Electronic Supplementary Information

Title: In-situ TPR Removal: A Generic Method for Fabricating Tubular Array Devices with Mechanical and Structural Soundness, and Functional Robustness on Various Substrates

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1. Experimental Section

1.1. Preparation of ZnO, CeO_2-ZnO and LSCO-ZnO composite NRAs on planar Si substrates: Before growth, a ZnO seed layer of 30 nm was deposited onto the thermally oxidized Si(100) substrate by a RF magnetron sputter (Torr International, Inc.) and annealed at 600°C for 2 h. The ZnO NRAs were further grown on the substrate using a hydrothermal method. In a typical synthesis, the Si substrate with ZnO seed layer was sticked onto a cap and floated in a container filled with 25 mL of zinc acetate ($ZnAc_2$, 0.02 mol L^{-1}) and hexamethylenetetramine (HMT, 0.02 mol L^{-1}). Subsequently, the container was sealed and put into a water bath. The growth was carried out at 90°C for 5 h. Finally, the sample was cleaned several times with DI water and dried at 80°C overnight as the template.

The CeO_2 and LSCO nanofilms of ~100 nm were deposited on the ZnO NRAs template by a RF magnetron sputter. Both films were sputtered in 7.38×10^{-3} Torr of argon plasma. After sputtering, the CeO_2-ZnO and LSCO-ZnO samples were annealed at 500°C and at 800°C for 3 hrs, respectively.

1.2. Preparation of the CeO_2-ZnO composite NRAs on 3D cordierite honeycomb: The CeO_2-ZnO composite NRAs on the cordierite honeycomb was prepared by in situ deposition of CeO_2 nano-layer on ZnO nanorod array. ZnO nanorod growth was conducted by a classic hydrothermal process. Equal molar zinc nitrate hexahydrate ($Zn(NO_3)_2\bullet6H_2O$) and hexamethylenetetramine ($C_6H_{12}N_4$, HMT) (25 mM) were dissolved in 200 mL DI water as precursor. The substrate was then put in the prepared precursor solution to grow ZnO nanorod. After 2 hr growth of ZnO nanorod arrays at 75 ^oC, cerium nitrate hexahydrate ($Ce(NO_3)_3\bullet6H_2O$, 125 mM) was then added into the solution. After rinsing and drying, the ZnO-CeO_2 core-shell nanorod arrays were obtained on the 3D cordierite substrate.

2. Supporting Results

Figure S1. (a) SEM images, (b) EDX, (c) TEM and (d) SAED patterns of the CeO_2/ZnO composite NRAs on the thermal oxidized Si substrate.

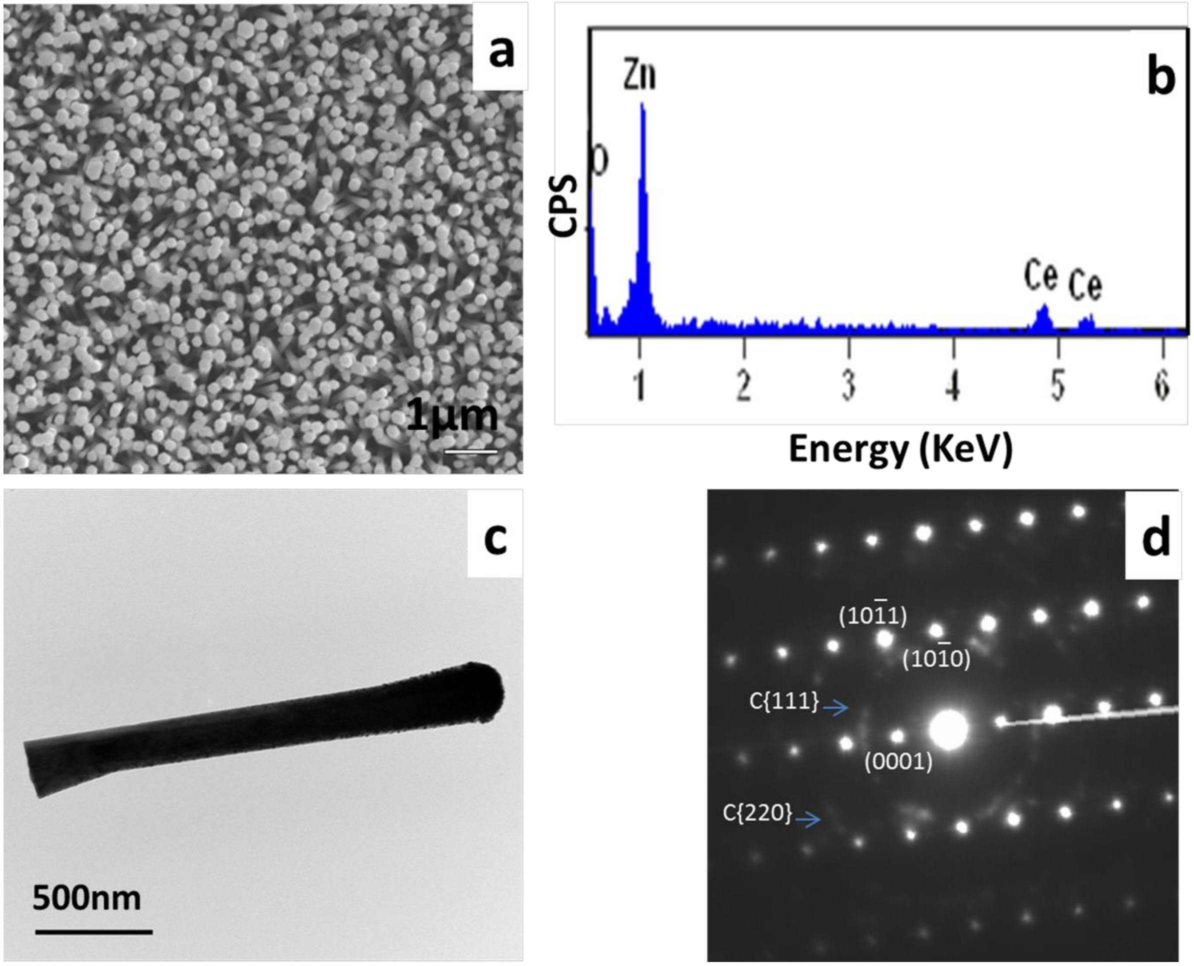

Figure S2. (a) SEM images, (b) EDX, (c) TEM and (d) SAED patterns of the LSCO/ZnO composite NRAs on the thermal oxidized Si substrate.

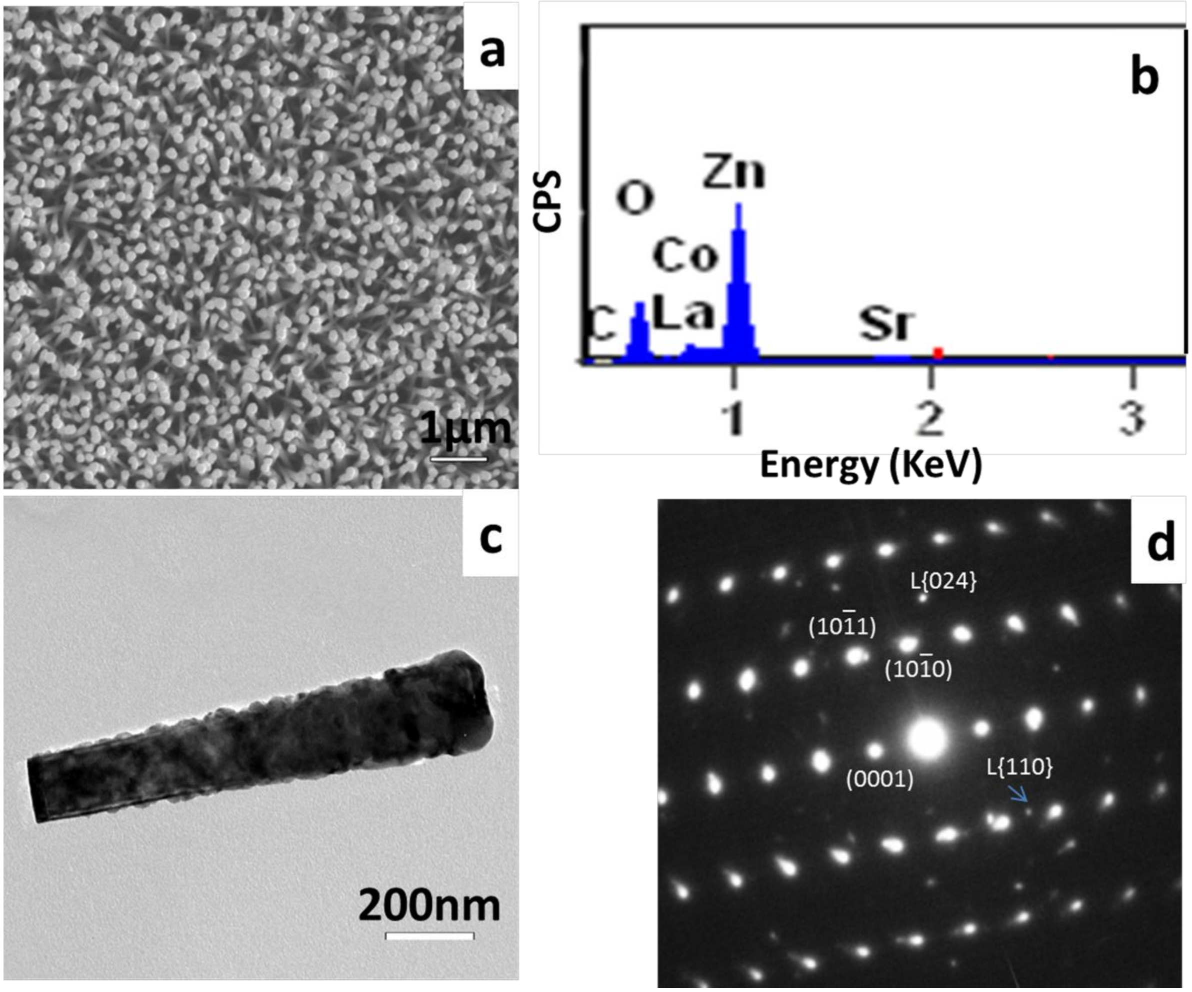

Figure S3. (a) EDX, (b) XRD, (c) TEM and (d) SAED patterns of the CeO_2 NTAs on 3D cordierite honeycomb (CH) substrates. As shown in Figure S3b, the diffraction peaks from CeO_2 were covered by the strong diffraction peaks from the 3D cordierite substrate. As seen from electron diffraction in Figure S3d, there exist obvious diffraction rings from CeO_2 because the inference from the substrate has been eliminated.

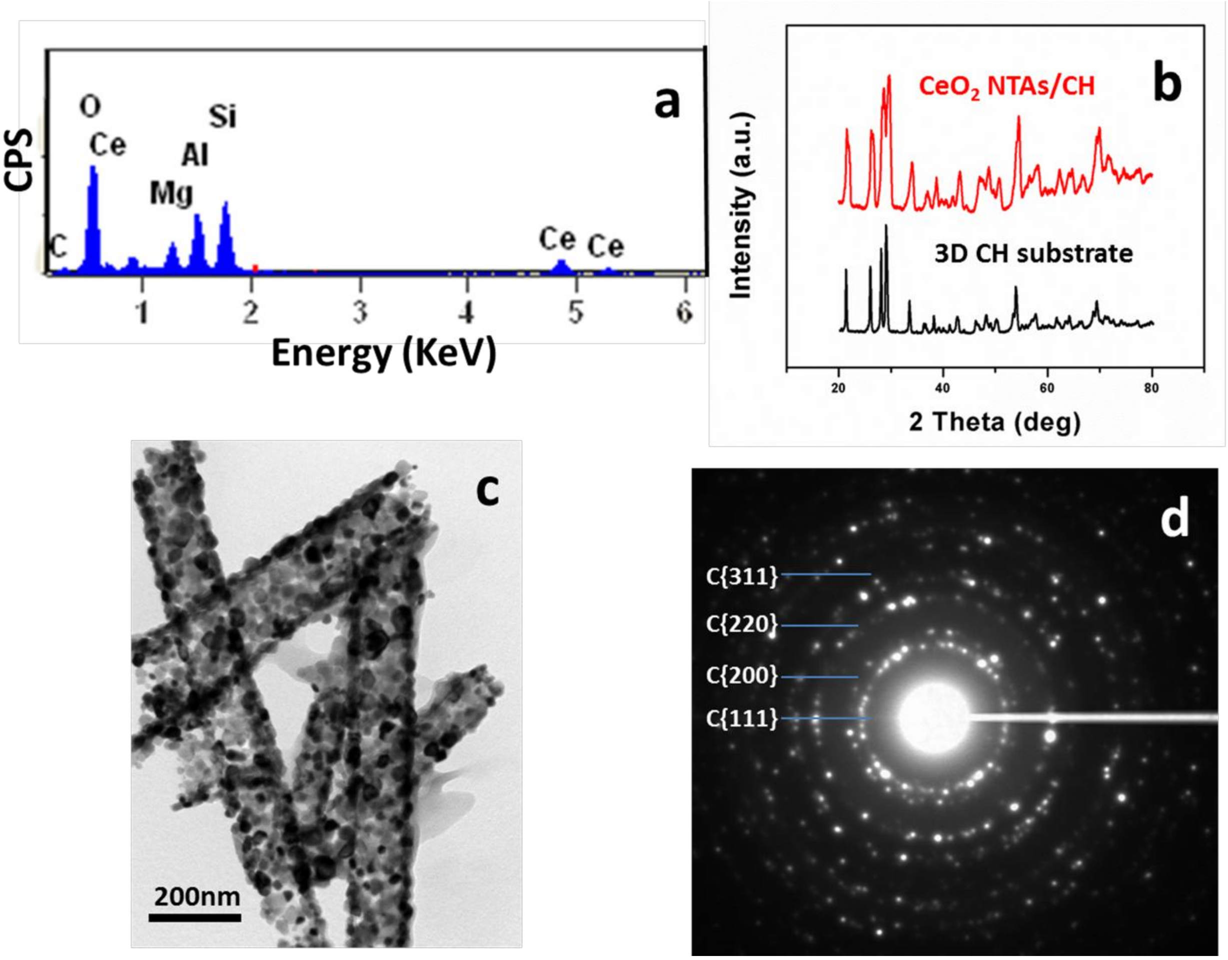

Figure S4. (a) top view and (b) tilted (45^{o}) SEM images, and (c) EDX patterns of the CeO_2 NTAs on the thermal oxidized Si substrate after the photocatalysis for 4 hrs.