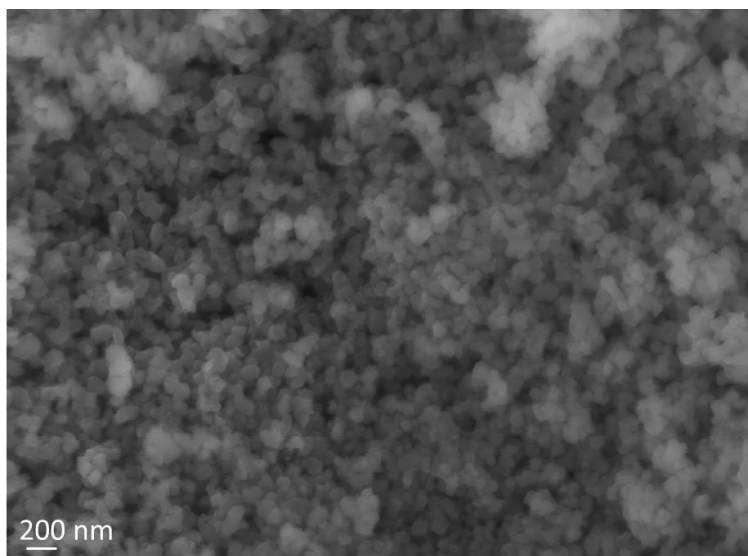


VOCs photothermo-catalytic removal on $\text{MnO}_x\text{-ZrO}_2$ catalysts

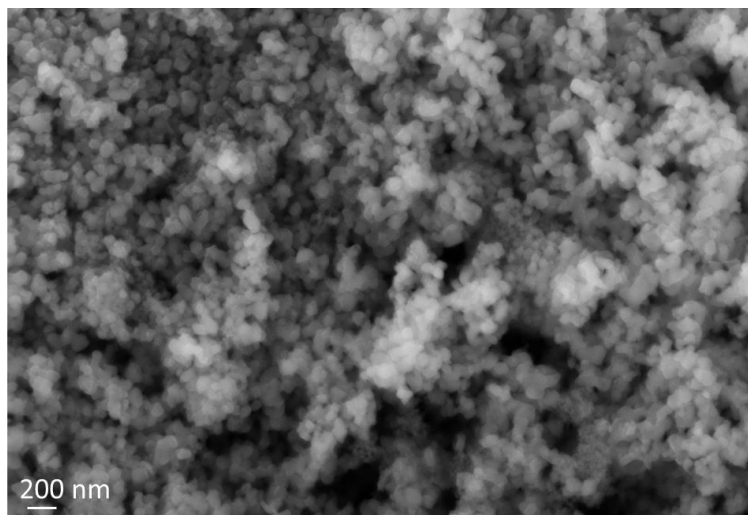
Roberto Fiorenza ^{1,*}, Roberta Agata Farina ¹, Enrica Maria Malannata ¹; Francesca Lo Presti¹, and Stefano Andrea Balsamo ¹

Supporting information

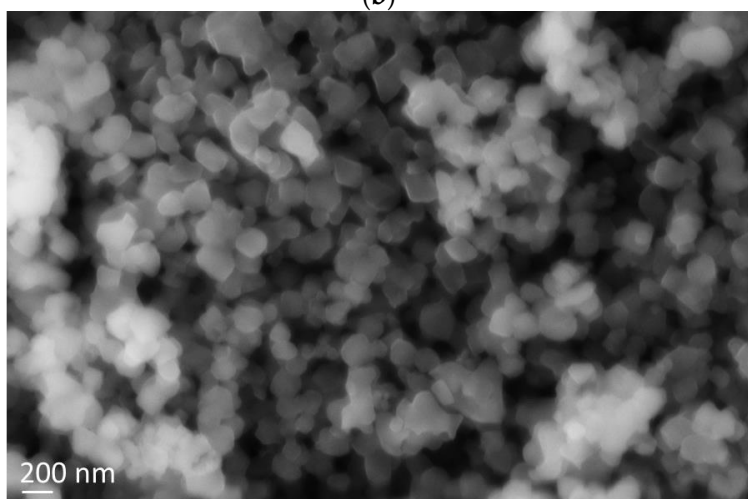
- S1: SEM images of the other investigated samples



(a)



(b)



(c)

Figure S1. SEM images of: (a) ZrO_2 ; (b) Mn_3O_4 and (c) MnO_x -10% ZrO_2 .

- S2: XPS characterization of the MnO_x-5% ZrO₂ sample

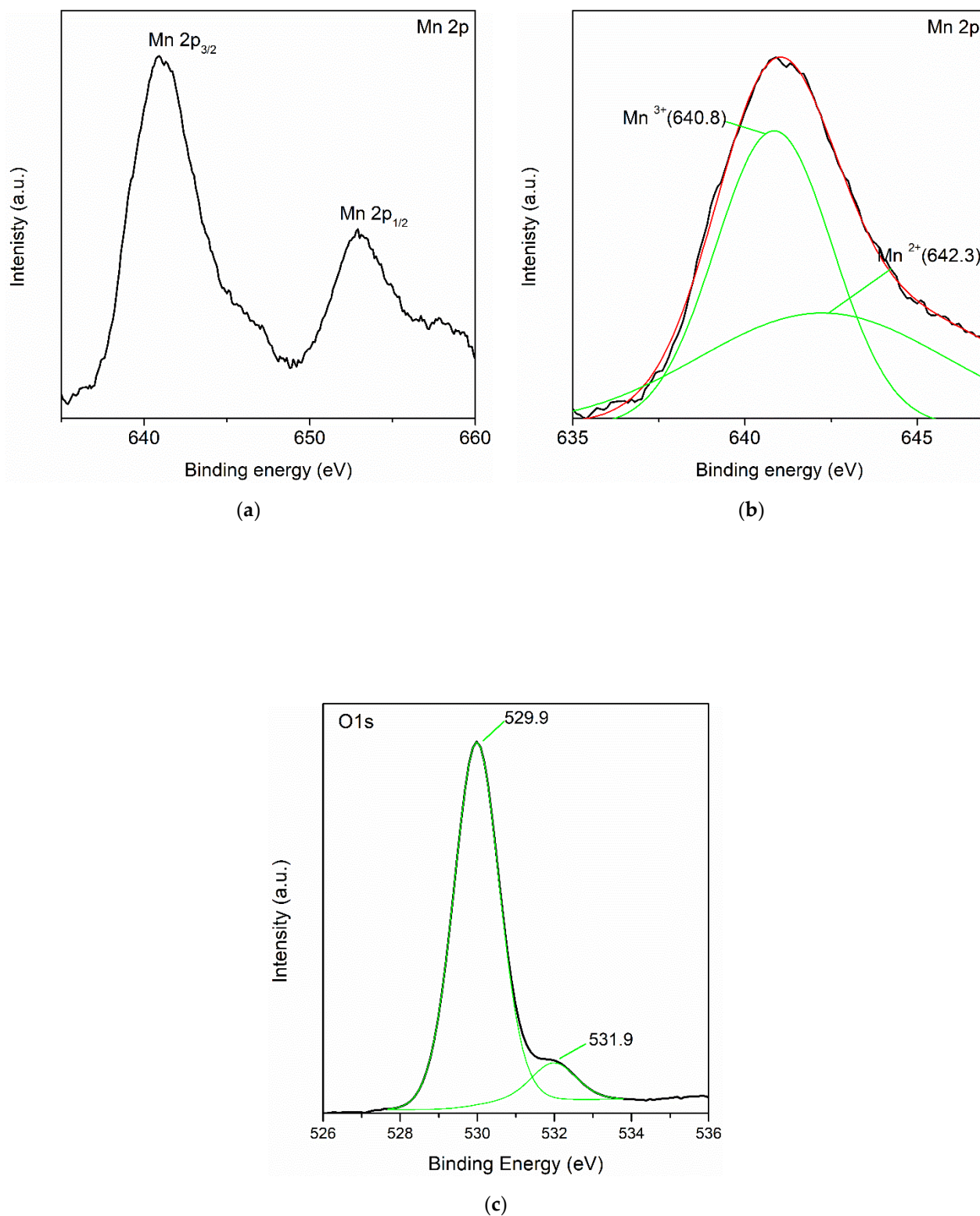
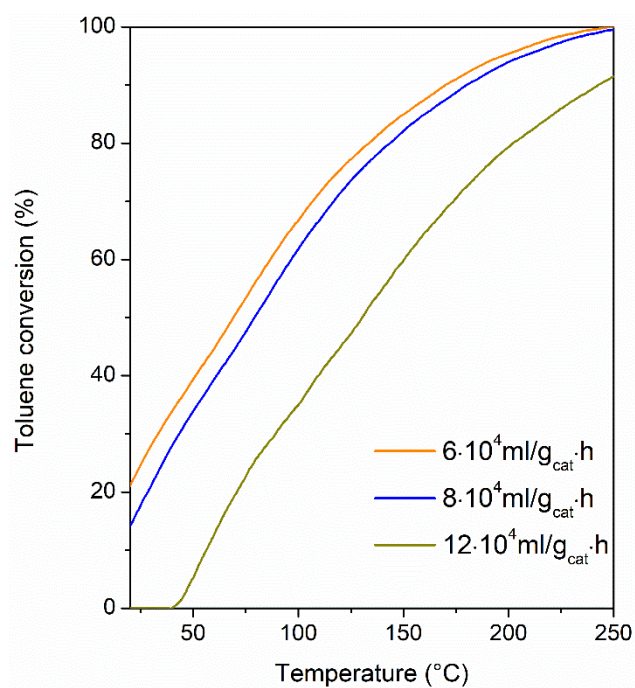
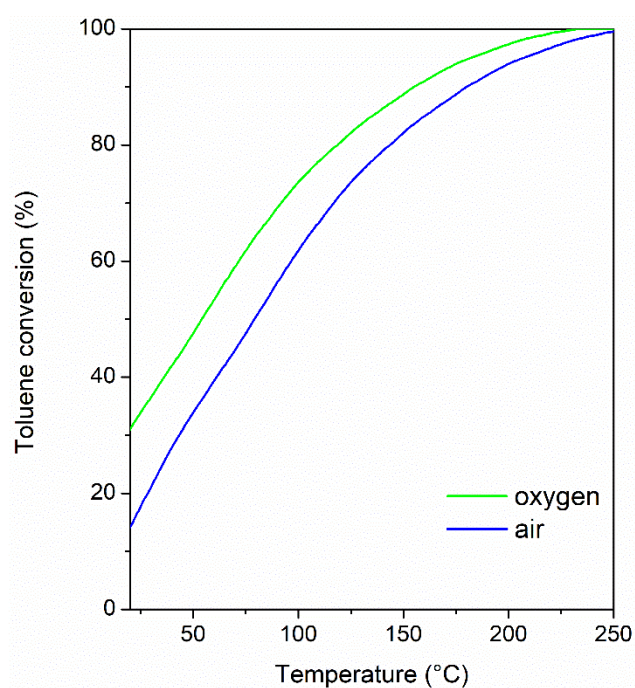


Figure S2. XPS spectra of the MnO_x-5% ZrO₂ as representative samples. In the (a and b) the Mn 2p region and in (c) the O 1s region. In the figures S2b and S2c there are present the deconvolution features. The components at 640.8 and 642.3 eV were ascribed to Mn³⁺ and Mn²⁺ species, respectively [1]. The peaks at 529.9 and 531.9 eV refer to surface lattice oxygen and chemisorbed/defective oxygen, respectively [2]. The red line superimposed to the experimental profiles refers to the sum of all the Gaussian components. Structure due to satellite radiation has been subtracted from the spectra.

- S3: Photothermo-catalytic oxidation of toluene: influence of different parameters on MnO_x-5% ZrO₂ sample



(a)



(c)

Figure S3. Influence of different parameters in the photothermo-catalytic oxidation of toluene using the MnO_x-5% ZrO₂ sample: (a) influence of the flow rates; (b) influence of air or oxygen in the gas mixture.

- **S4: Thermocatalytic oxidation of ethanol**

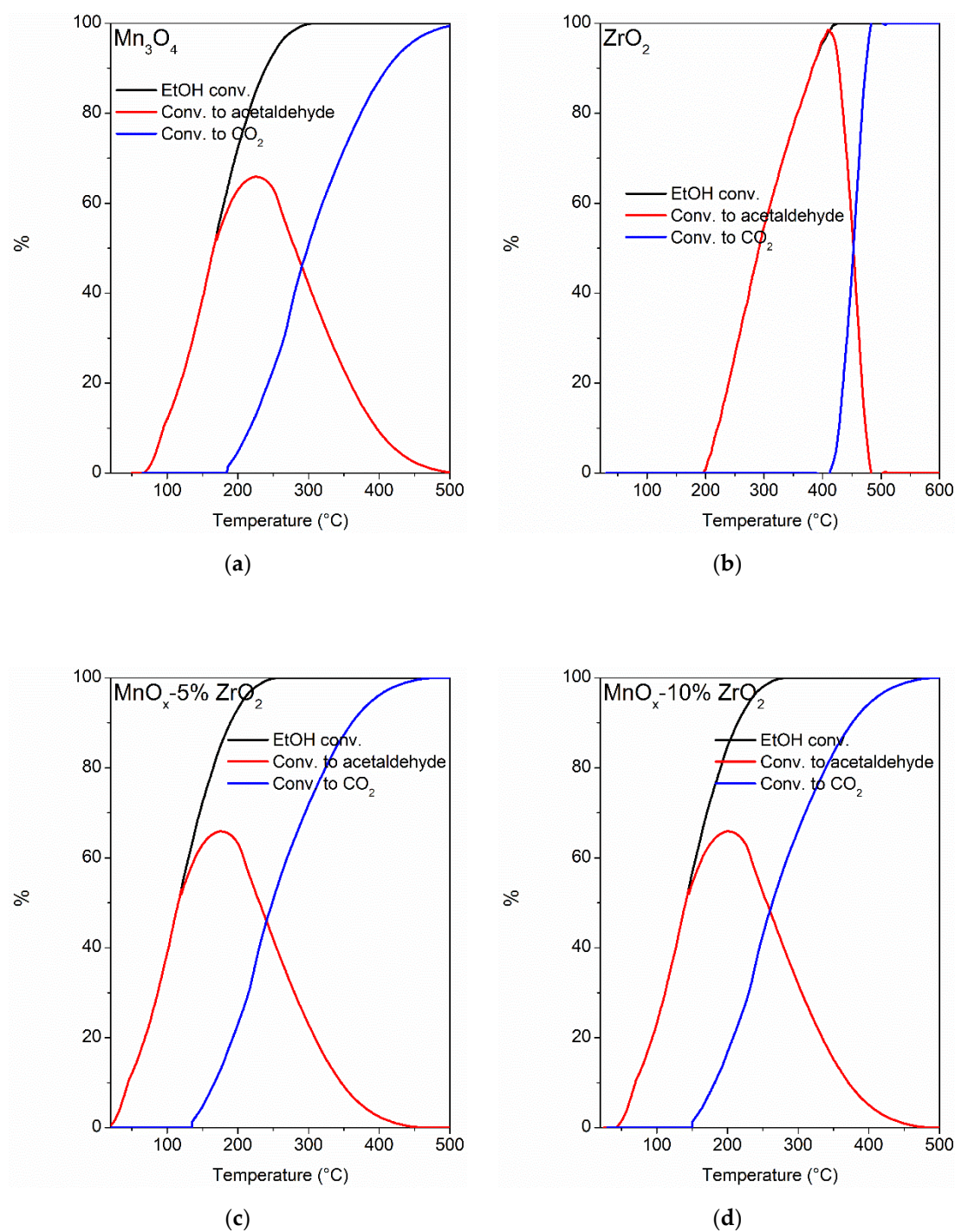


Figure S4. Thermocatalytic oxidation of ethanol: (a) Mn_3O_4 ; (b) ZrO_2 ; (c) MnO_x -5% ZrO_2 ; (d) MnO_x -10% ZrO_2 .

- **S5: Photothermo-catalytic oxidation of ethanol**

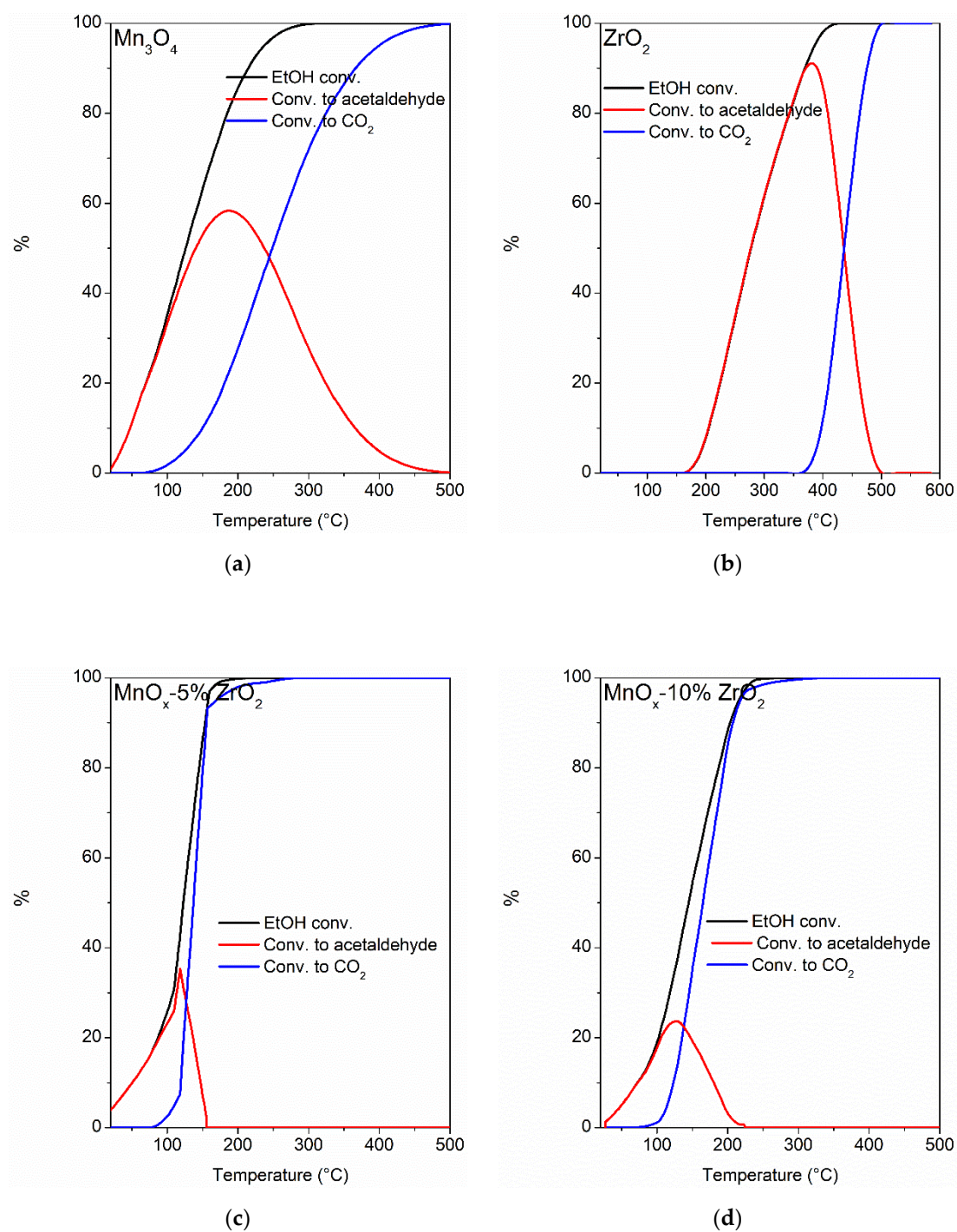


Figure S5. Photothermo-catalytic oxidation of ethanol: (a) Mn_3O_4 ; (b) ZrO_2 ; (c) MnO_x -5% ZrO_2 ; (d) MnO_x -10% ZrO_2 .

References:

1. Wang, Y.; Hao, J.; Li, W.; Zuo, X.; Xiang, B.; Qiang, Y.; Zou, X.; Tan, B.; Hu, Q.; Chen, F. Mn₃O₄/Co(OH)₂ cactus-type nanoarrays for high-energy-density asymmetric supercapacitors. *J. Mater. Sci.* **2020**, *55*, 724–737.
2. Zuo, J.; Chen, Z.; Wang, F.; Yu, Y.; Wang, L.; Li, X. Low-Temperature Selective Catalytic Reduction of NO_x with NH₃ over Novel Mn–Zr Mixed Oxide Catalysts. *Ind. Eng. Chem. Res.* **2014**, *53*, 2647–2655.