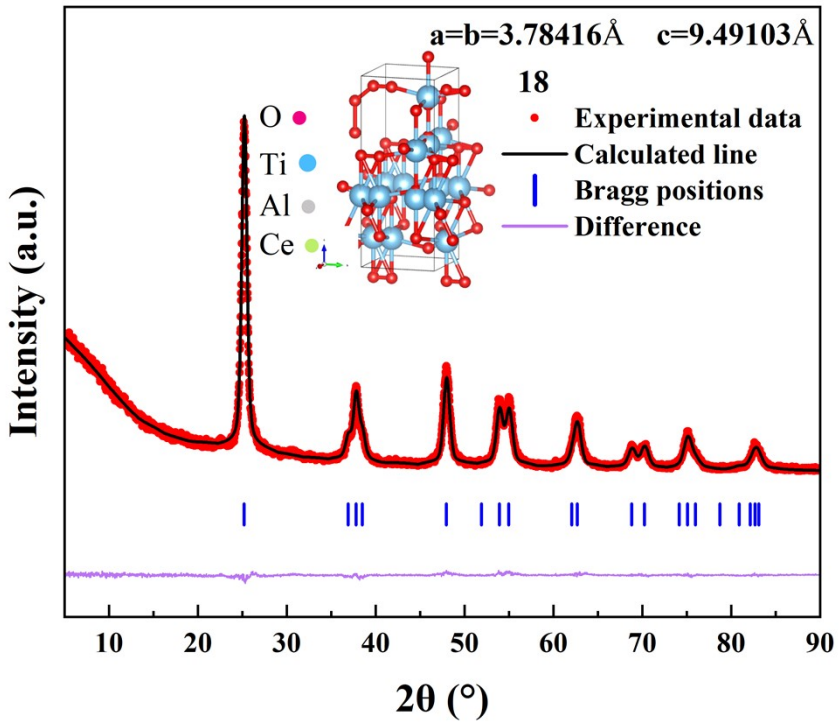
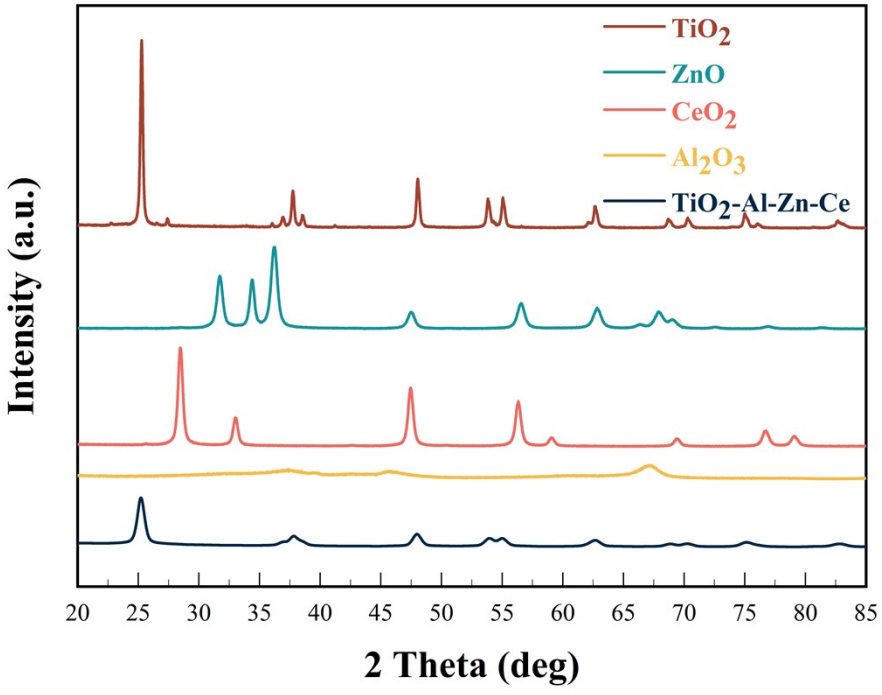
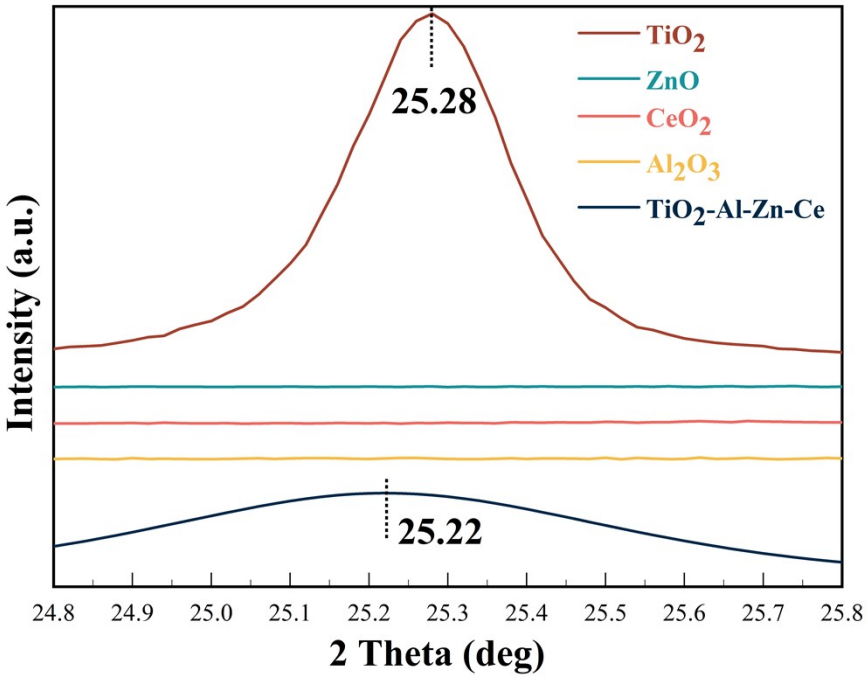


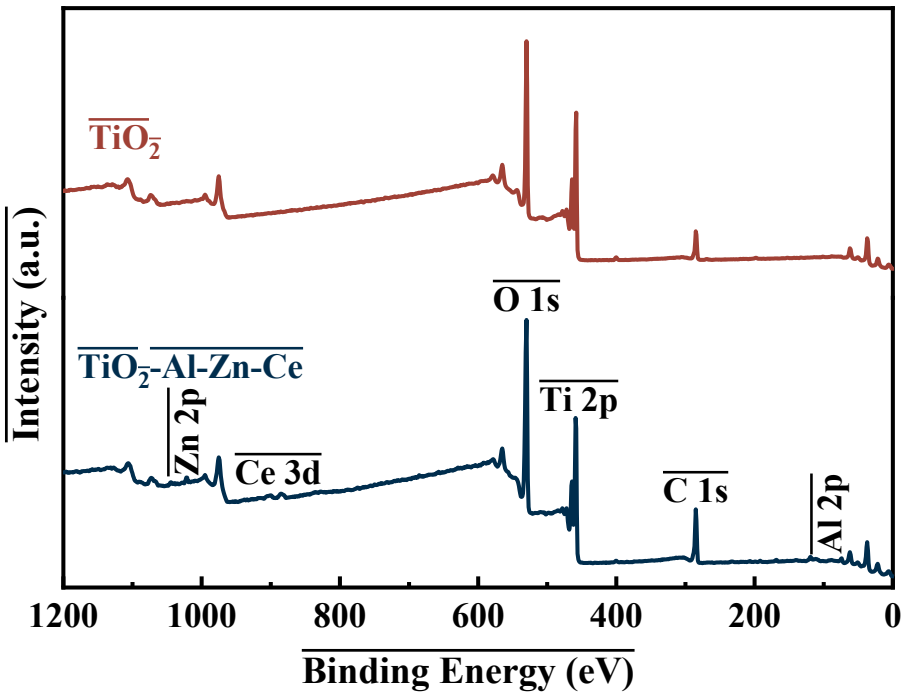
S1 Schematic diagram of the unit cell of TiO_2-Al-Zn-Ce and XRD pattern.



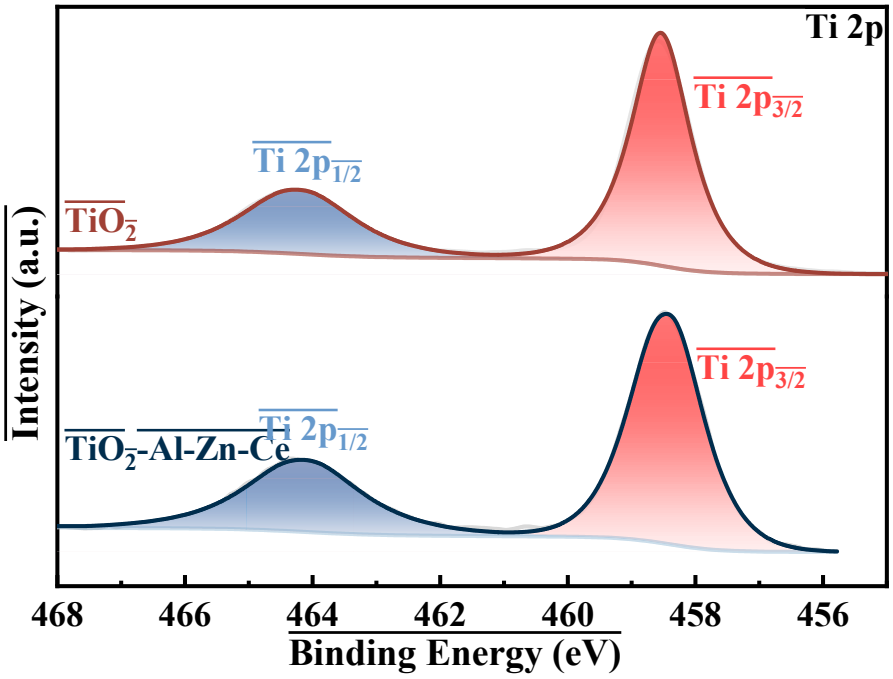
S2 XRD patterns of ZnO, CeO_2, Al_2O_3, TiO_2, and TiO_2-Al-Zn-Ce.



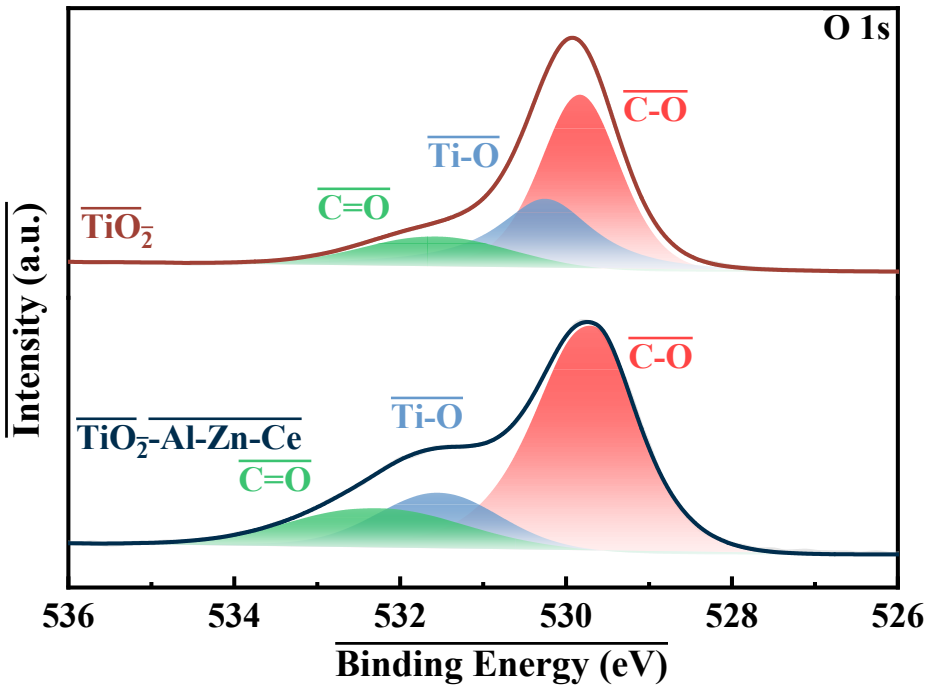
S3 Detailed XRD pattern from 24.8° to 25.8°.



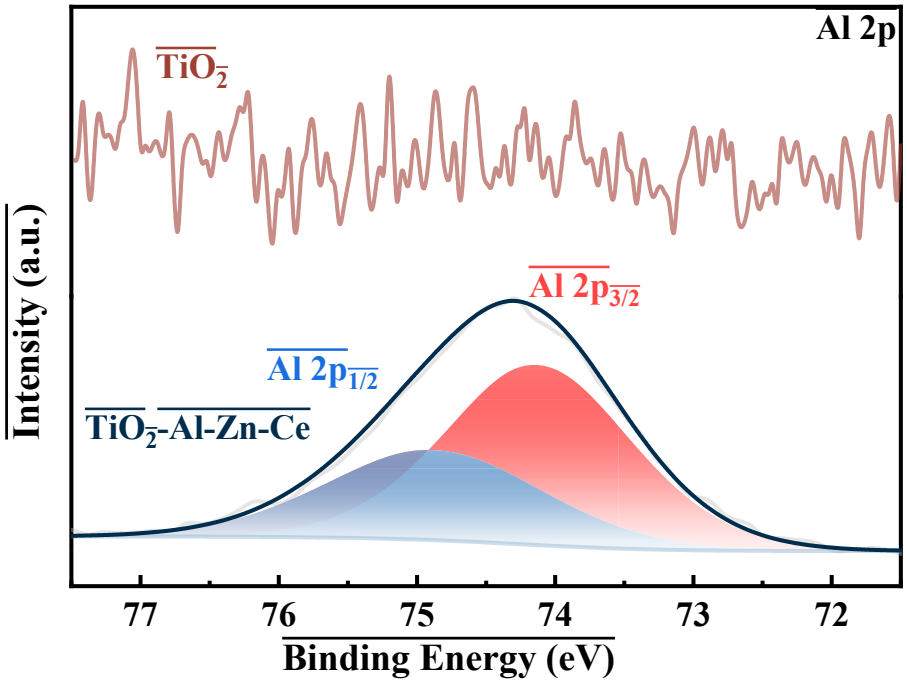
S4 XPS spectra of TiO_2-Al-Zn-Ce and TiO_2.



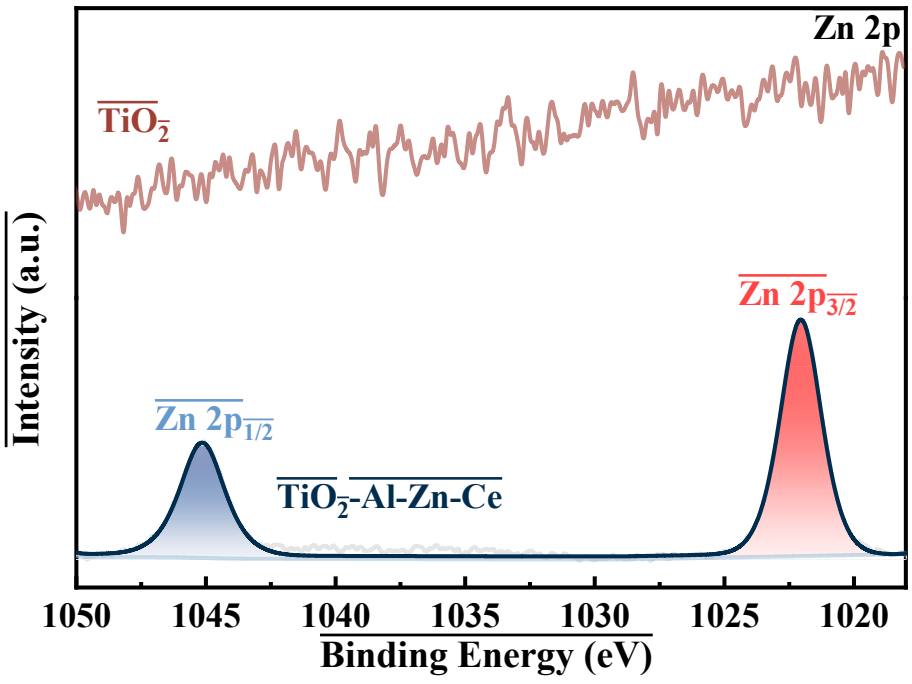
S5 XPS spectrum of Ti 2p;



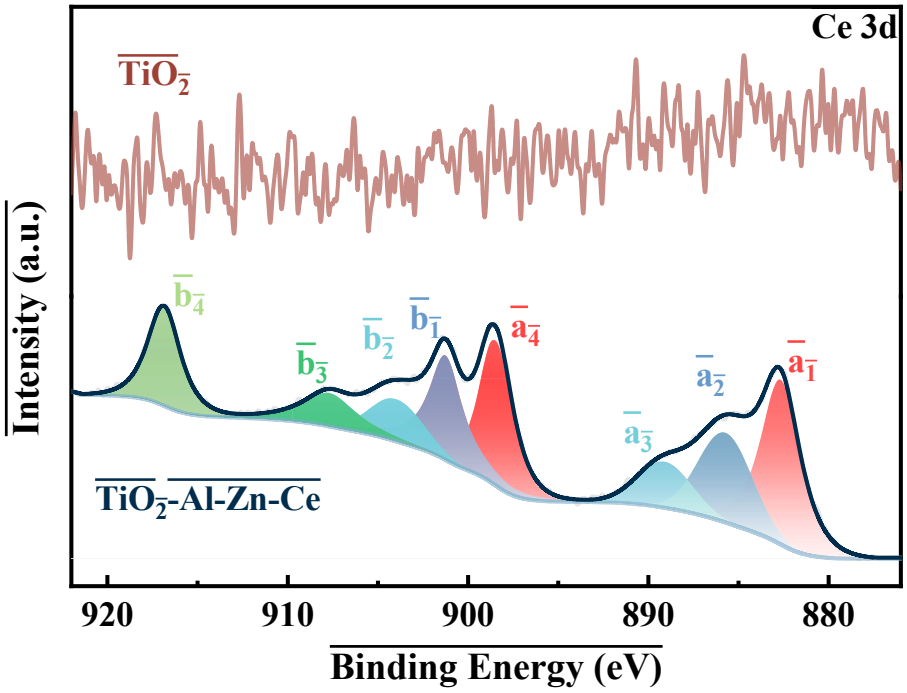
S6 XPS spectrum of O 1s;



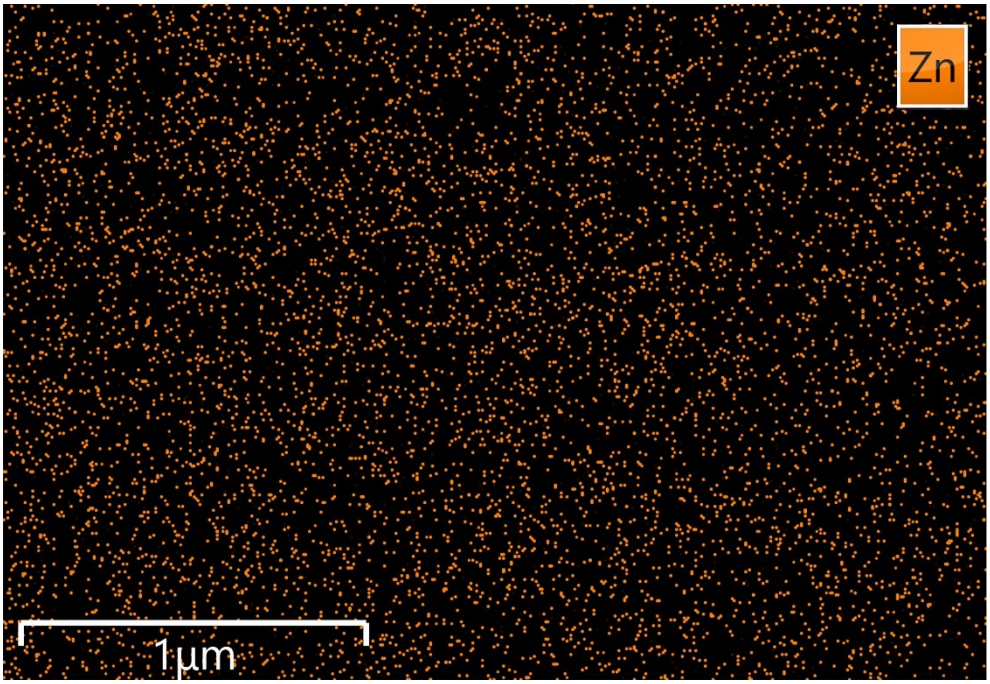
S7 XPS spectrum of Al 2p.



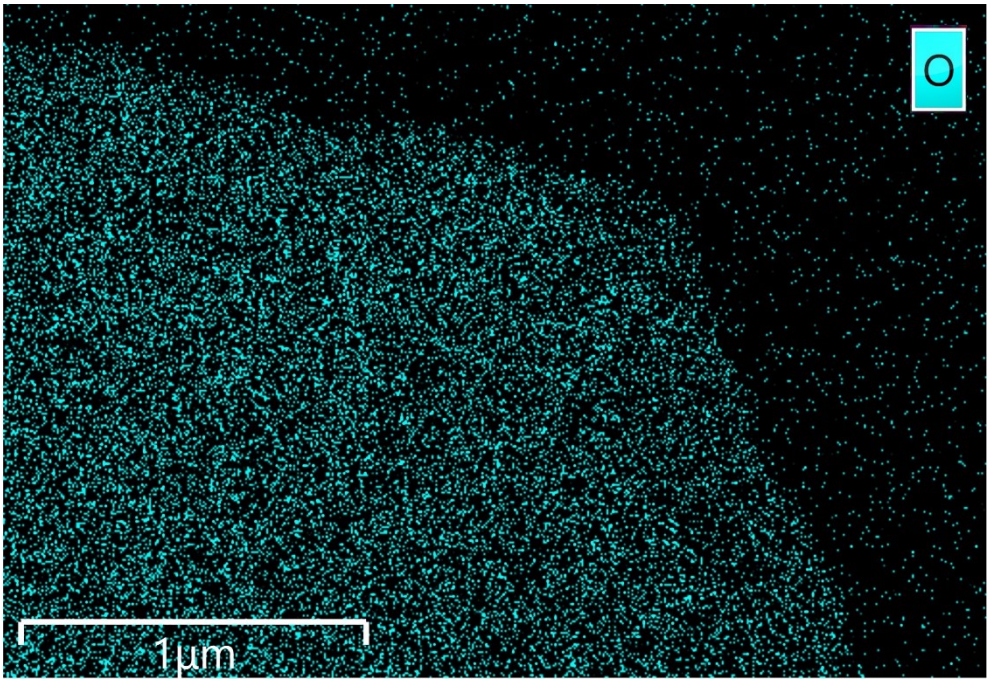
S8 XPS spectrum of Zn 2p.



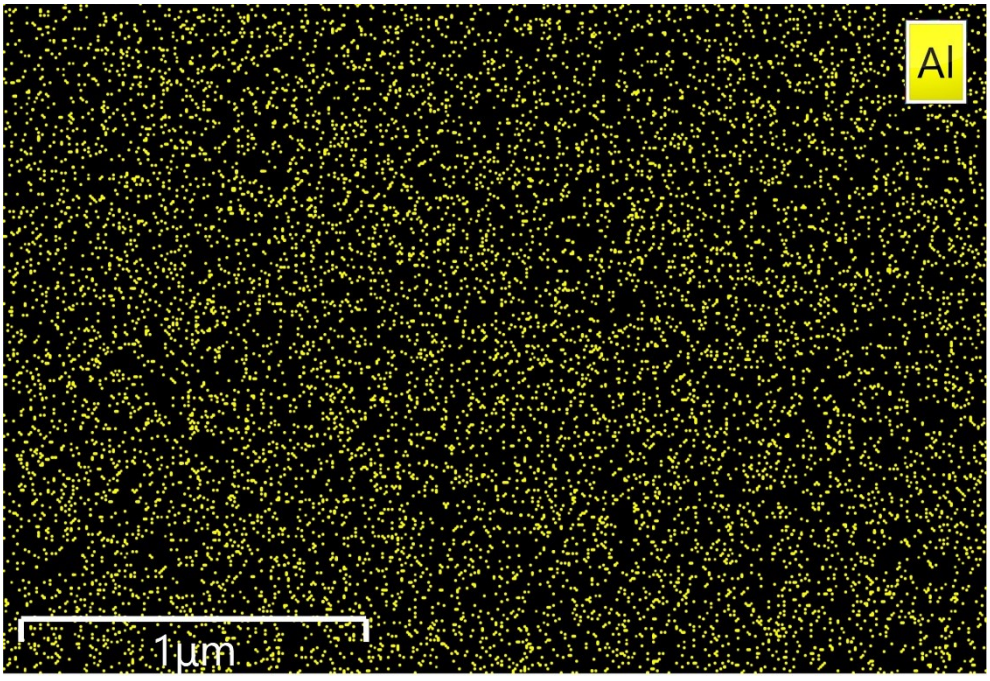
S9 XPS spectrum of Ce 3d.



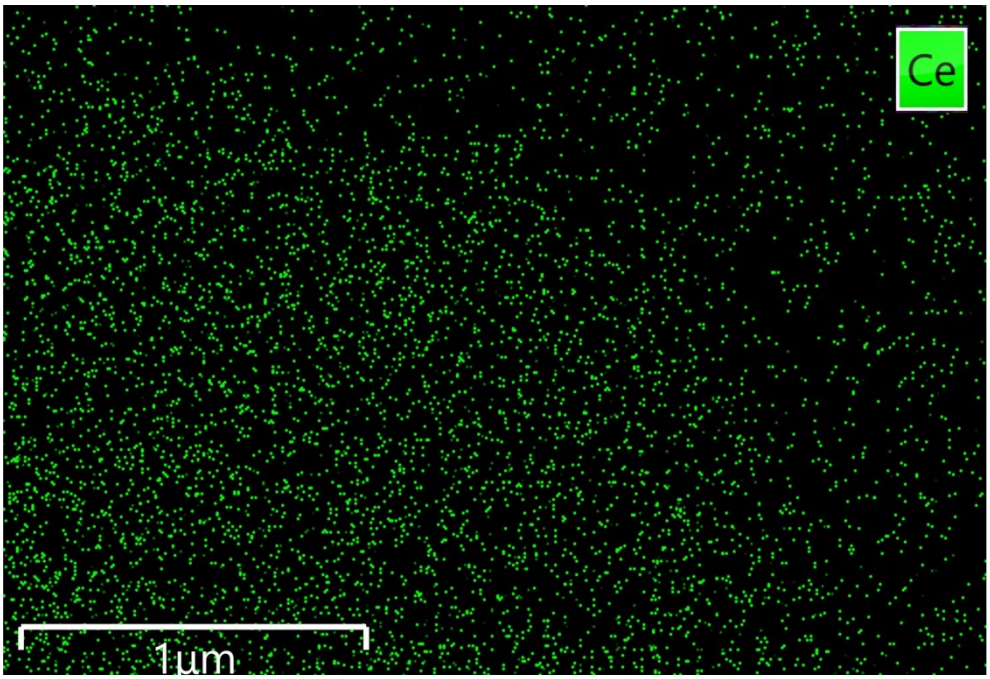
S10 Zn element mapping image of TiO_2-Al-Zn-Ce.



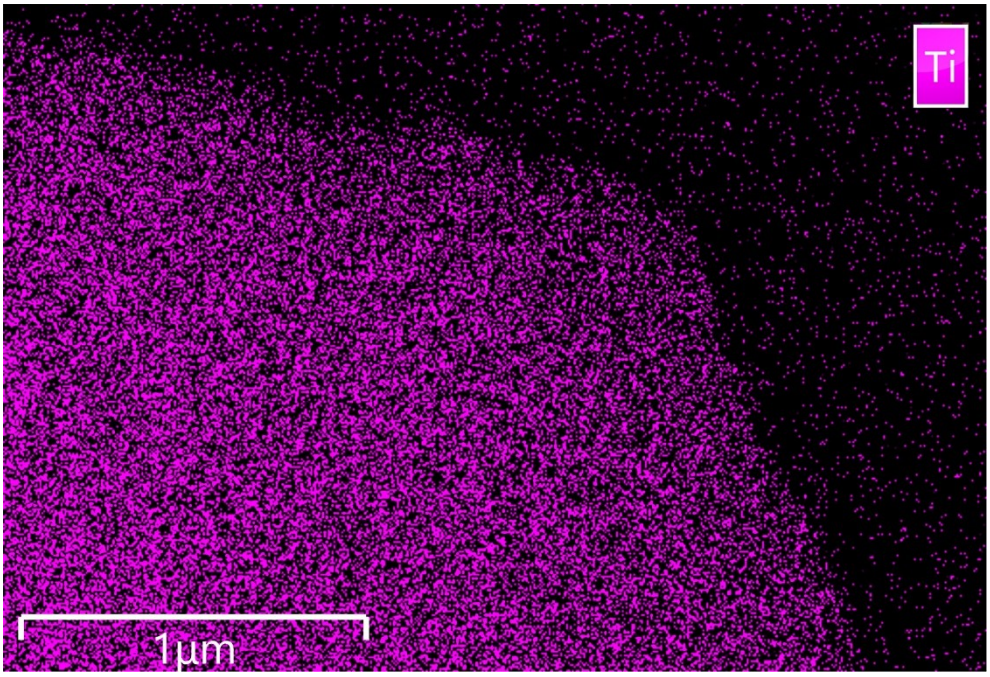
S11 O element mapping image of TiO_2-Al-Zn-Ce.



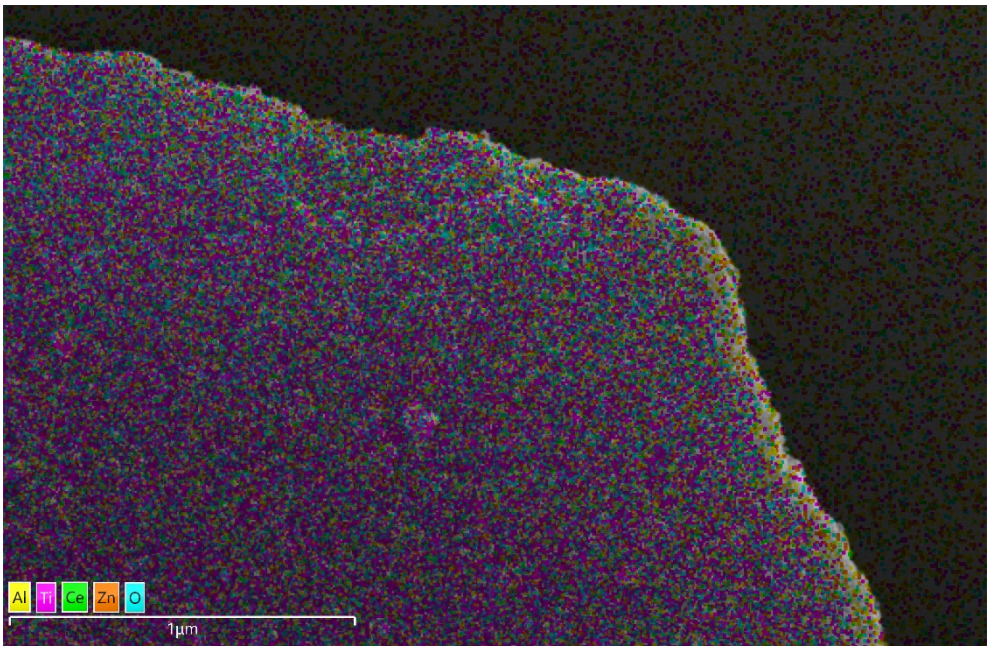
S12 Al element mapping image of TiO_2-Al-Zn-Ce.



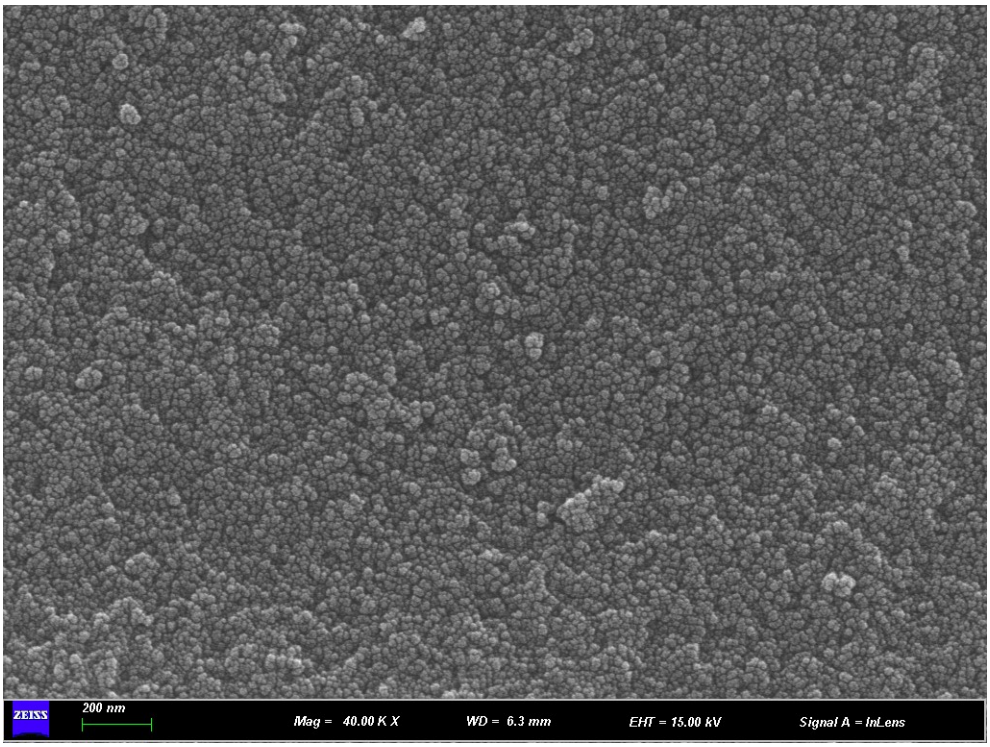
S13 Ce element mapping image of TiO_2-Al-Zn-Ce.



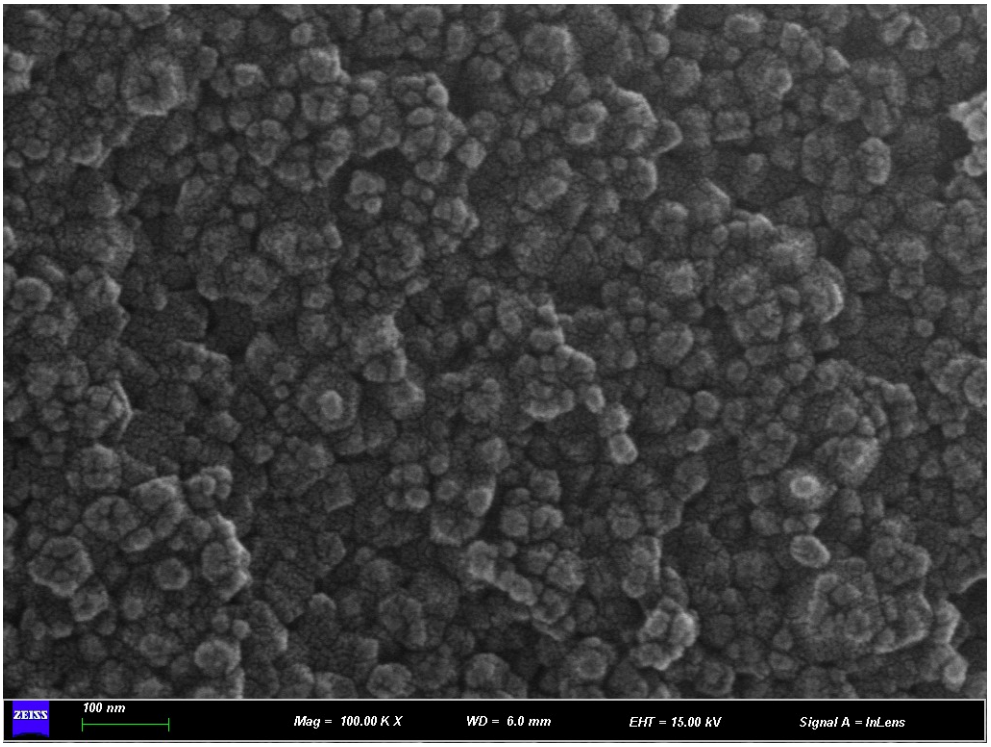
S14 Ti element mapping image of TiO_2-Al-Zn-Ce.



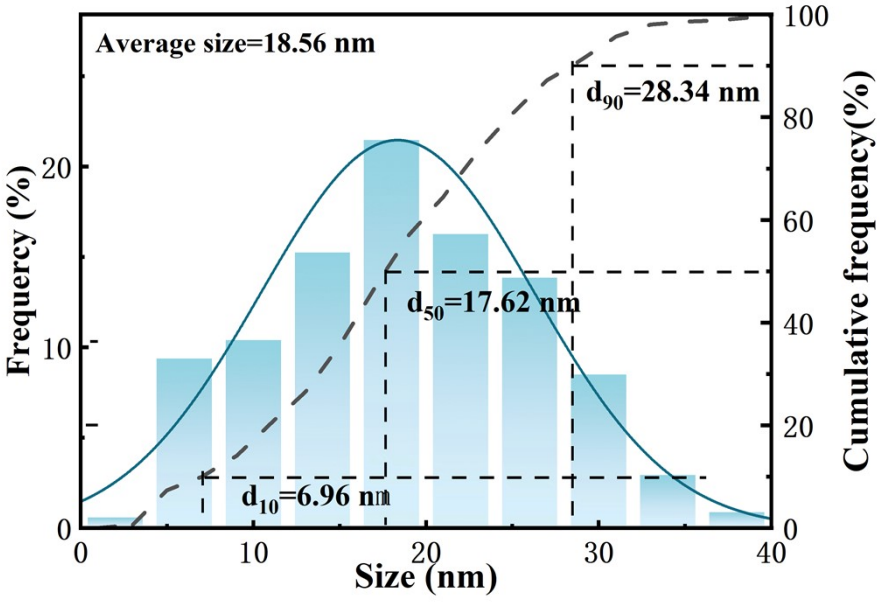
S15 EDS-SEM diagram of TiO_2-Al-Zn-Ce.



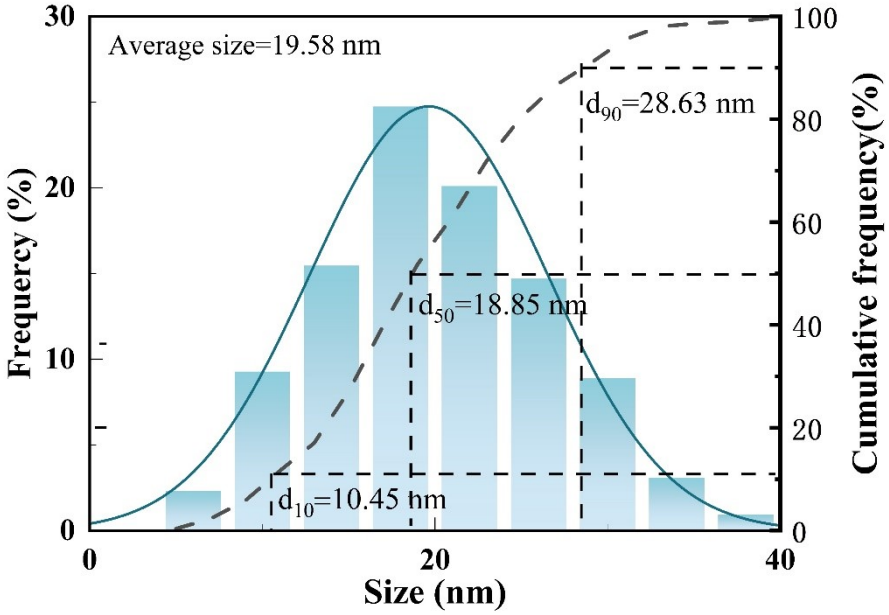
S16 SEM image and particle size distribution of TiO_2-Al-Zn-Ce.



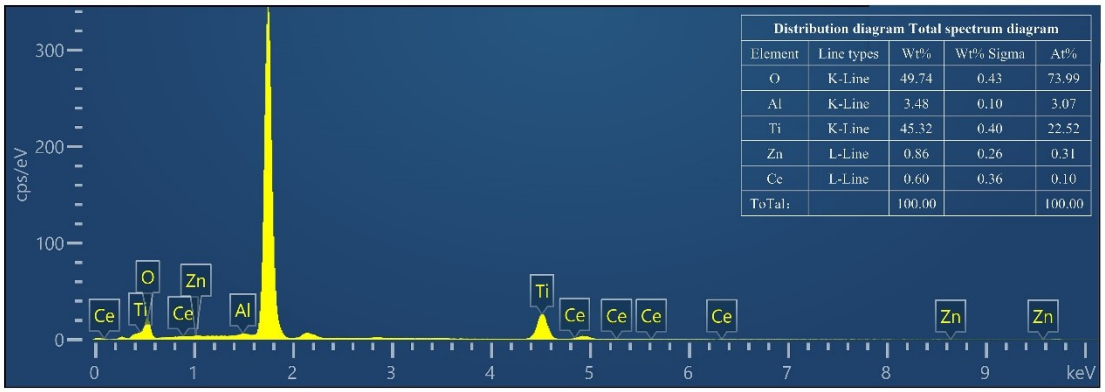
S17 SEM image and particle size distribution of TiO_2.



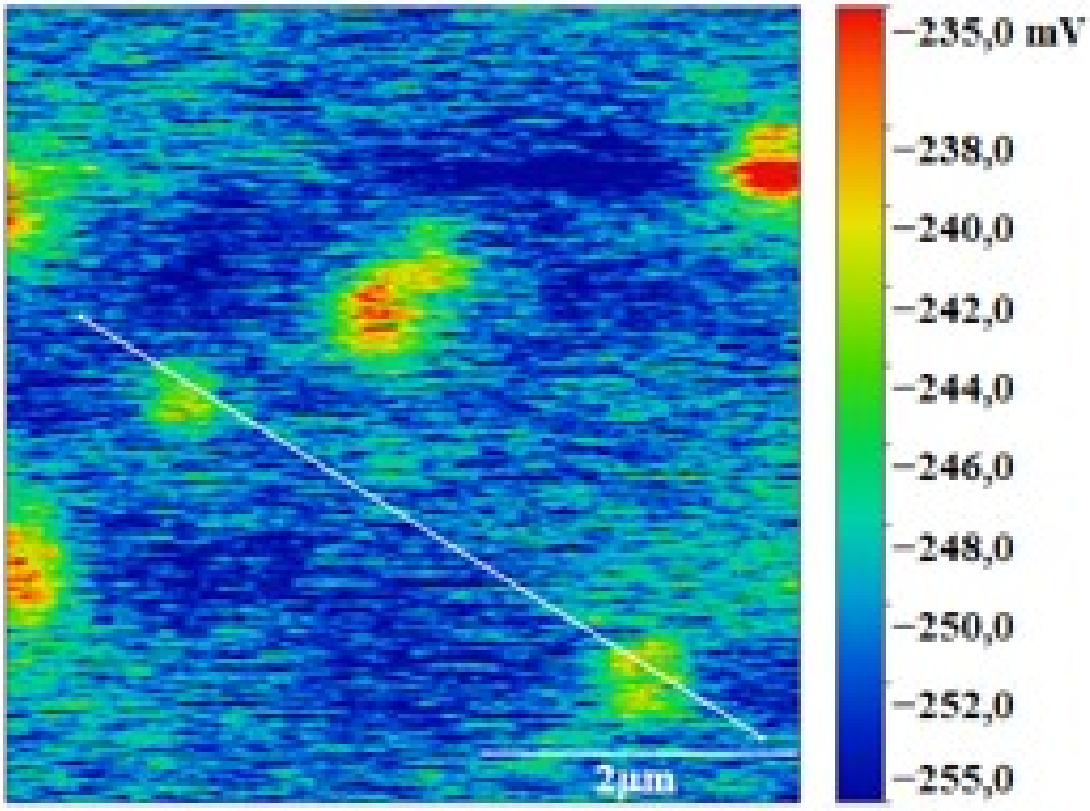
S18 SEM image and particle size distribution of TiO_2-Al-Zn-Ce.



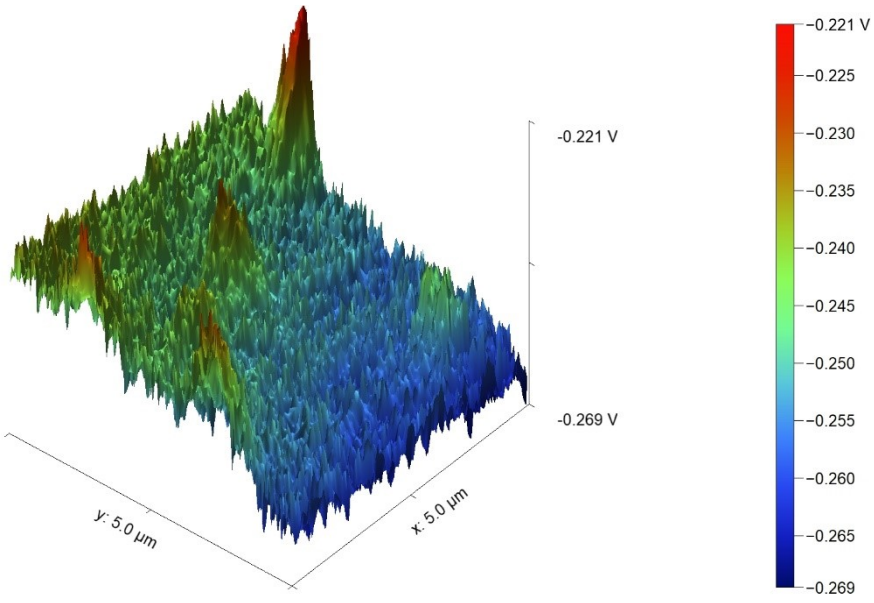
S19 SEM image and particle size distribution of TiO_2.



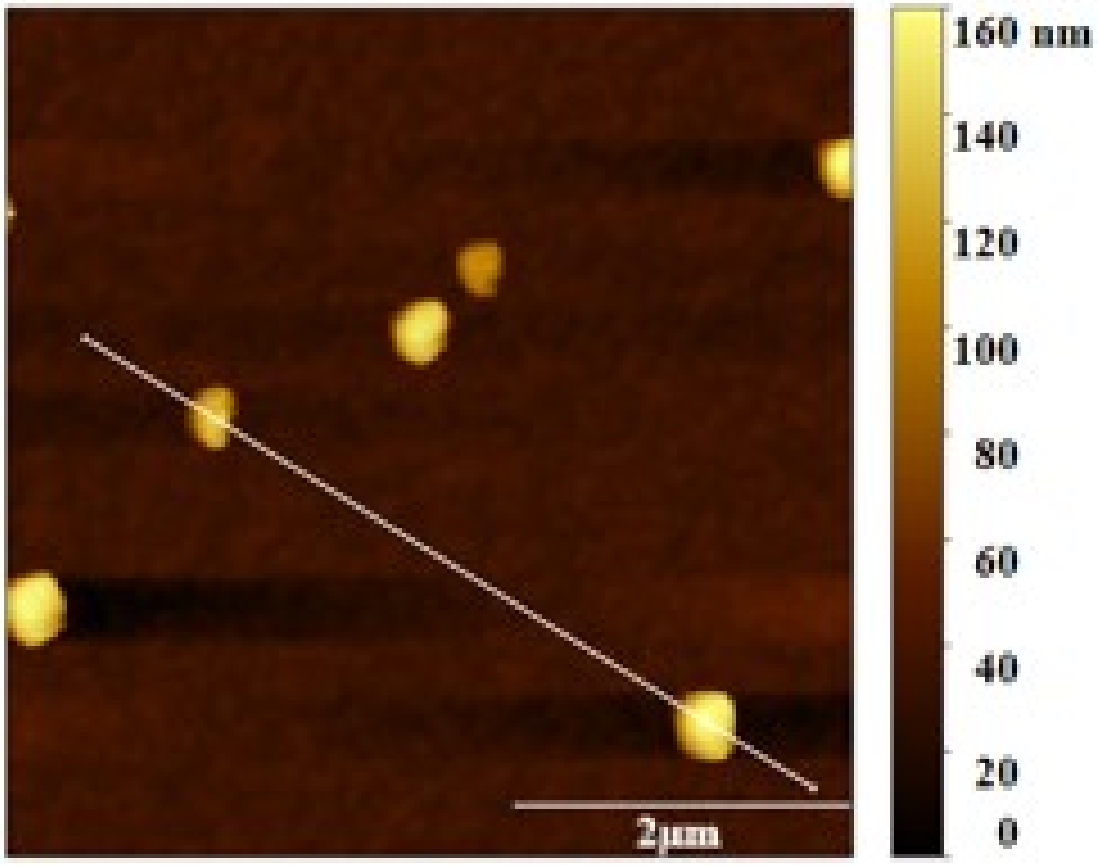
S20 Element distribution total spectrum and statistical table of TiO_2-Al-Zn-Ce.



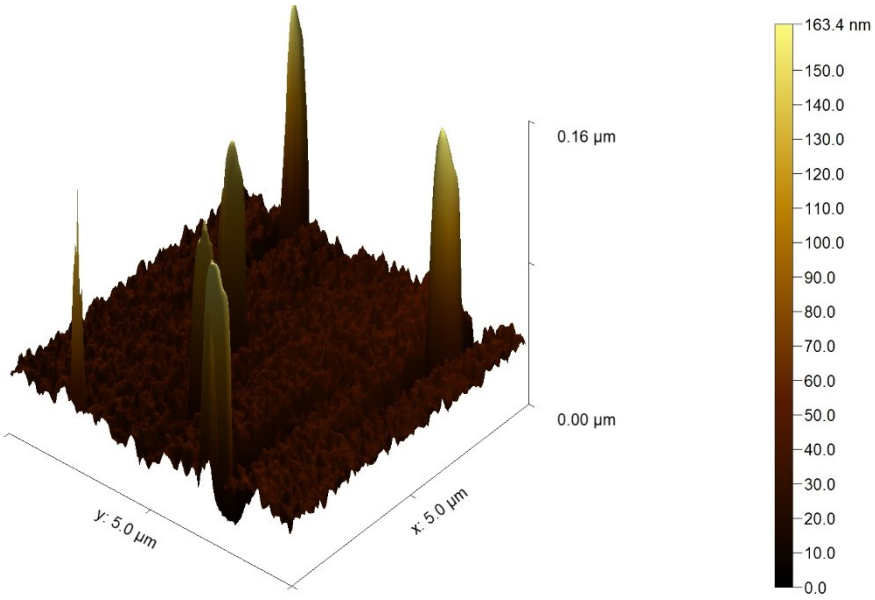
S21 KPFM image of TiO_2.



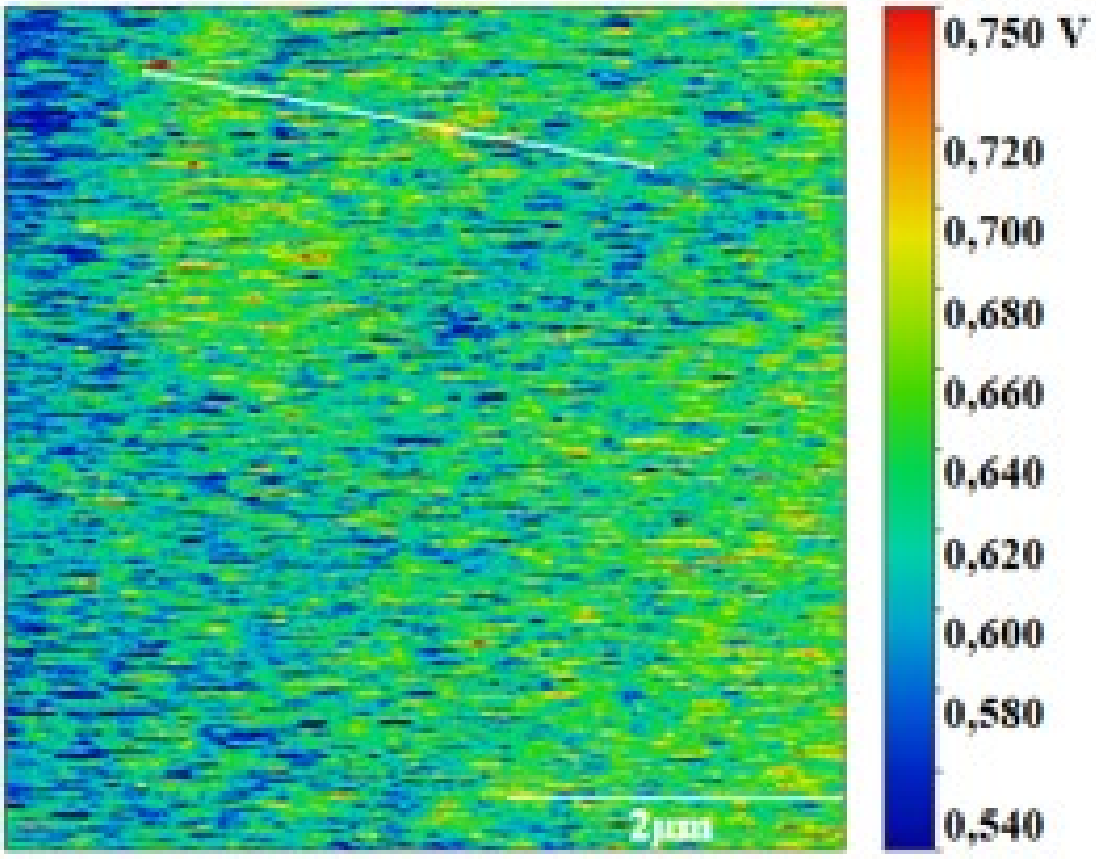
S22 3D KPFM diagram of TiO_2.



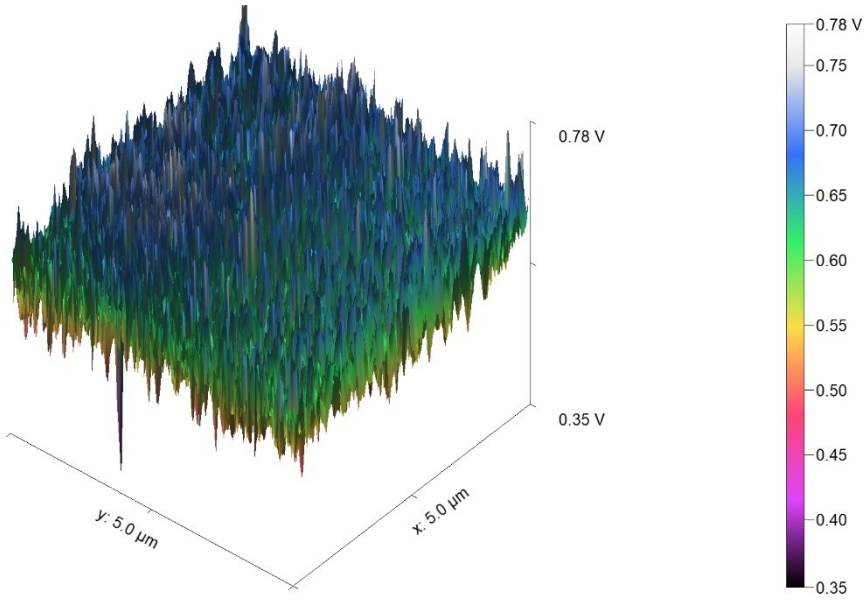
S23 AFM image of TiO_2.



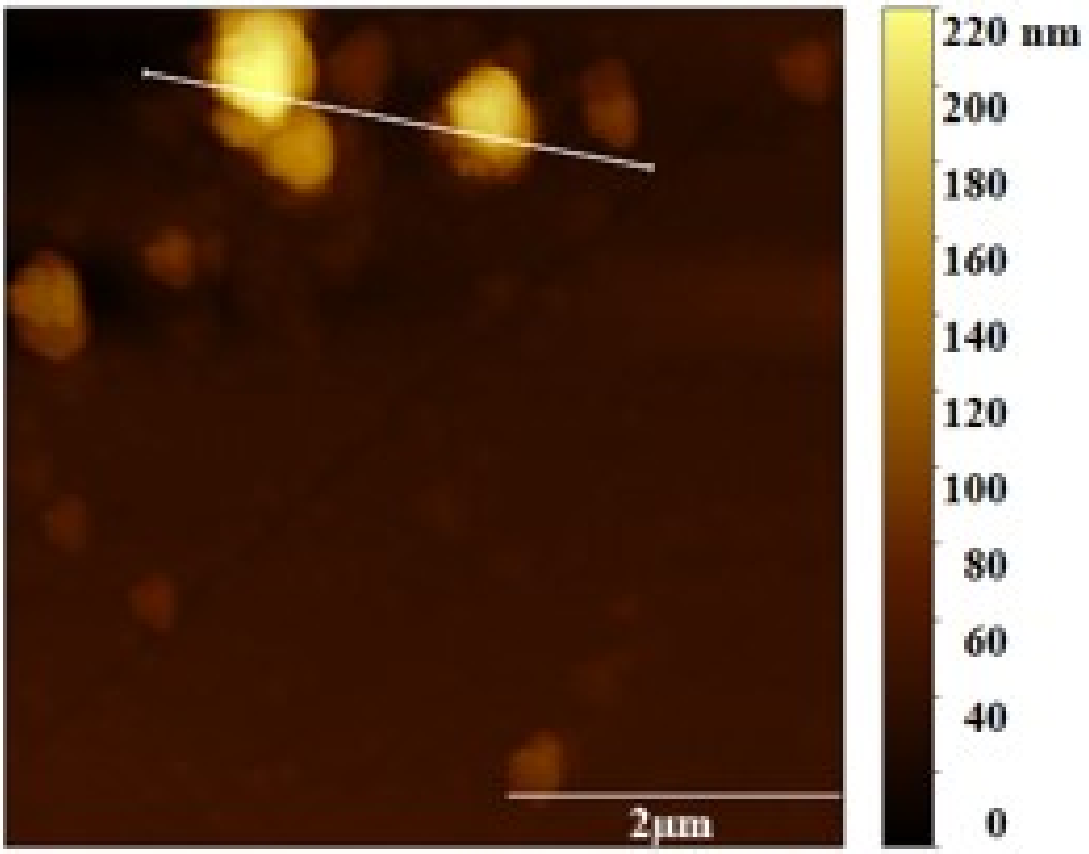
S24 3D AFM diagram of TiO_2.



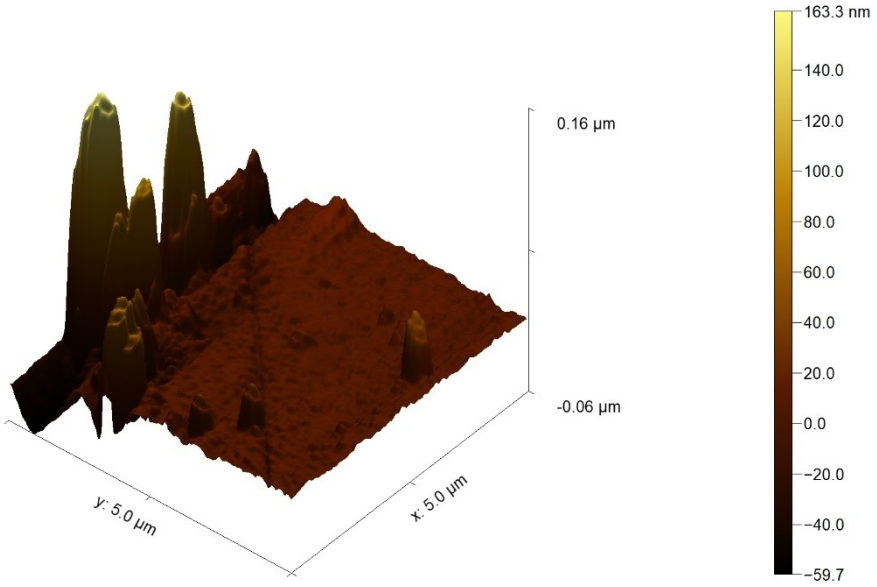
S25 KPFM image of TiO_2-Al-Zn-Ce.



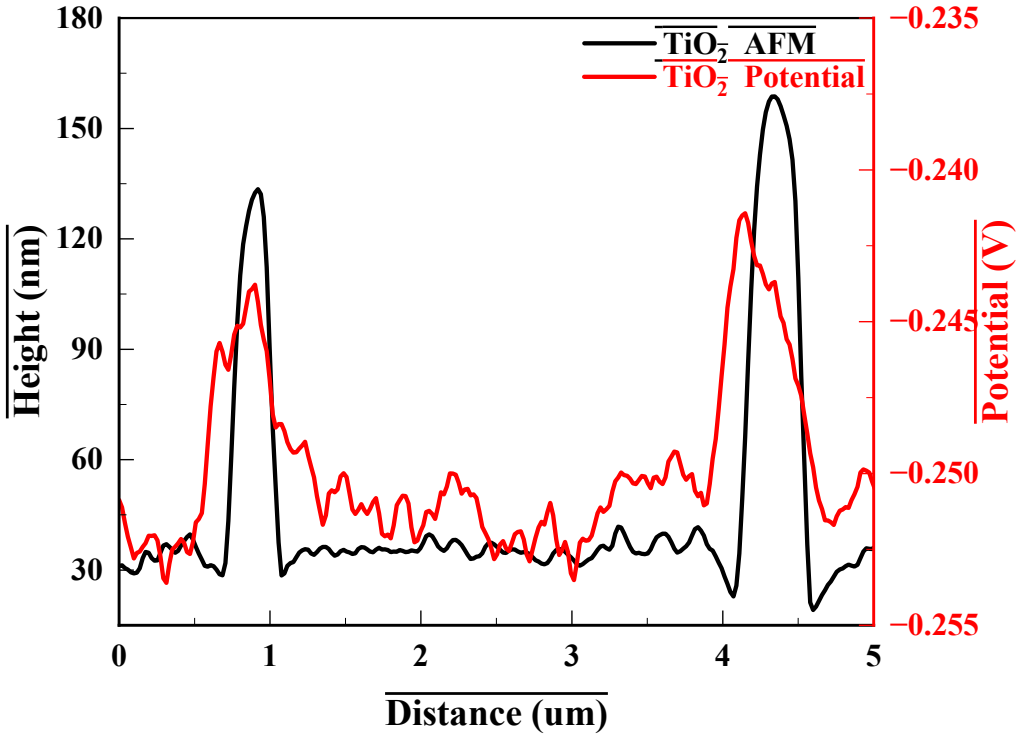
S26 3D KPFM diagram of TiO_2-Al-Zn-Ce.



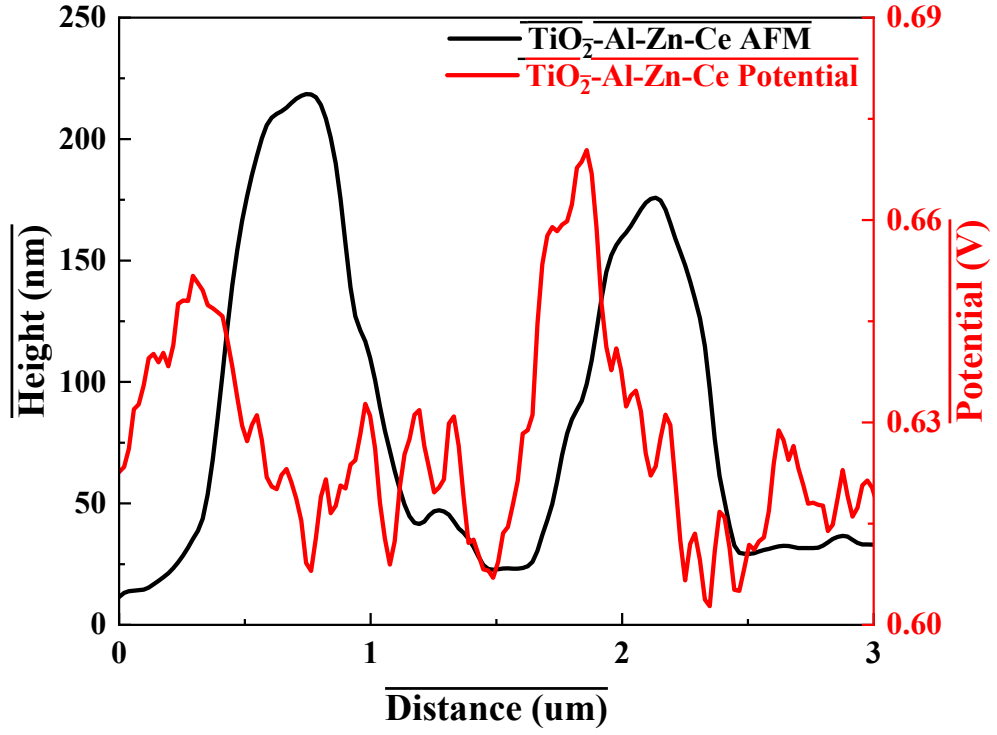
S27 AFM image of TiO_2-Al-Zn-Ce.



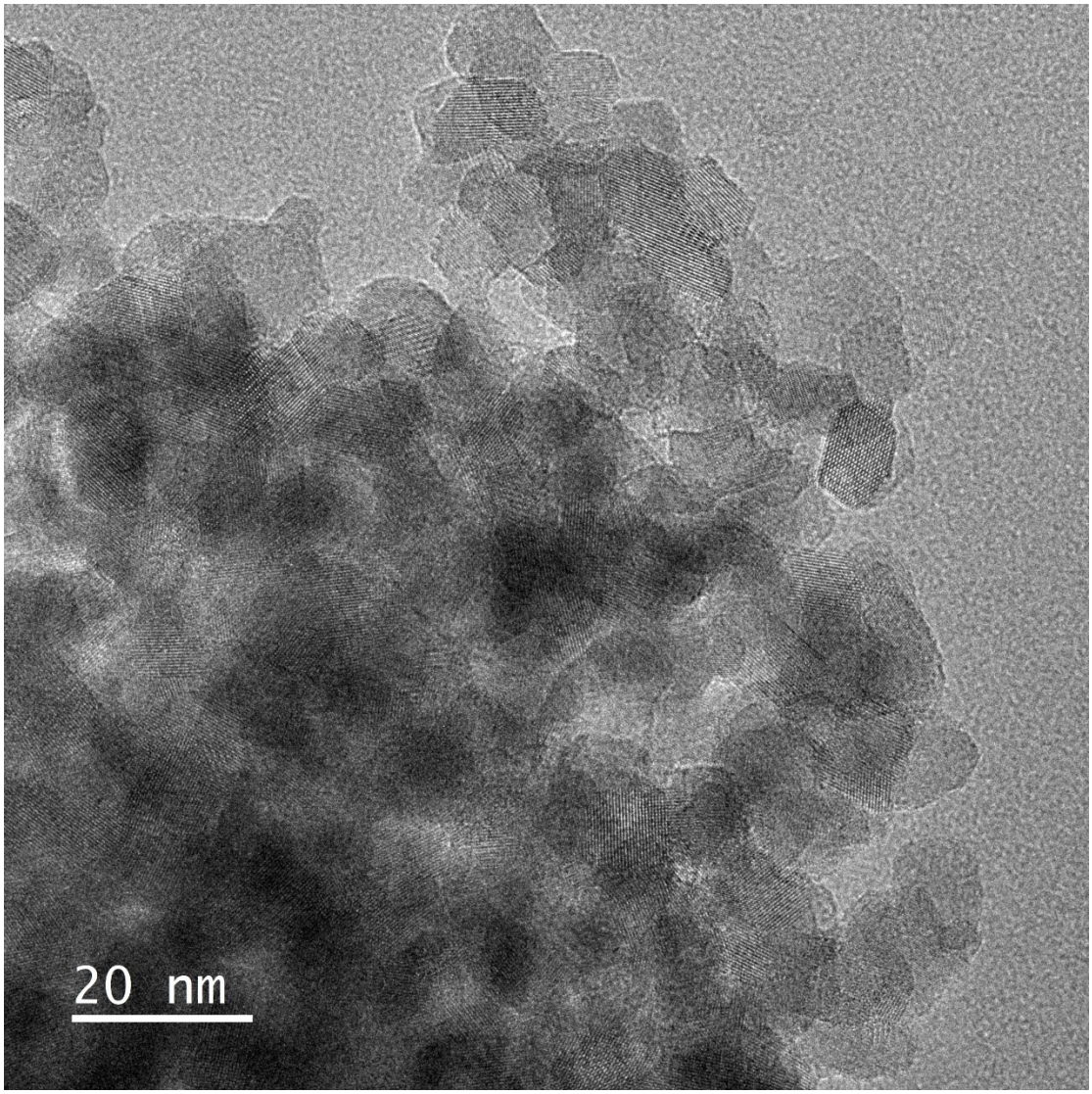
S28 3D AFM diagram of TiO_2-Al-Zn-Ce.



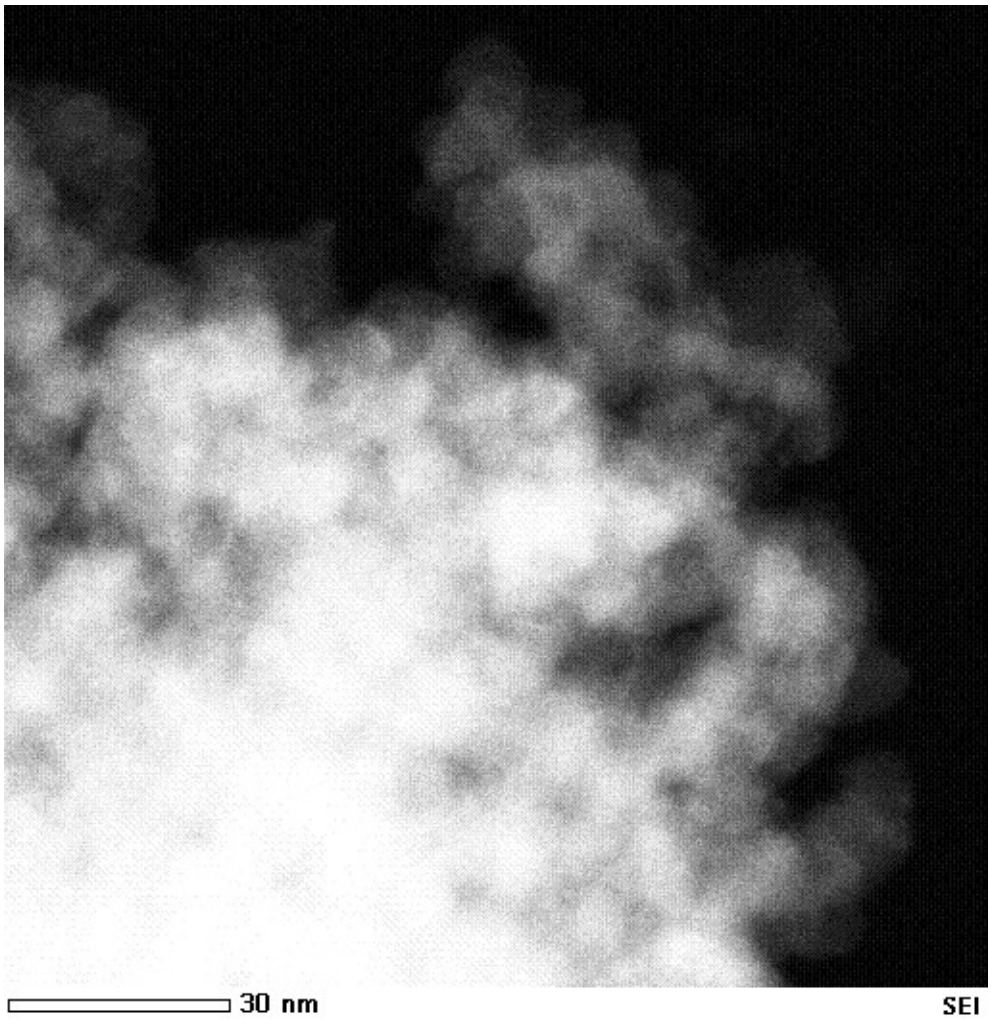
S29 Relative position-potential comparison diagram of TiO_2.



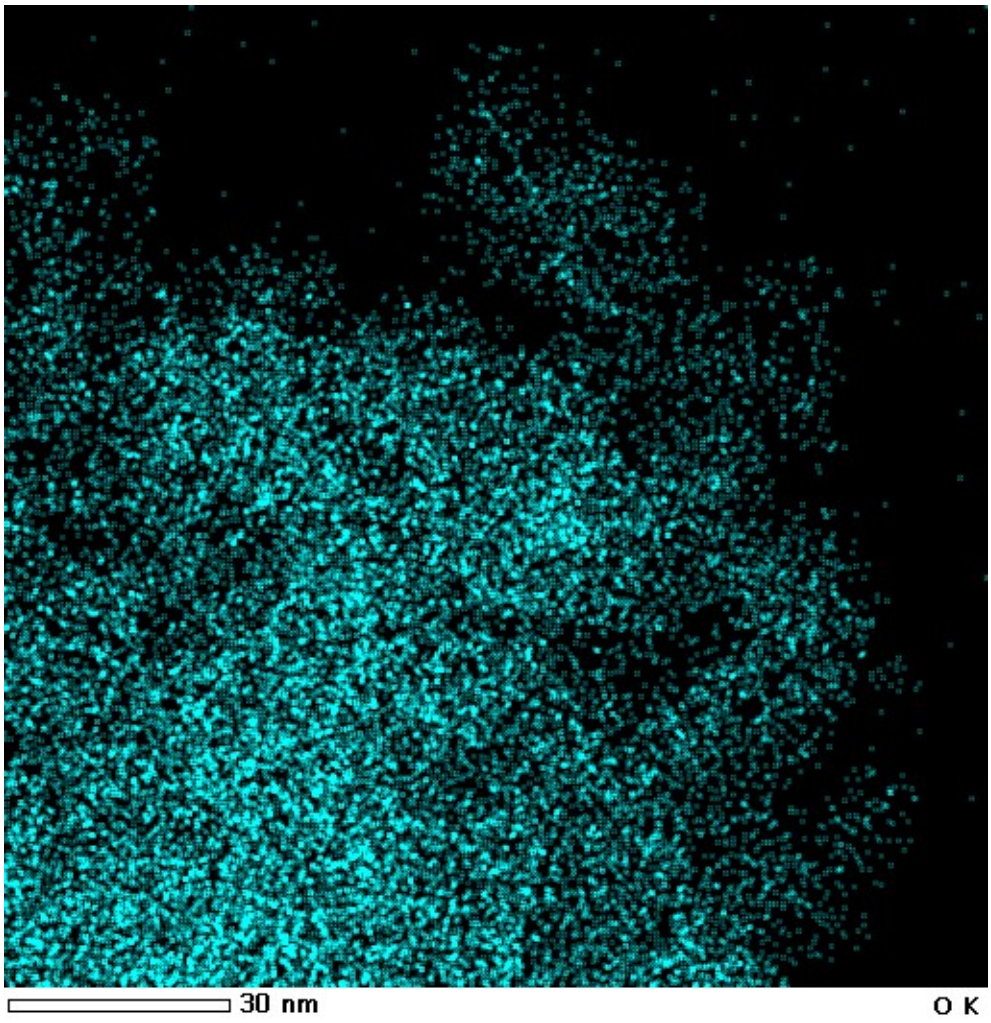
S30 Relative position-potential comparison diagram of TiO_2-Al-Zn-Ce.



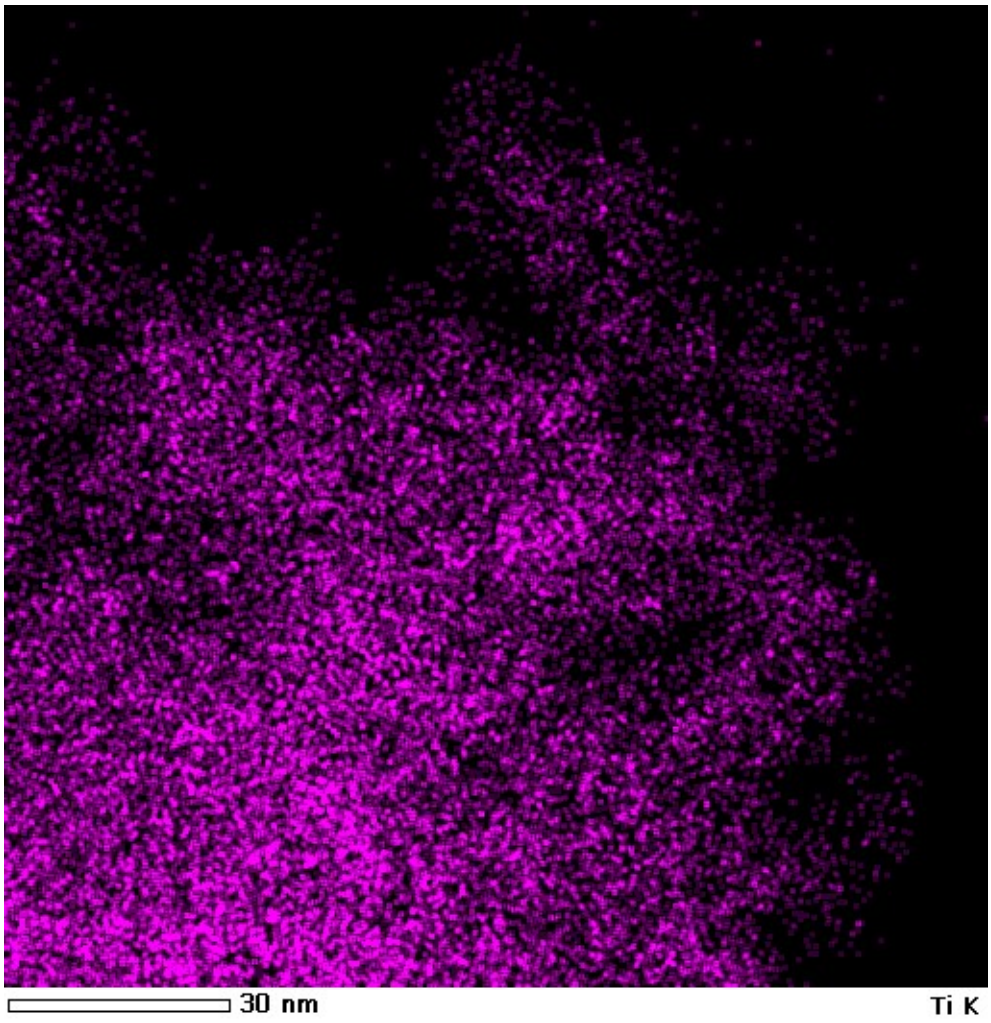
S31 EDS-TEM diagram of TiO_2-Al-Zn-Ce .



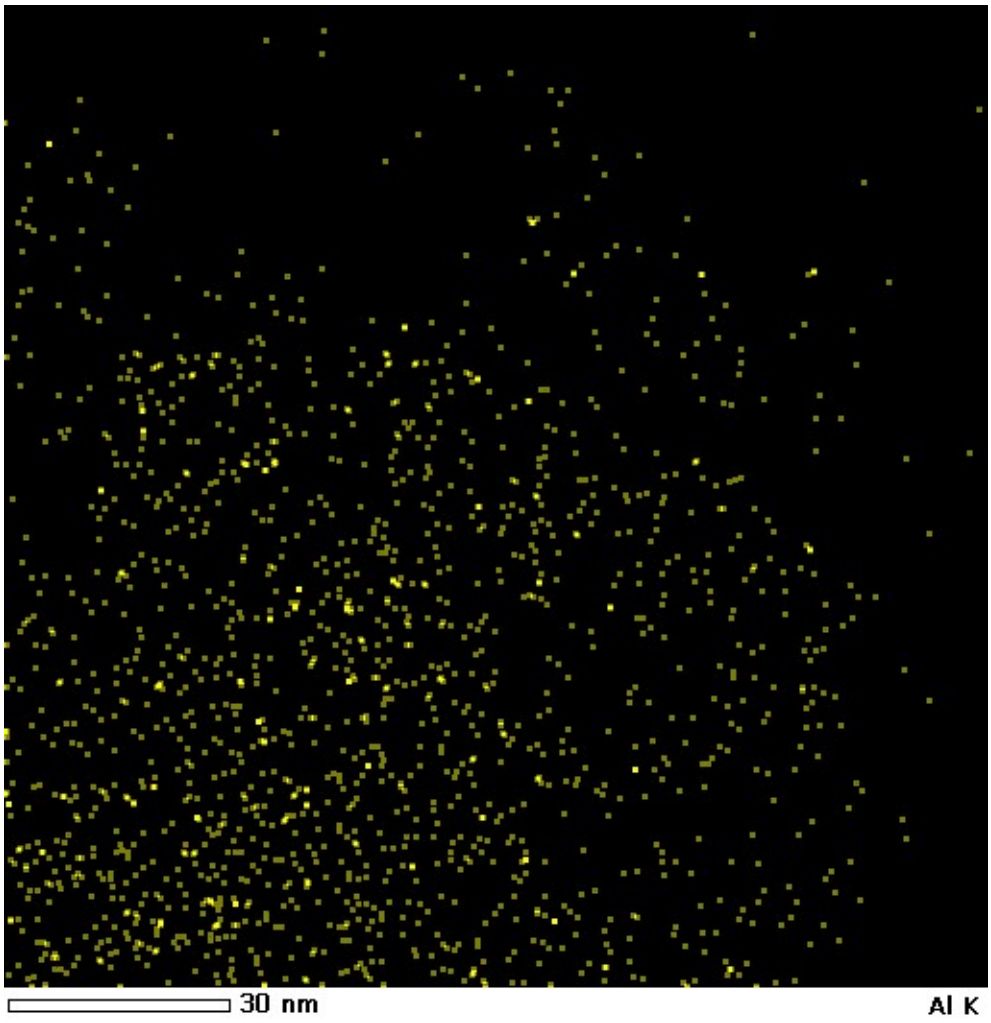
S32 HAADF-STEM images of TiO_2-Al-Zn-Ce.



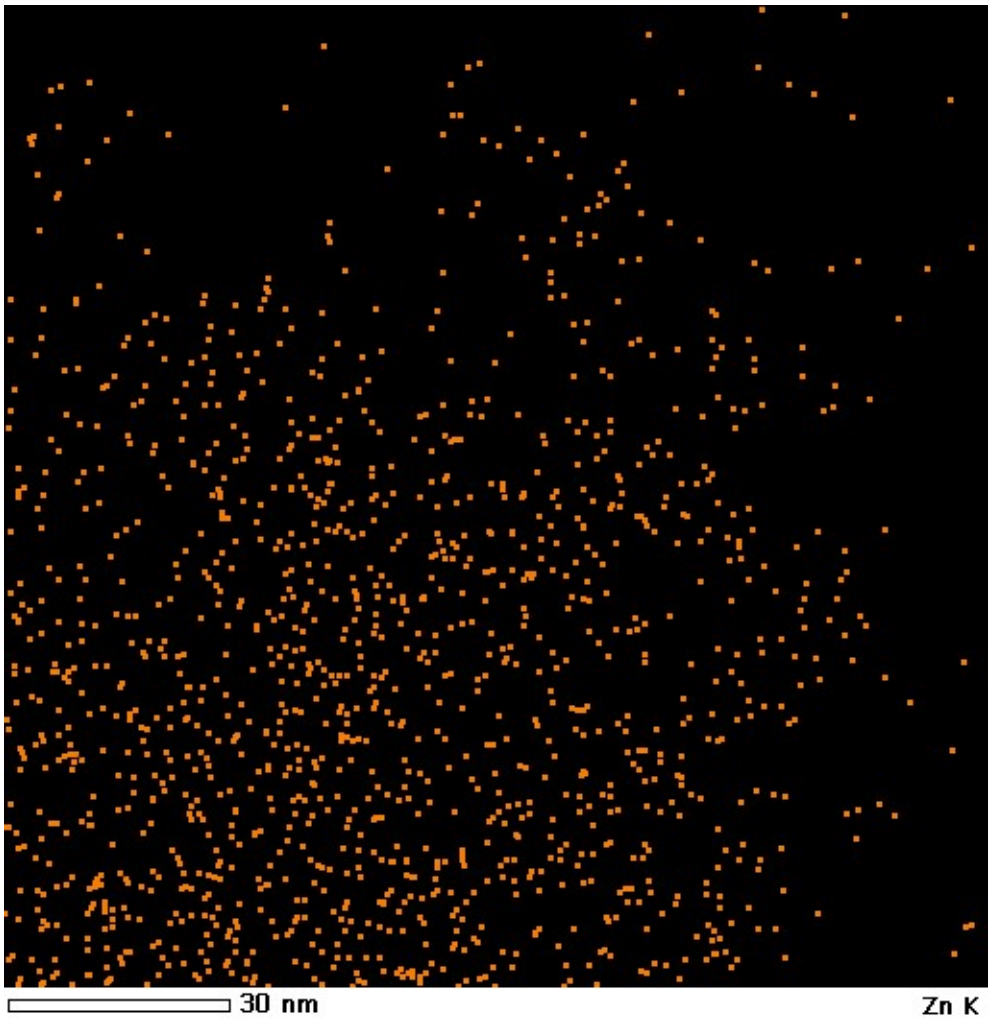
S33 O element mapping image of TiO_2-Al-Zn-Ce.



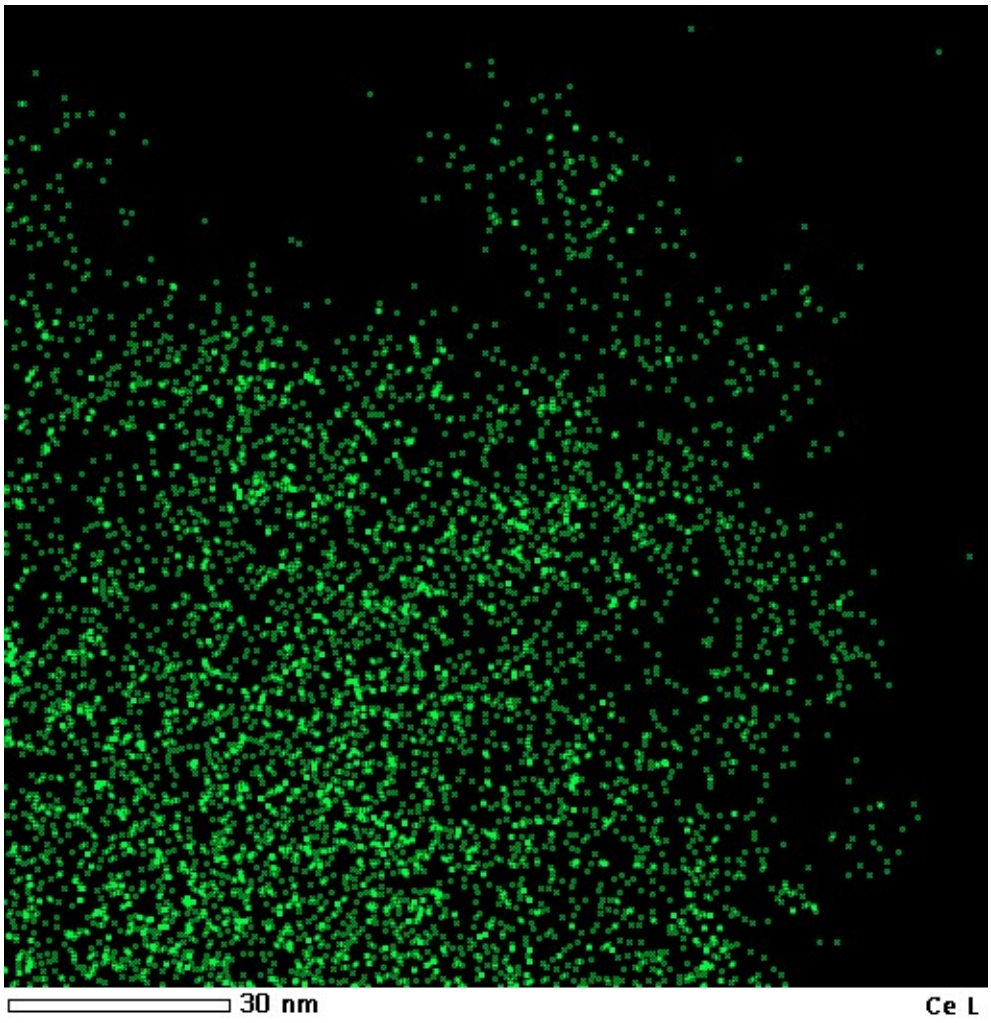
S34 Ti element mapping image of TiO_2-Al-Zn-Ce.



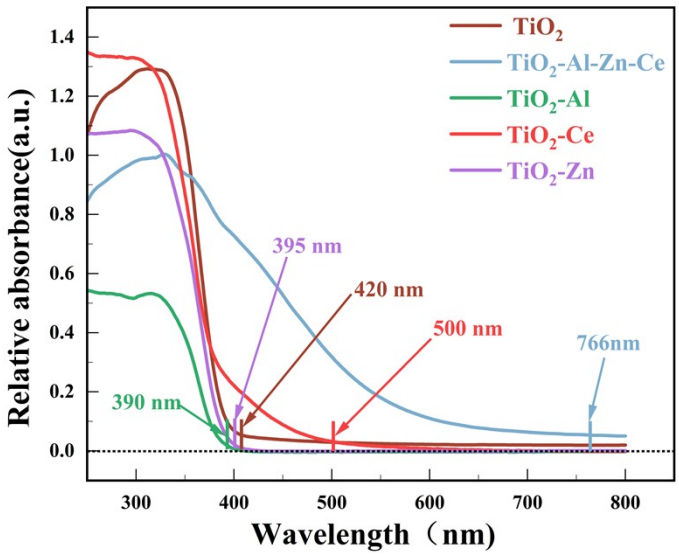
S35 Al element mapping image of TiO_2-Al-Zn-Ce.



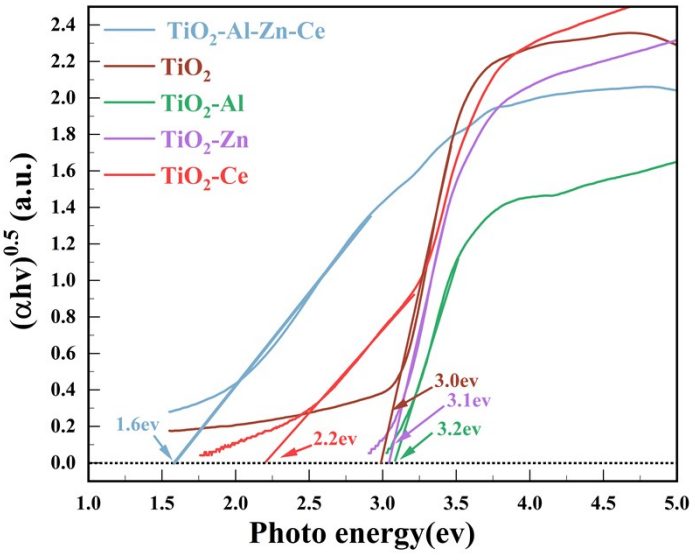
S36 Zn element mapping image of TiO_2-Al-Zn-Ce.



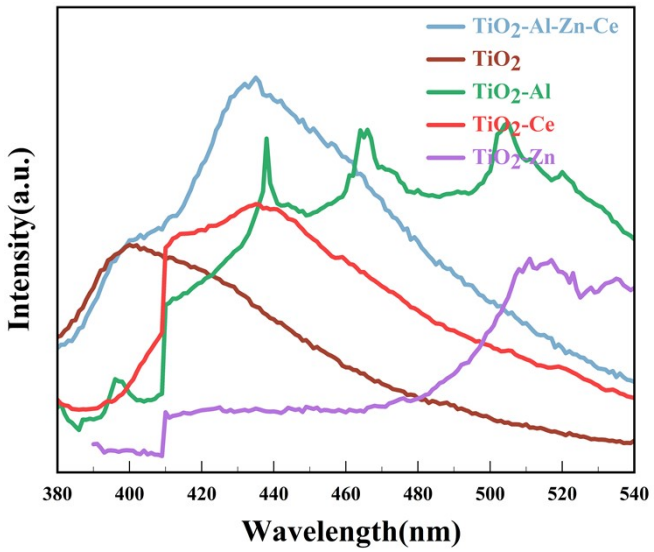
S37 Ce element mapping image of TiO_2-Al-Zn-Ce.



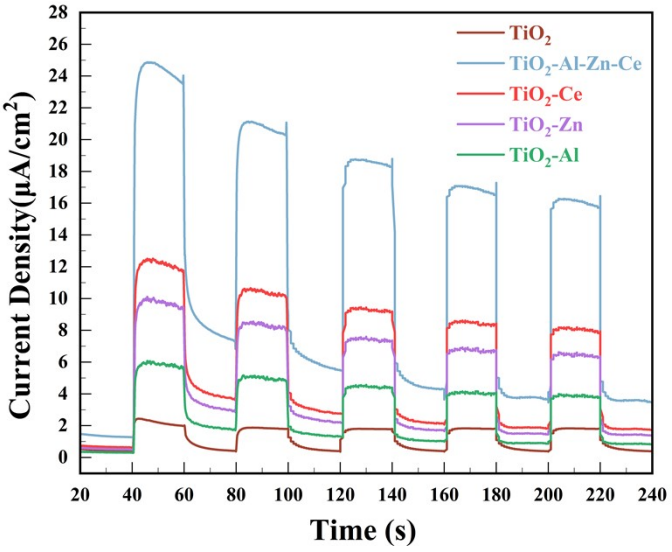
S38 UV-vis absorption spectra of TiO_2, TiO_2-Al-Zn-Ce, TiO_2-Al, TiO_2-Zn, and TiO_2-Ce.



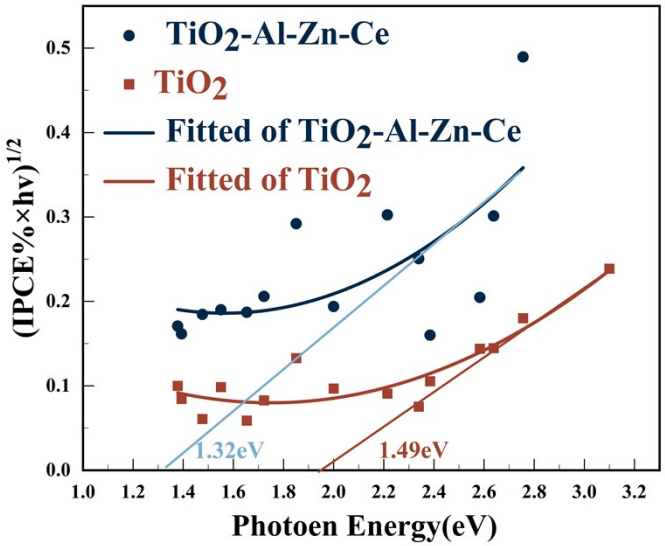
S39 Band gap widths of TiO_2, TiO_2-Al-Zn-Ce, TiO_2-Al, TiO_2-Zn, and TiO_2-Ce measured by UV-vis.



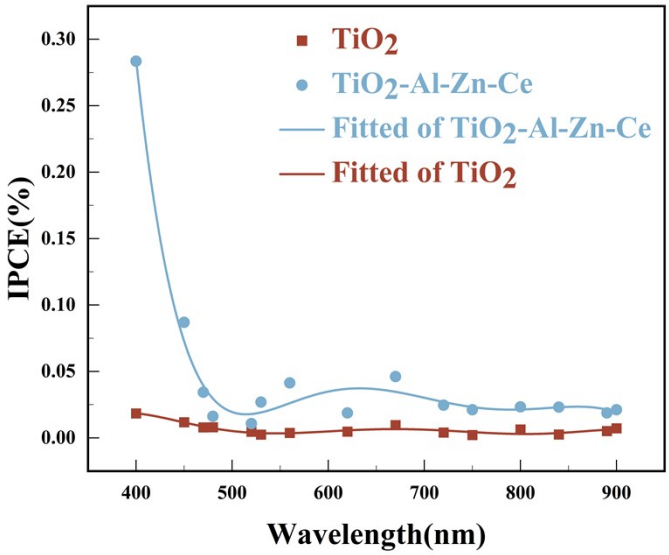
S40 Fluorescence absorption spectra of TiO_2, TiO_2-Al-Zn-Ce, TiO_2-Al, TiO_2-Zn, and TiO_2-Ce.



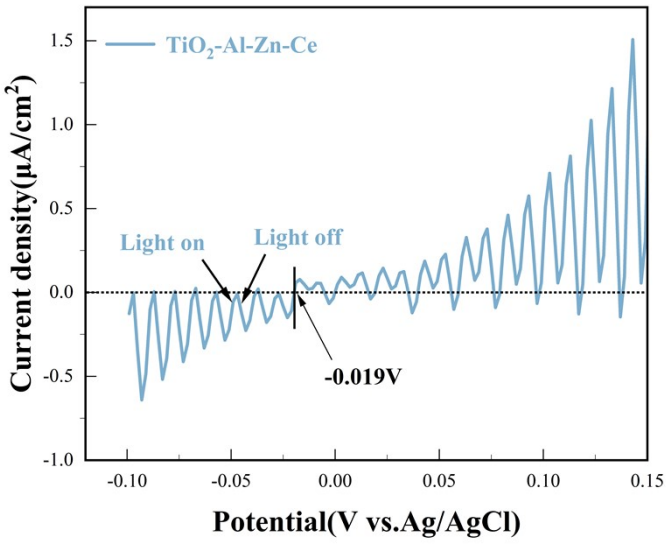
S41 Amperometric data plots of TiO_2, TiO_2-Al-Zn-Ce, TiO_2-Al, TiO_2-Zn, and TiO_2-Ce at 0.8 V vs. Ag/AgCl.



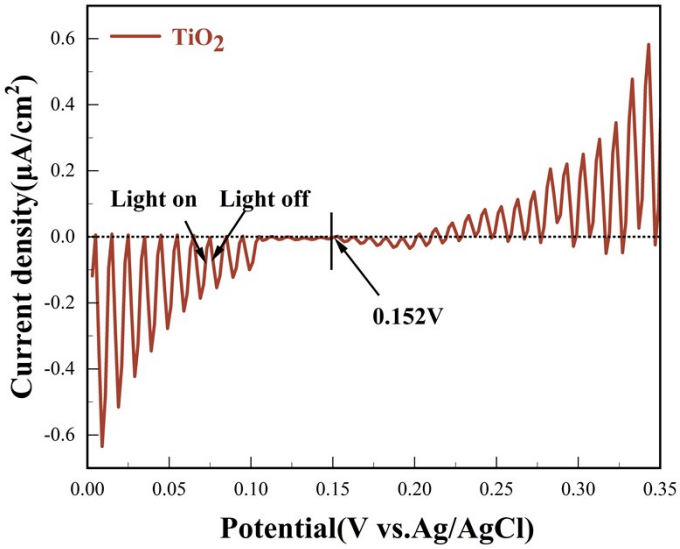
S42 Band gap widths of TiO_2, TiO_2-Al-Zn-Ce, TiO_2-Al, TiO_2-Zn, and TiO_2-Ce measured by IPCE.



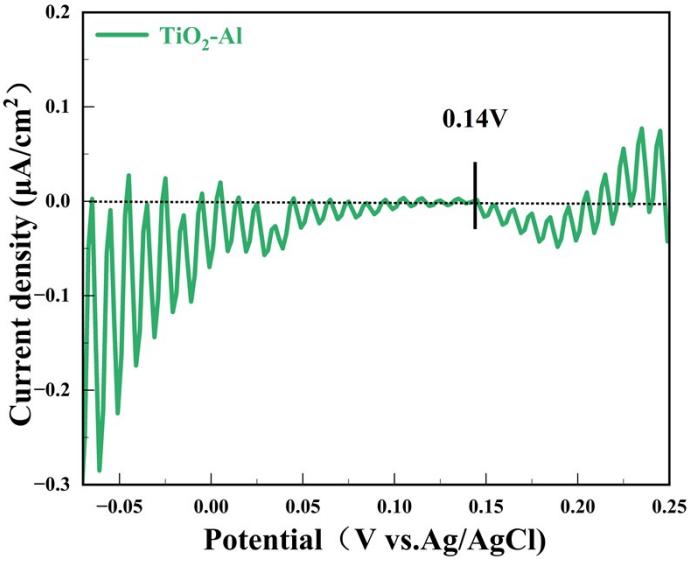
S43 IPCE plots of TiO_2, TiO_2-Al-Zn-Ce, TiO_2-Al, TiO_2-Zn, and TiO_2-Ce.



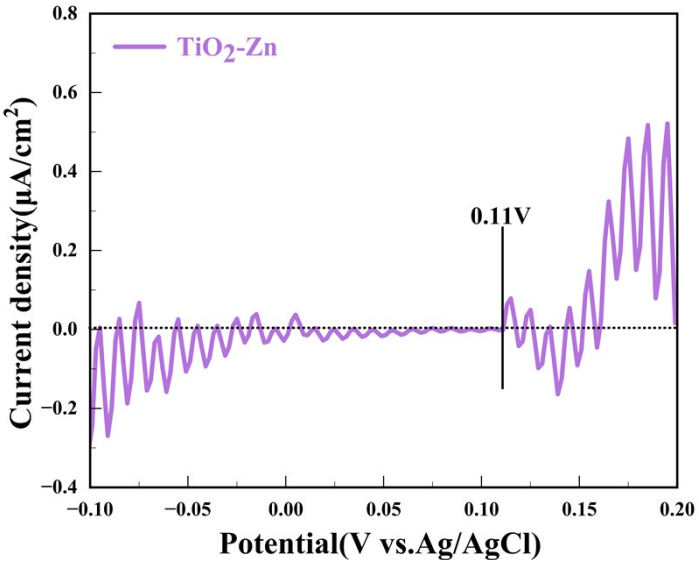
S44 Micro-area high-frequency chopped linear sweep voltammetry (LSV) curve of TiO_2-Al-Zn-Ce.



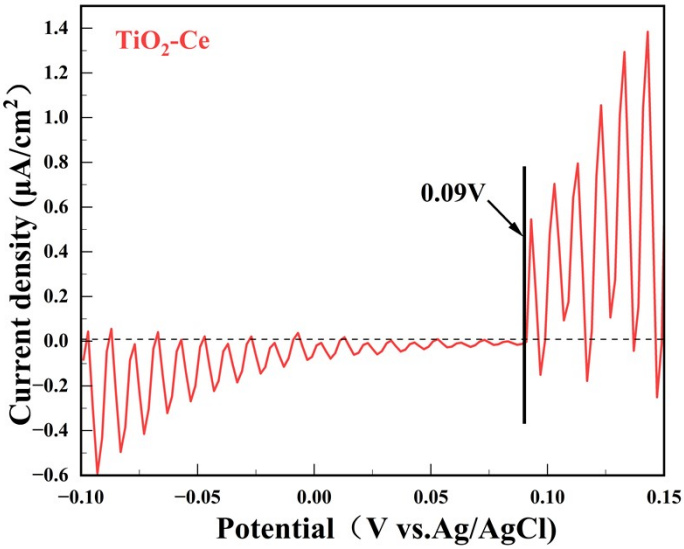
S45 Micro-area high-frequency chopped LSV curve of TiO_2.



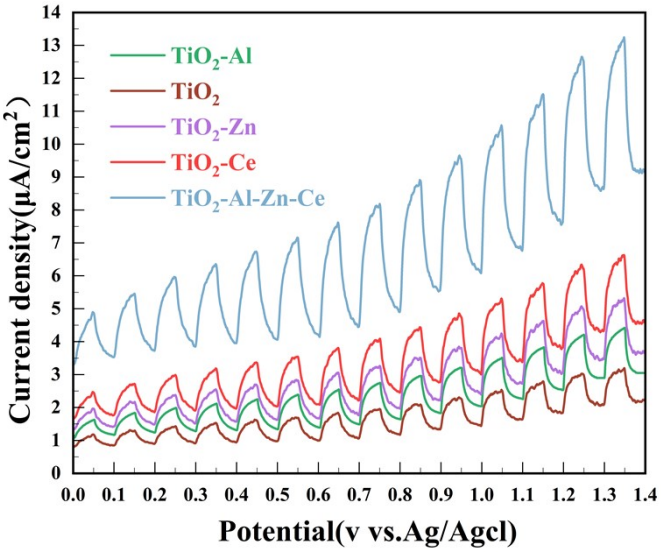
S46 Micro-area high-frequency chopped LSV curve of TiO_2-Al.



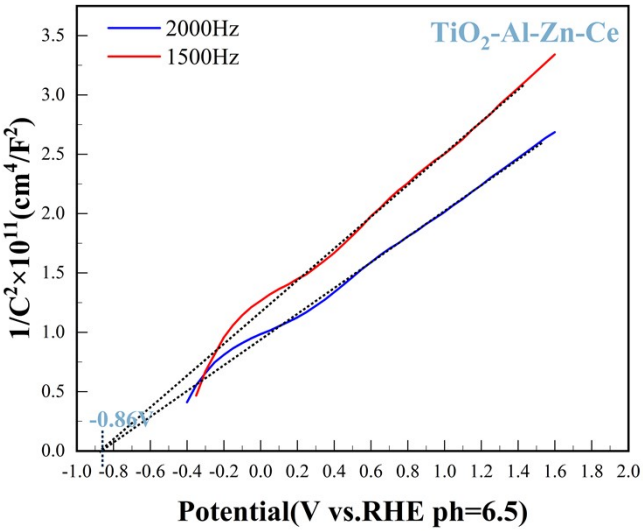
S47 Micro-area high-frequency chopped LSV curve of TiO_2-Zn.



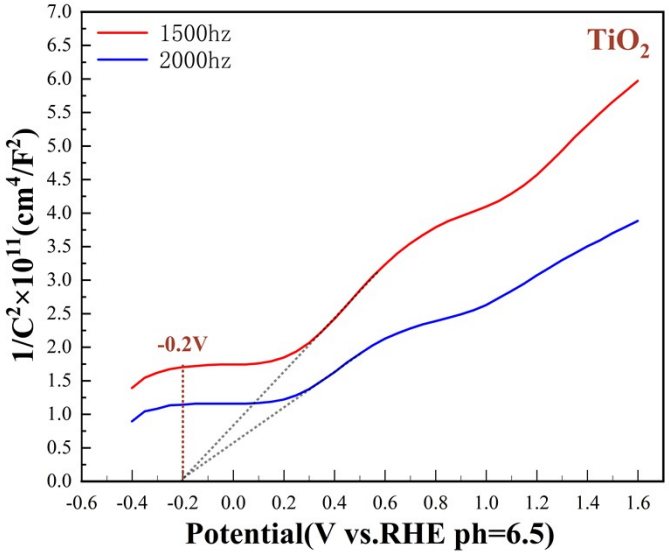
S48 Micro-area high-frequency chopped LSV curve of TiO_2-Ce.



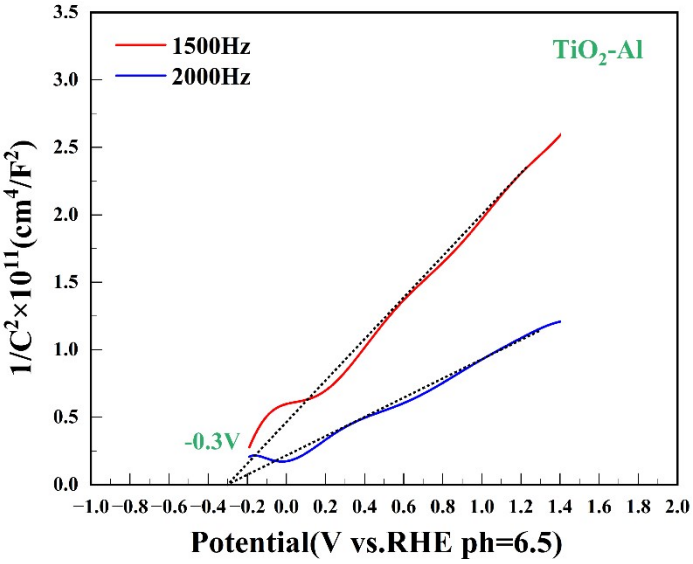
S49 Chopped LSV curves of TiO_2, TiO_2-Al-Zn-Ce, TiO_2-Al, TiO_2-Zn, and TiO_2-Ce.



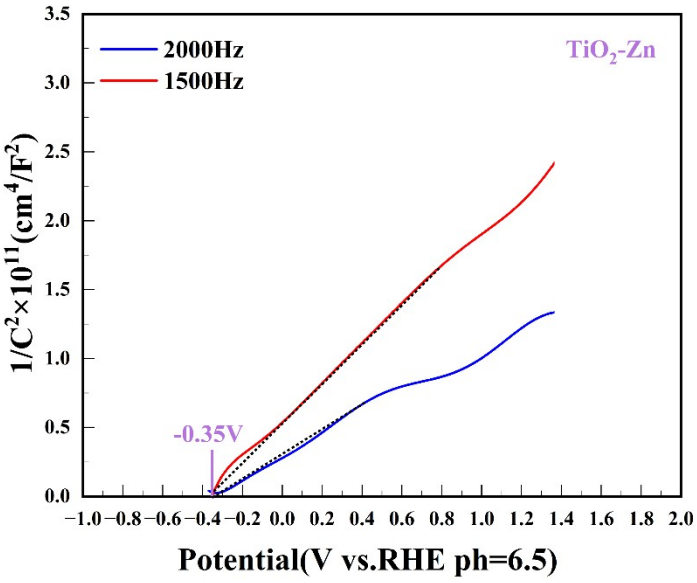
S50 Mott-Schottky plots of TiO_2-Al-Zn-Ce.



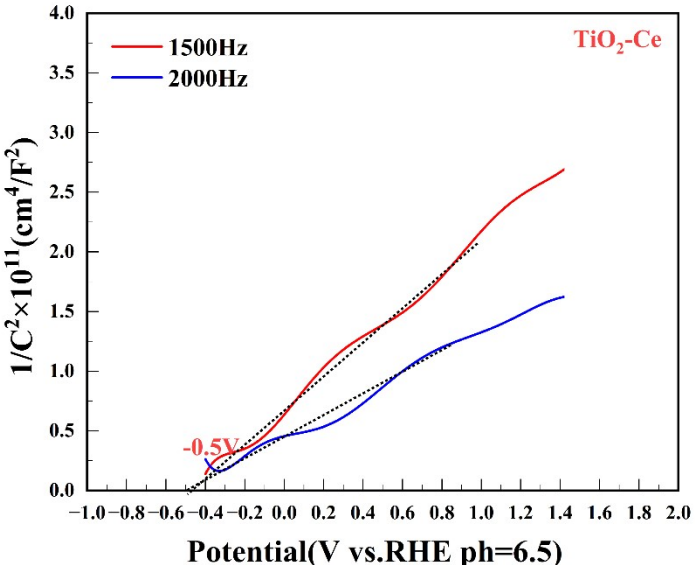
S51 Mott-Schottky plots of TiO_2.



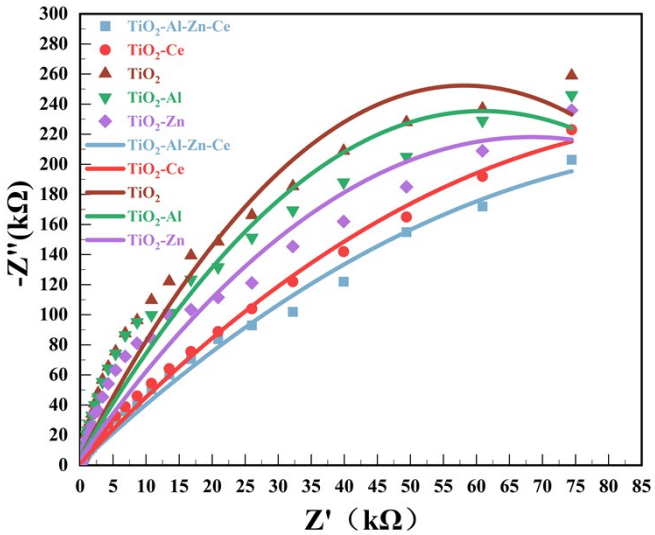
S52 Mott-Schottky plots of TiO_2-Al.



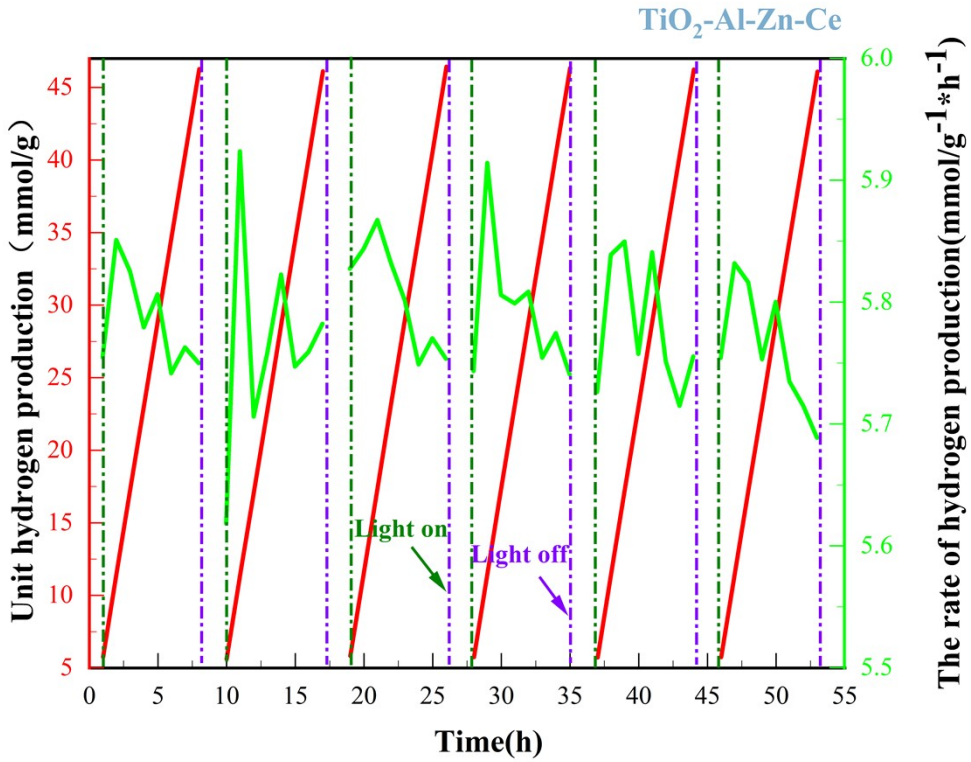
S53 Mott-Schottky plots of TiO_2-Zn.



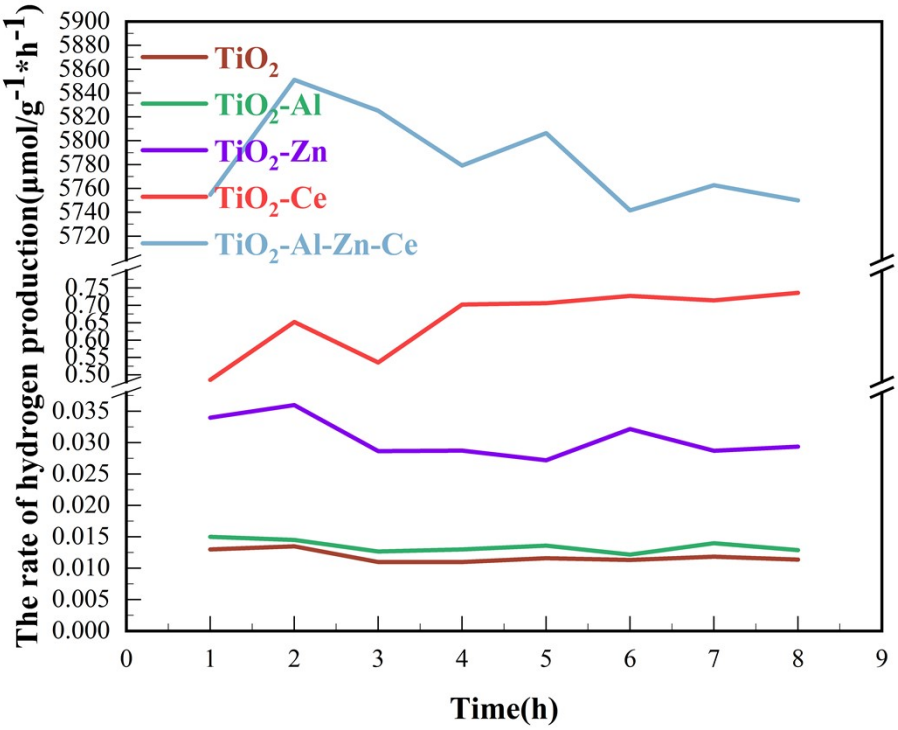
S54 Mott-Schottky plots of TiO_2-Ce.



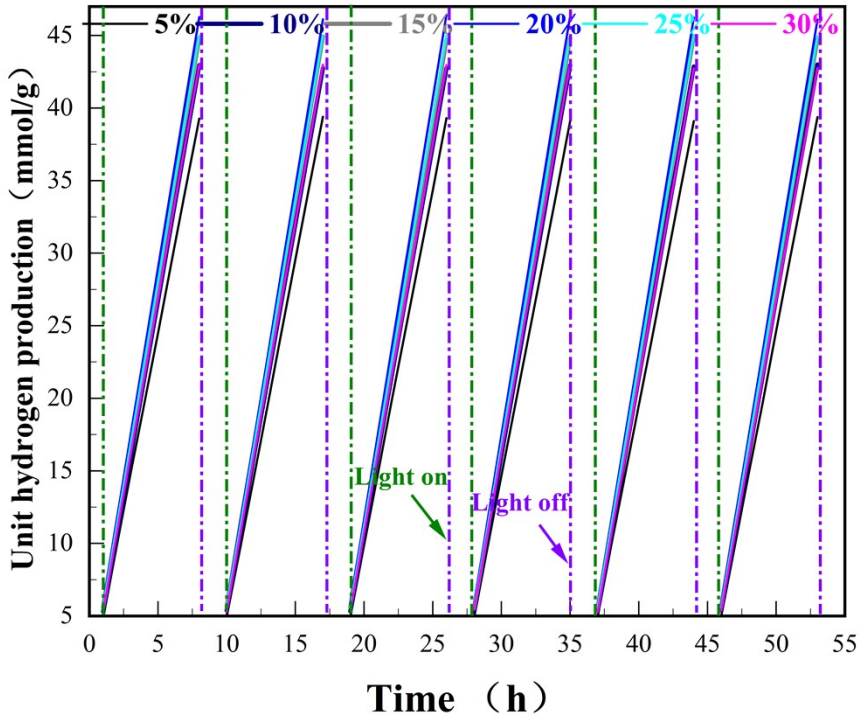
S55 EIS plots of TiO_2, TiO_2-Al-Zn-Ce, TiO_2-Al, TiO_2-Zn, and TiO_2-Ce with fitted equivalent circuits.



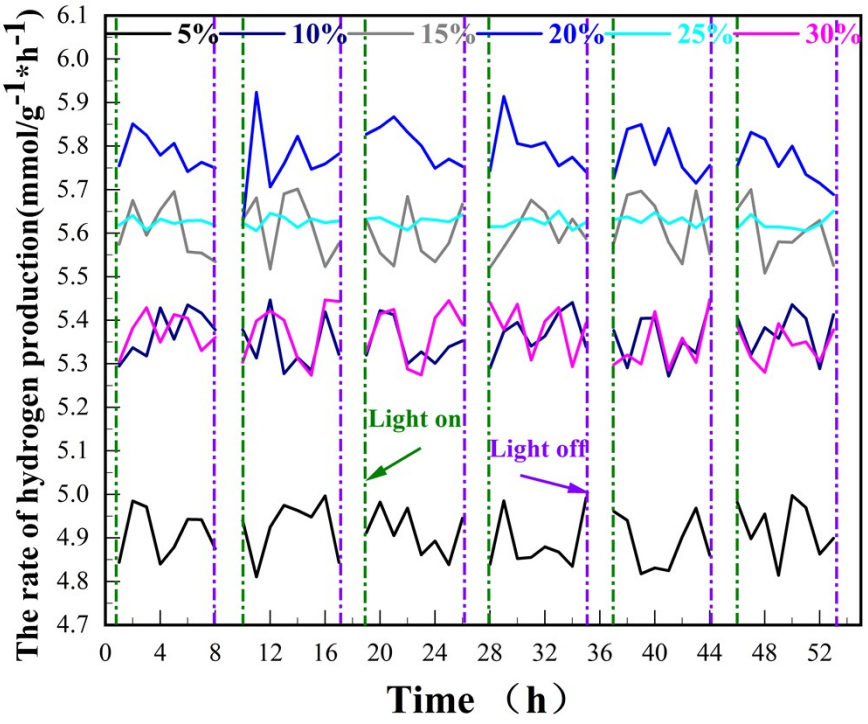
S56 Cumulative hydrogen production per unit mass and hydrogen production rate of TiO_2-Al-Zn-Ce in cycles.



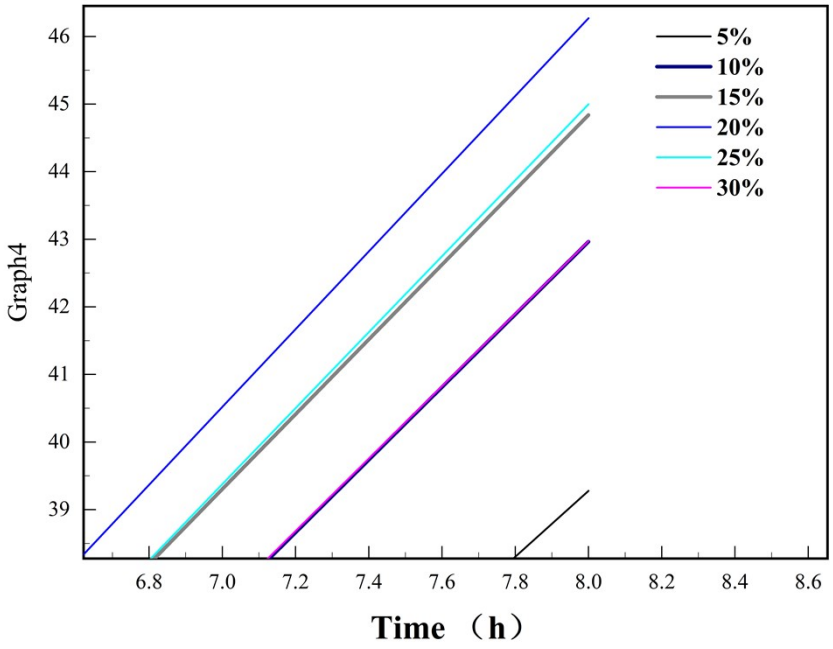
S57 Hydrogen production rate of TiO_2, TiO_2-Al, TiO_2-Zn, TiO_2-Ce and TiO_2-Al-Zn-Ce.



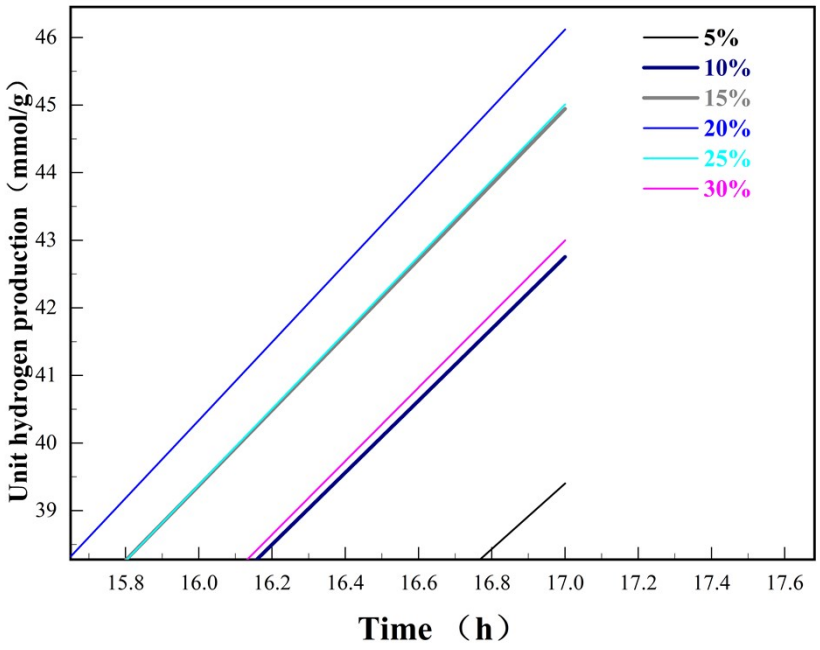
S58 Cumulative hydrogen production per unit mass of TiO_2 in cycles in 5%, 10%, 15%, 20%, 25% and 30% ethanol solutions.



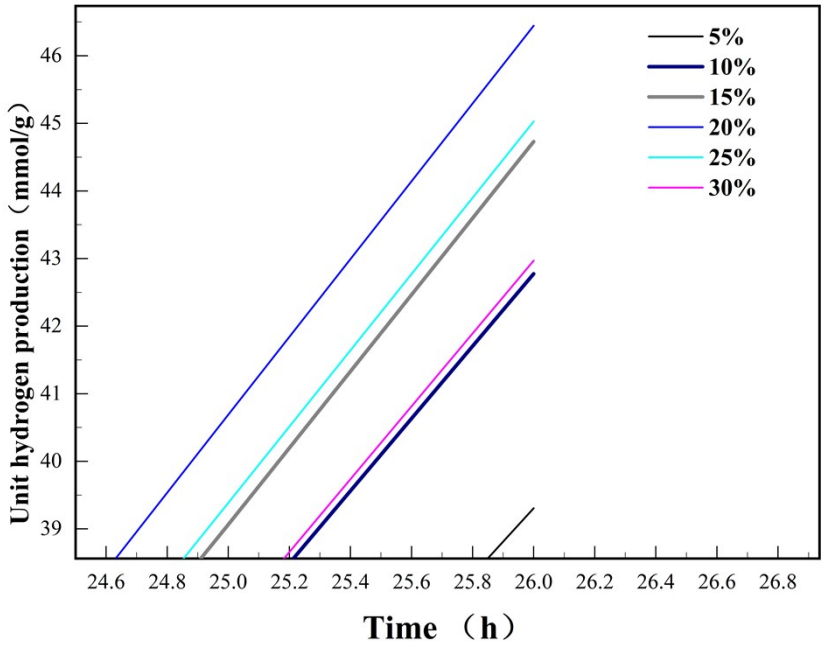
S59 Hydrogen production rate per unit mass of TiO_2 in cycles in 5%, 10%, 15%, 20%, 25% and 30% ethanol solutions.



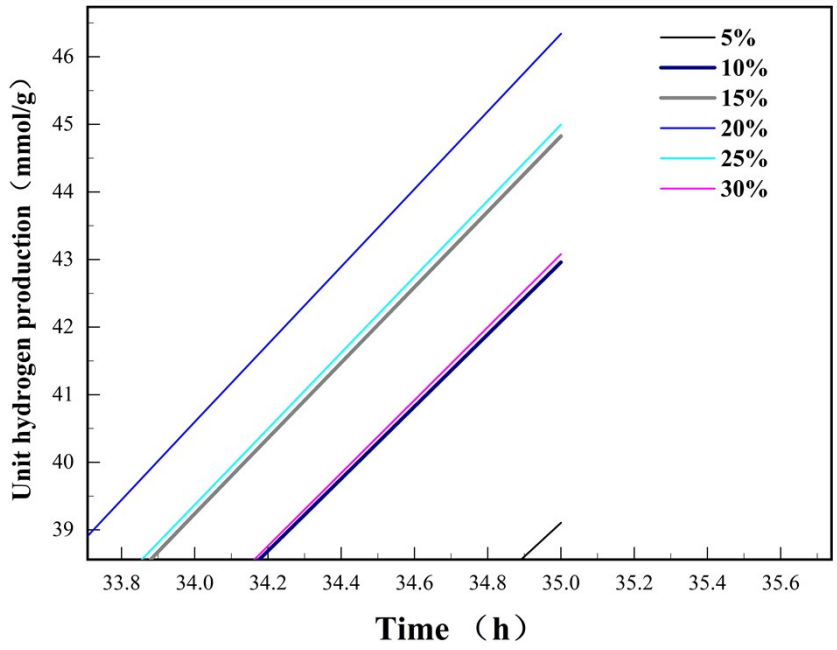
S60 Detail magnification of Figure 5-C 1.



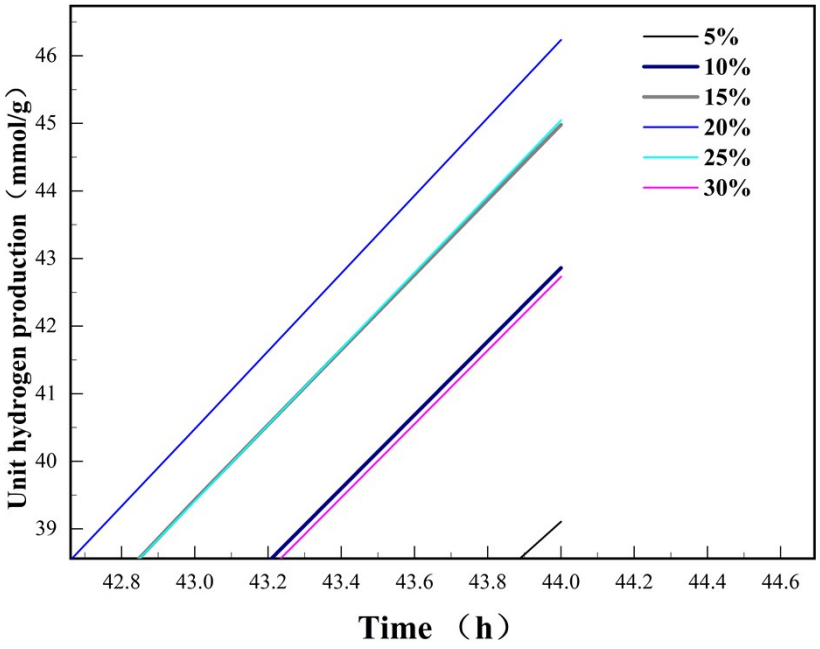
S61 Detail magnification of Figure 5-C 2.



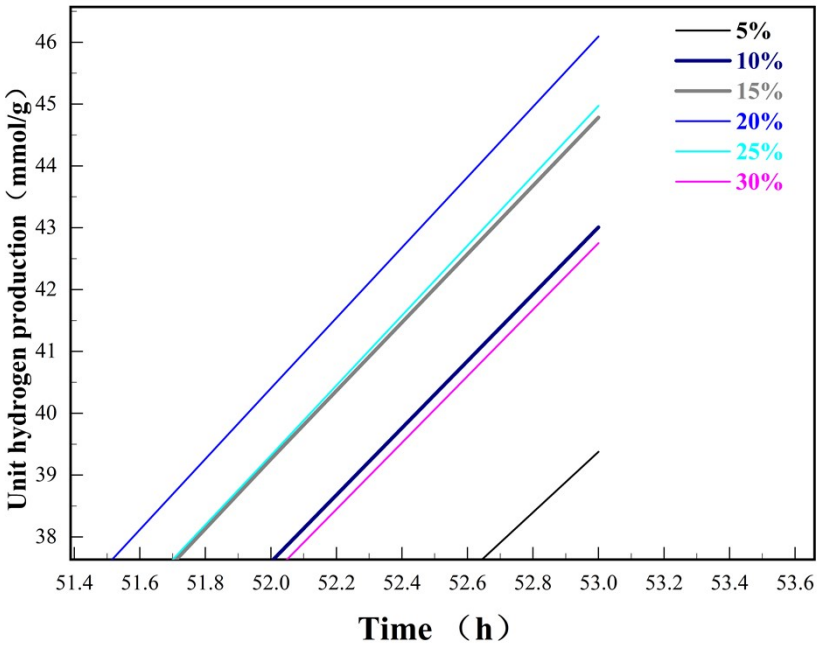
S62 Detail magnification of Figure 5-C 3.



S63 Detail magnification of Figure 5-C 4.



S64 Detail magnification of Figure 5-C 5.



S65 Detail magnification of Figure 5-C 6.