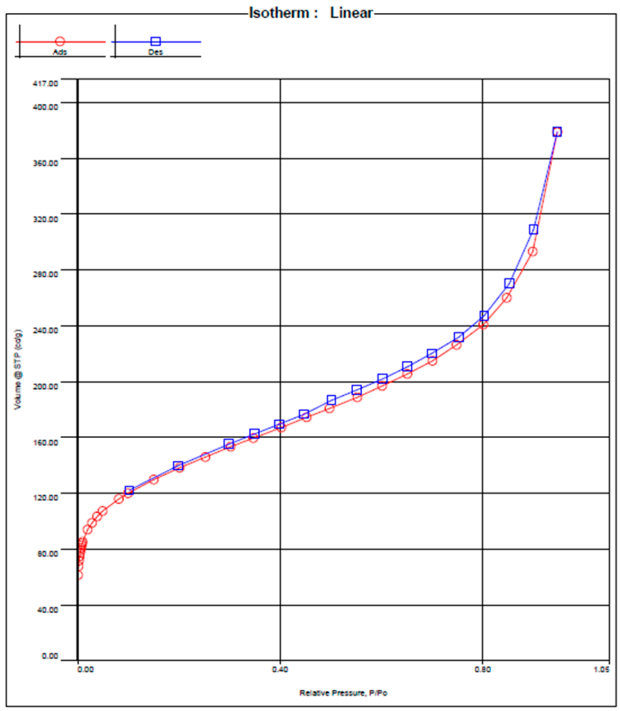
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Figure S2 N_2 adsorption and desorption isotherms at 77 K of the MXene/SiO_2 sample

- **UV-Vis DRS Spectra of the examined samples**

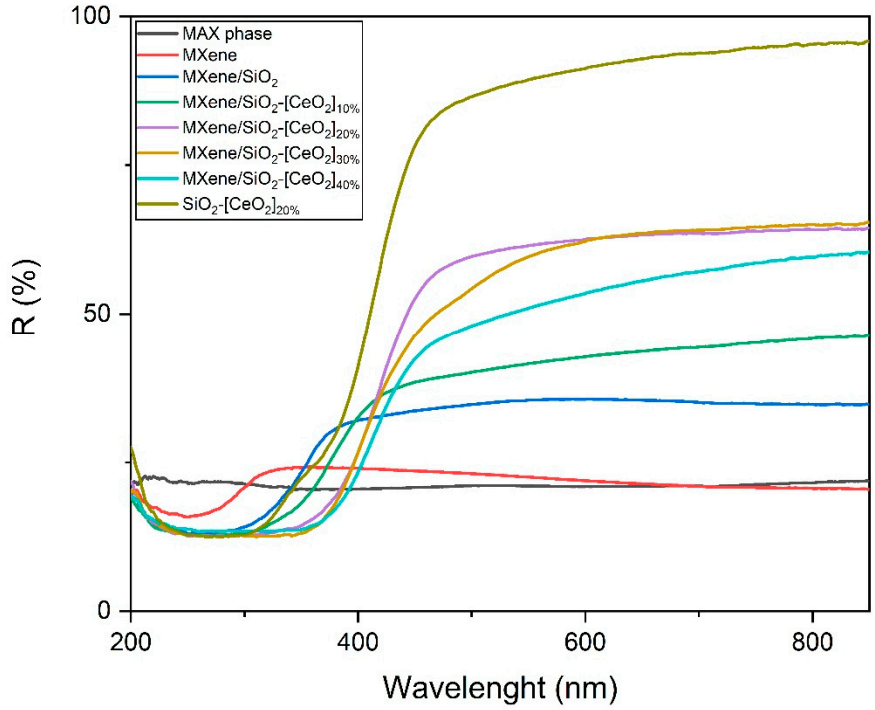


Figure S3 UV-vis-DRS spectra of the examined samples.

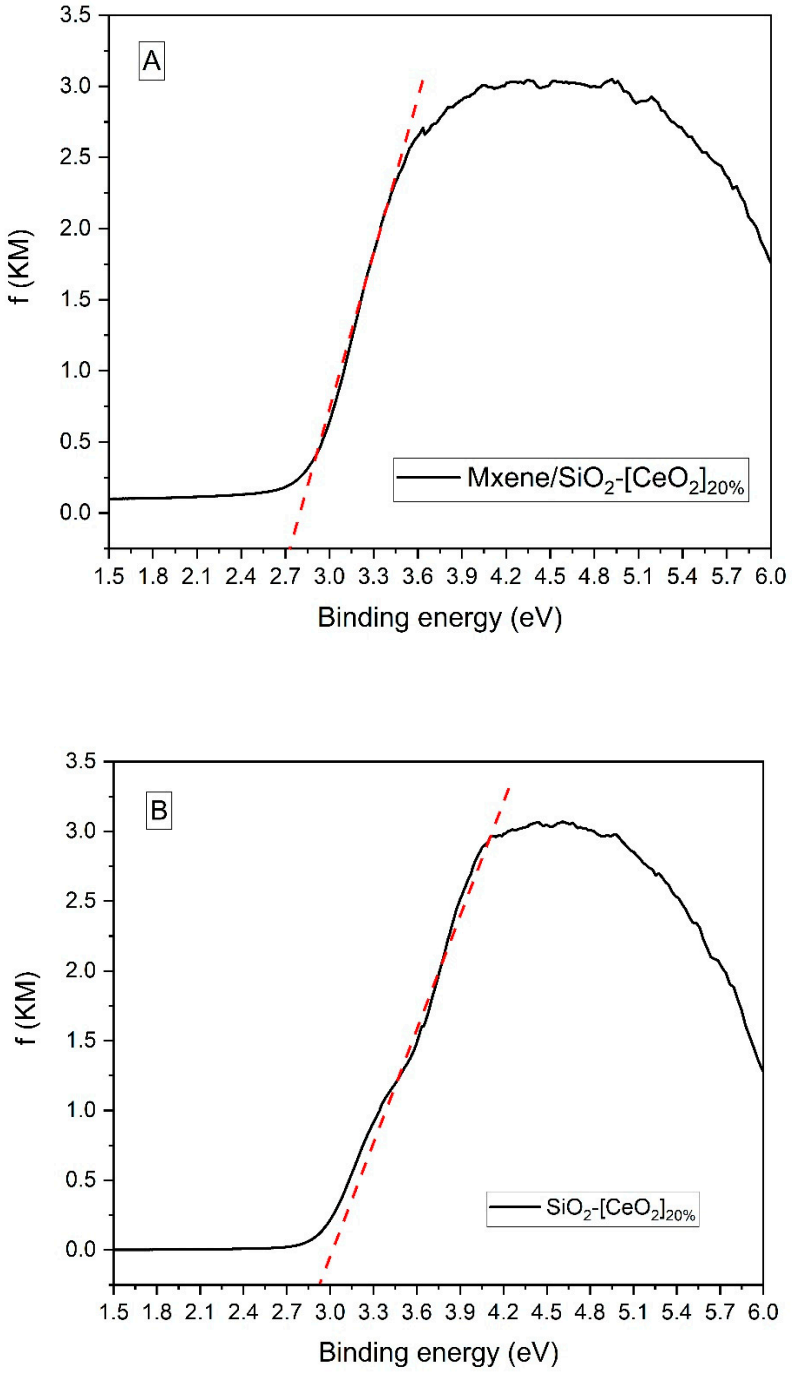


Figure S4 Modified Kubelka-Munk function vs binding energy for the estimation of the optical band-gap of: A) MXene/ SiO_2-$[CeO_2]_{20\%}$ and B) the SiO_2-$[CeO_2]_{20\%}$ as representative samples.

- **SEM-EDX and TEM-EDX of the examined samples**

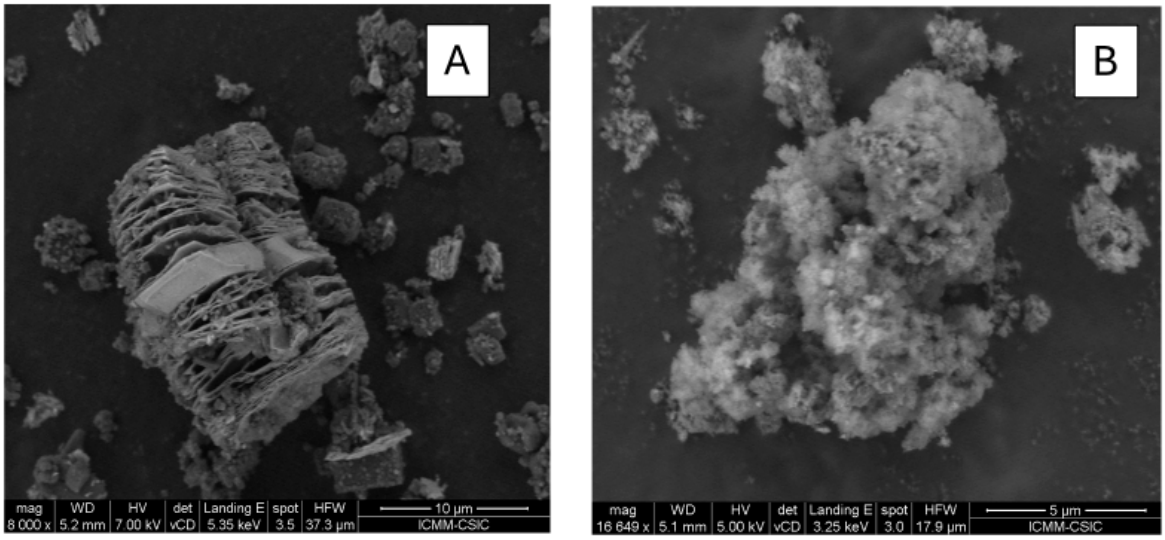


Figure S5 SEM images of A) MXene and B) MXene/SiO_2

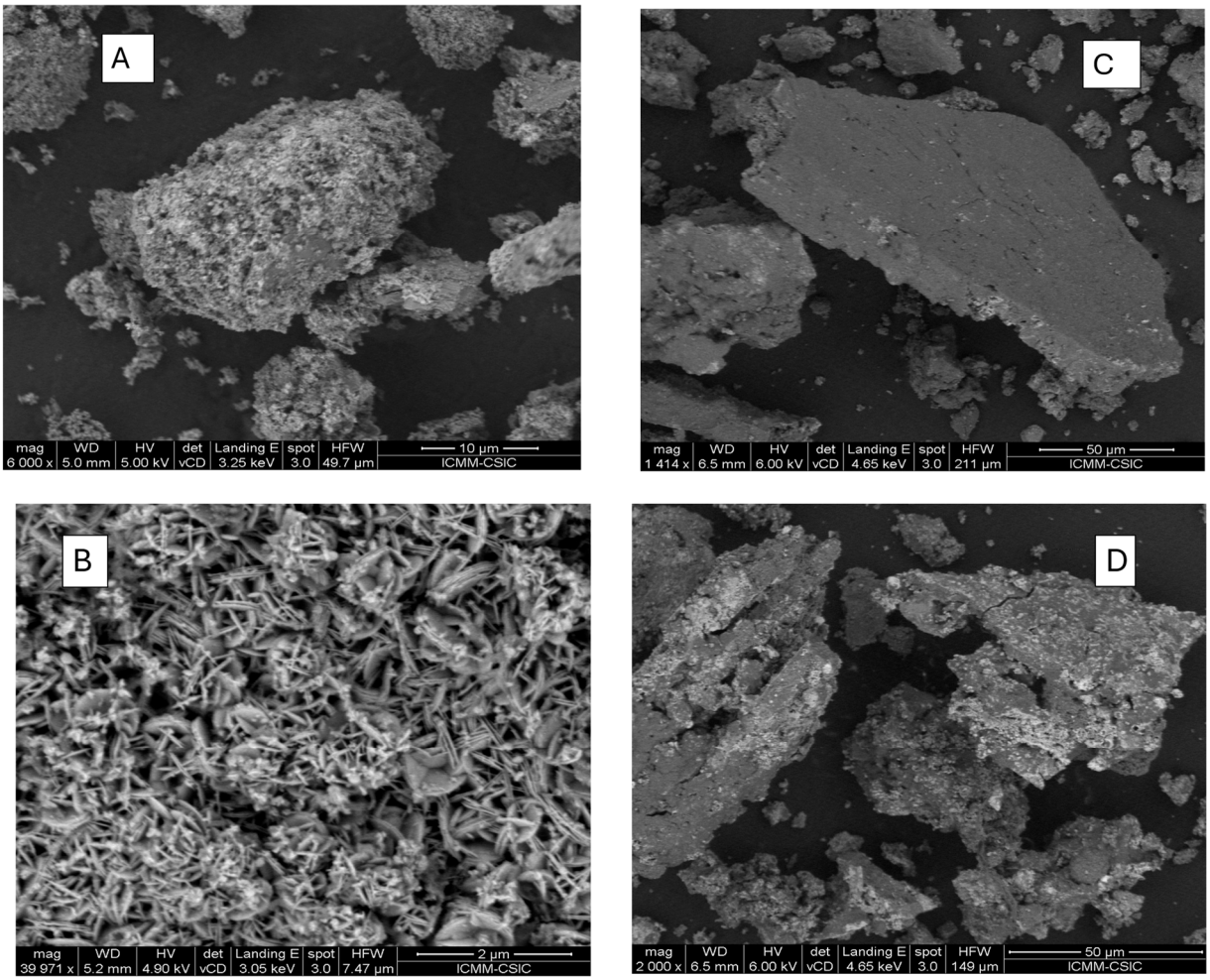


Figure S6 SEM image of MXene/SiO_2 with different weight percentages of CeO_2 A) 10% B) 20% C) 30% D) 40%

Table S1 TEM-EDX analysis of the examined samples.

MAX phase	
Element	Atomic%
Ti	50.0
Al	12.5
C	37.5
Total	100
MXene	
Element	Atomic%
F	27.39
Al	3.02
Ti	45.59
C	24.0
Total:	100
MXene/SiO_2	
Element	Atomic%
F	9.91
Al	0.59
O	33.21
Si	24.47
Ti	20.6
C	11.22
Total:	100

- **Zoom of the XRD patterns of the examined samples**

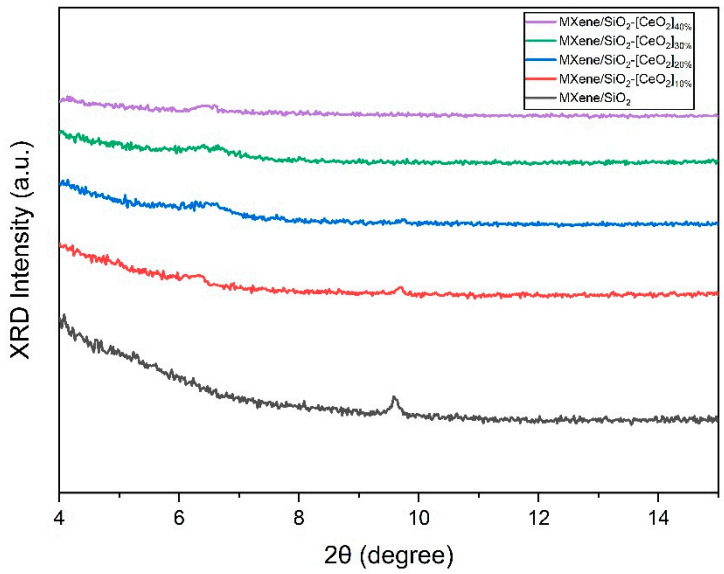


Figure S7 Zoom of the XRD patterns of the figure 3 related to MXene/silica composites with different weight percentages of CeO_2.

- **SEM-EDX maps and TEM-EDX of the examined samples**

Table S2 TEM-EDX of the MXene/SiO_2-$[CeO_2]_{10\%}$ sample.

MXene/SiO_2-$[CeO_2]_{10\%}$	
Element	Atomic%
C	11.9
O	49.82
F	1.93
Na	1.46
Al	0.86
Si	15.81
Ti	10.99
Ce	7.23
Total:	100

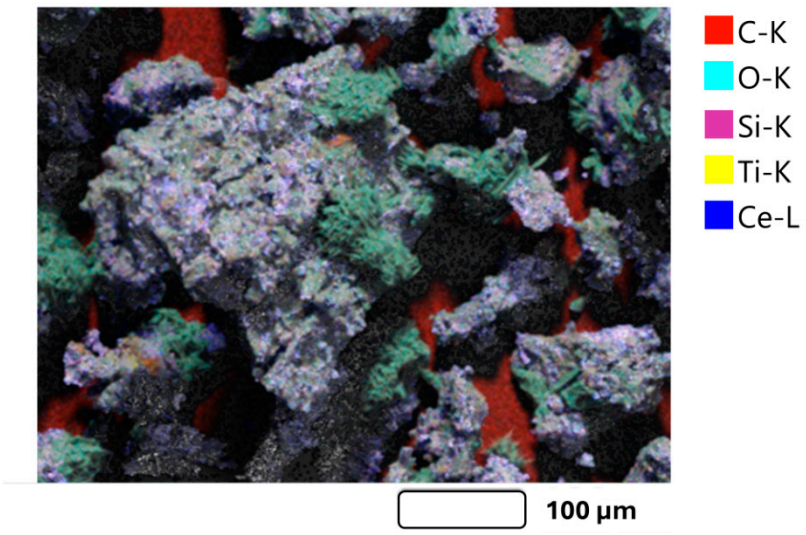


Figure S8 SEM image and corresponding EDX elemental maps of the MXene/SiO_2–$[CeO_2]_{10\%}$ hybrid material. The maps show the spatial distribution of Ti, Si, Ce, and O confirming the successful incorporation of CeO_2 on the MXene/SiO_2 surface.

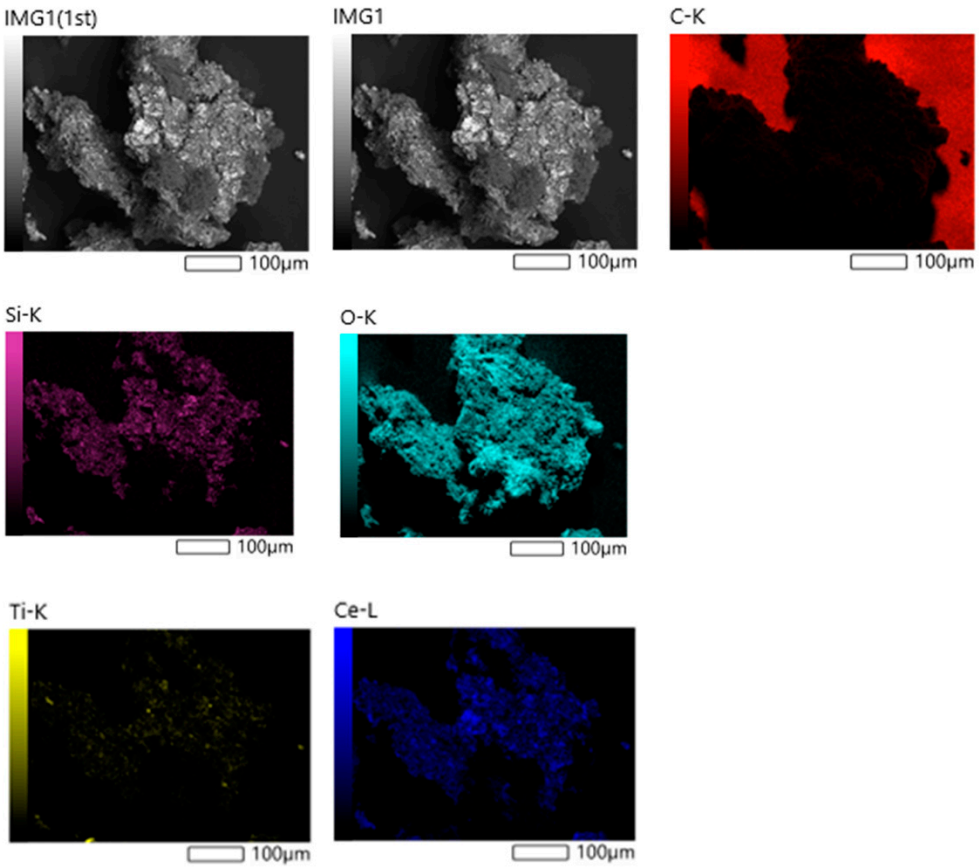


Figure S9 EDX elemental maps of the MXene/SiO_2–$[CeO_2]_{10\%}$. The maps show the single spatial distribution of the corresponding elements.

- **Raman spectra**

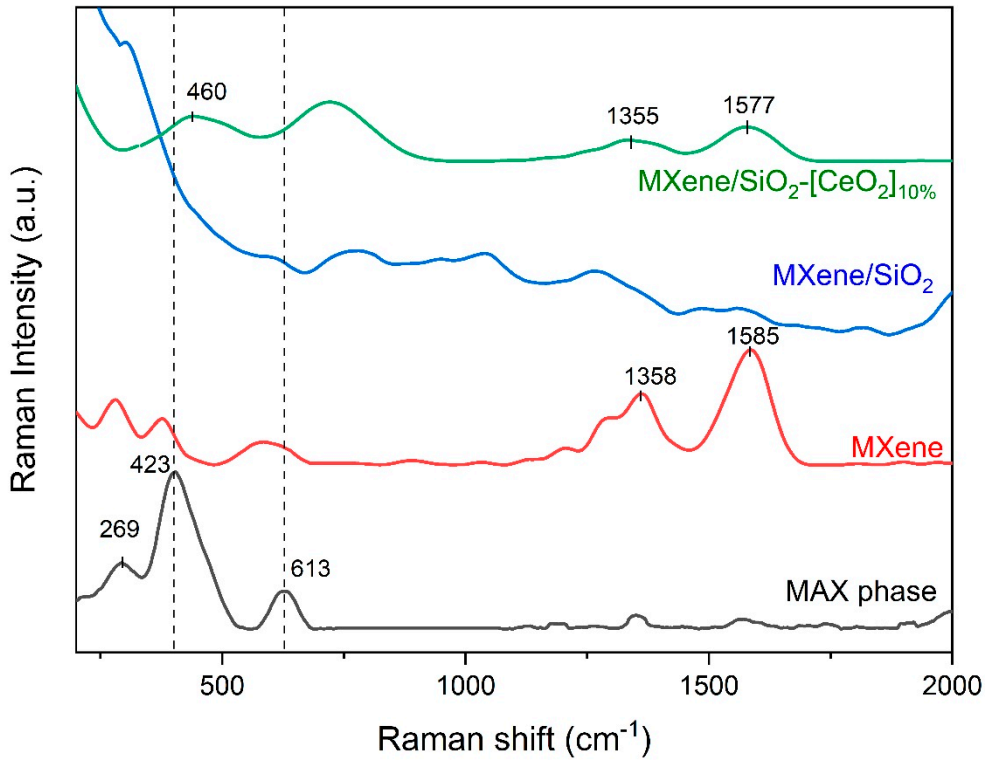
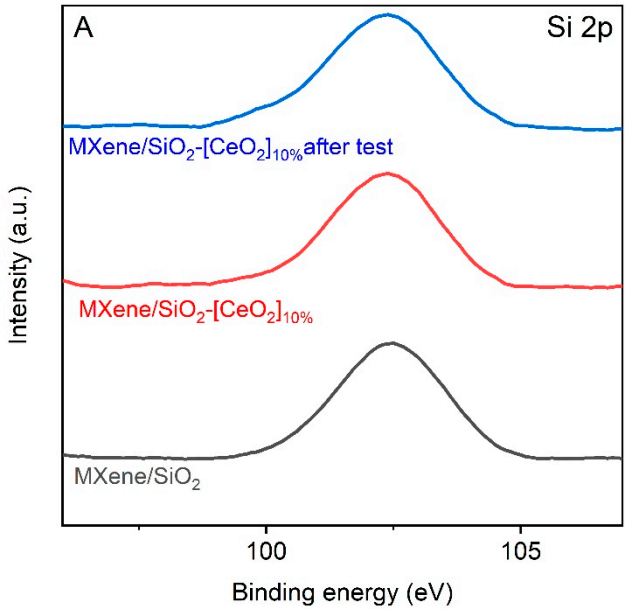
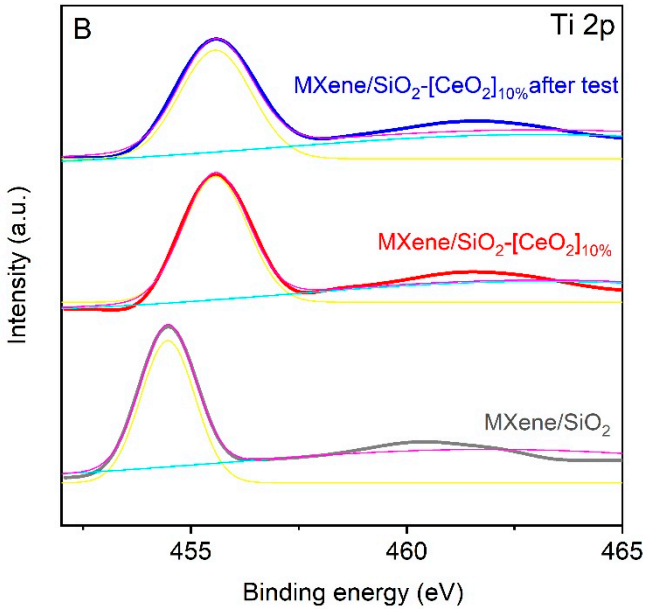


Figure S1 Raman spectra of the examined samples

- **XPS spectra**


A
Si 2p
MXene/SiO2-[CeO2]10%after test
MXene/SiO2-[CeO2]10%
MXene/SiO2
Intensity (a.u.)
100
105
Binding energy (eV)


B
Ti 2p
MXene/SiO2-[CeO2]10%after test
MXene/SiO2-[CeO2]10%
MXene/SiO2
Intensity (a.u.)
455
460
465
Binding energy (eV)

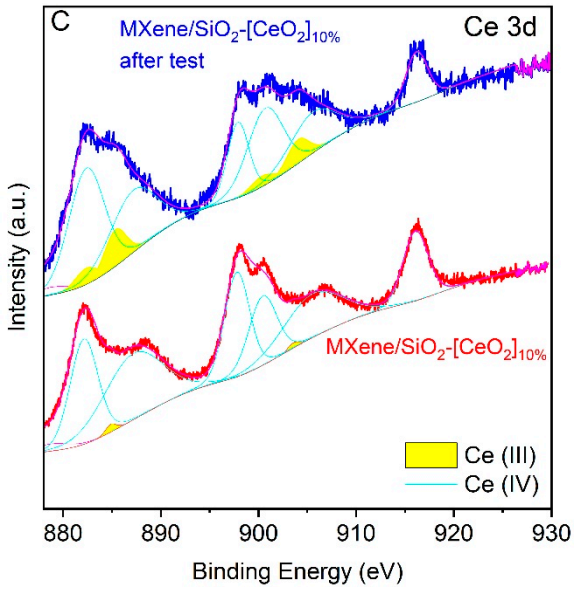


Figure S11 XPS spectra of the examined samples in the (A) Si 2p; (B) Ti 2p and (C) Ce 3d binding energy regions. For the spectra S11B-C, the yellow and cyan lines refer to the Gaussians components, whereas the magenta line superimposed on the experimental profiles refers to the sum of the Gaussian components.

- **Images from thermo-cameras**

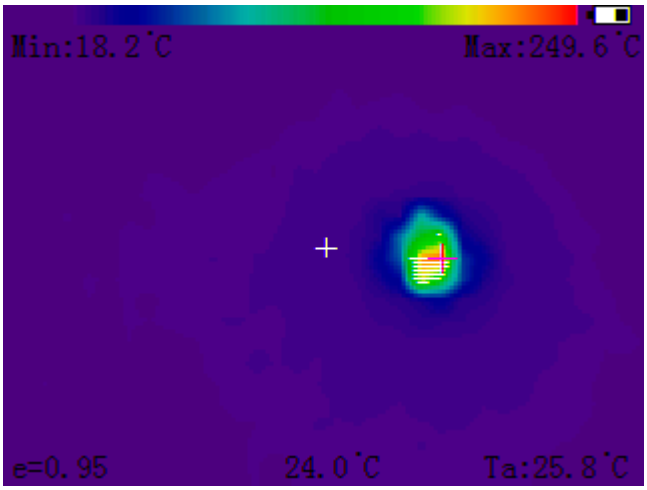


Figure S2 thermo-camera image of MXene after laser irradiation

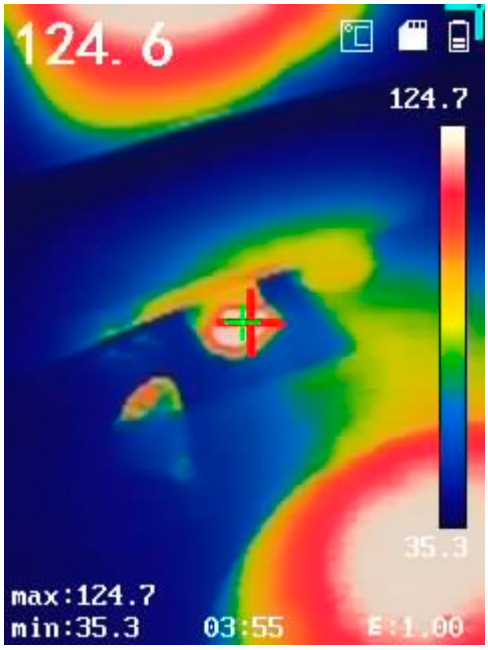
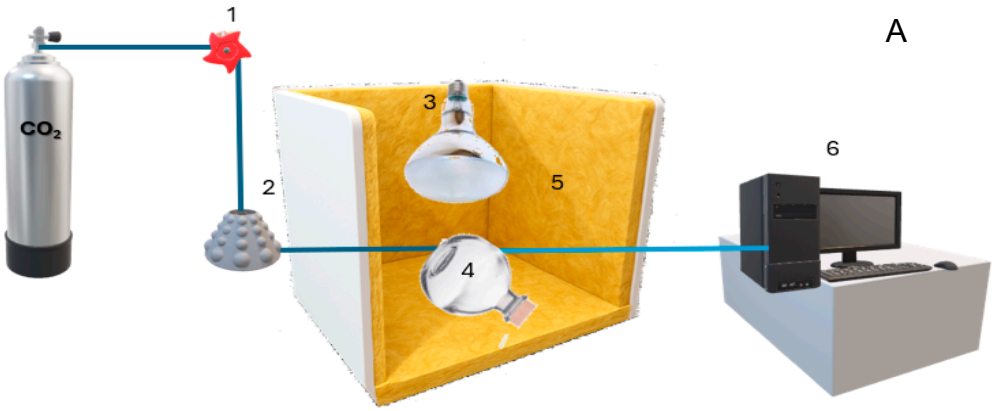


Figure S3 thermo-camera image of MXene/SiO_2-$[CeO_2]_{10\%}$ after irradiation with the solar lamp

- **Experimental set-up for the CO_2 conversion photothermo-catalytic tests**



1) Gas flow controller; **2**) Water bubbler; **3**) Solar lamp; **4**) Cylindrical batch photoreactor; **5**) Special insulated solar box; **6)** GC-TCD

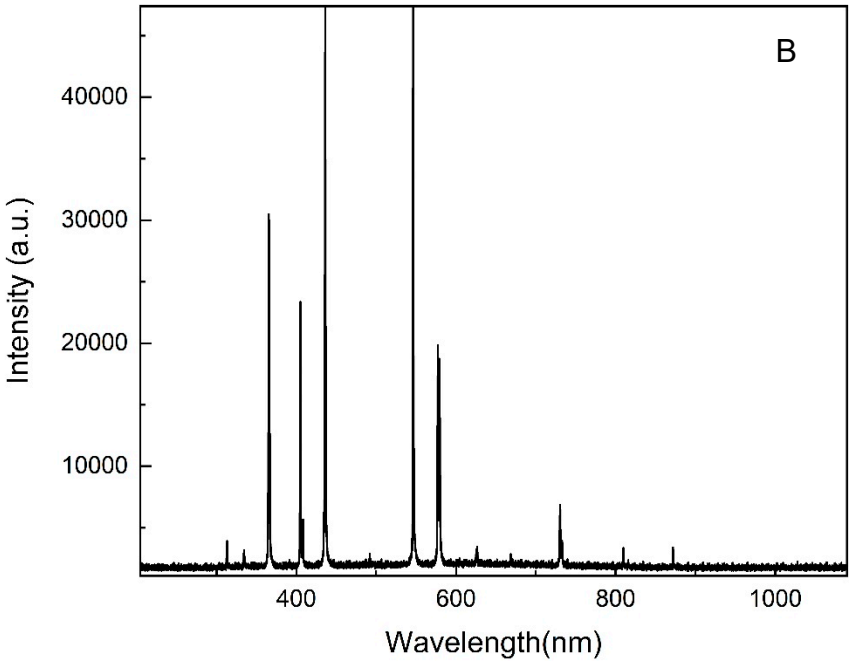


Figure S44 (A) Experimental set-up for the photothermo-catalytic conversion of CO_2; (B) emission spectrum of the employed solar lamp.

- **XRD spectra of the MXene/SiO_2-$[CeO_2]_{10\%}$ sample after the photothermo-catalytic test**

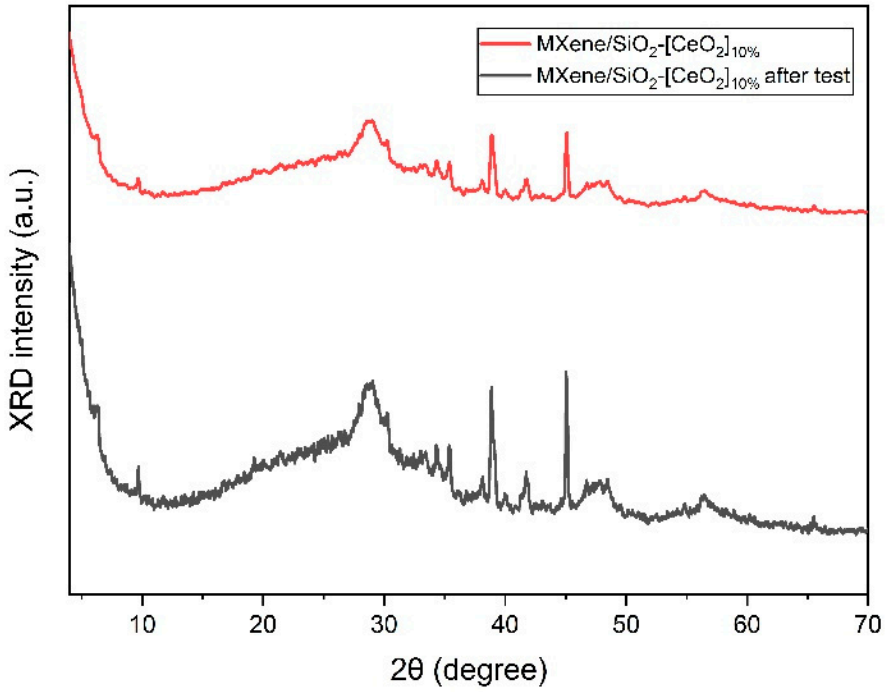


Figure S5 XRD patterns of the MXene/SiO_2-$[CeO_2]_{10\%}$ before and after the photothermo-catalytic test.