Supporting Information

Fabrication of Efficient Nano-MnOx/ACF Particle Electrodes and their Application in the Electrooxidation of m-Cresol in the 3-D Electrode System

Weijun Liu,[†, §] Pingzhou Duan,[†] Xiang Hu,[*, †] Jianjun Gao,[§] Fentao Zhou[§]

[†]College of Chemical Engineering, Beijing University of Chemical Technology, Beijing 100029, China

[§]Shanxi Jinhuankeyuan Environmental Resources Technology Co., Ltd, Taiyuan, Shanxi 030024, China

[//]College of Environmental & Energy Engineering, Beijing University of Technology, Beijing 100124, China

[*]Corresponding authors:

Prof. Xiang Hu

Email address: huxiang@mail.buct.edu.cn

Tel: +86-10-64427356; Fax: +86-10-64436781

Address: Beijing University of Chemical Technology, No. 15 Beisanhuan East Road, Beijing 100029, China.

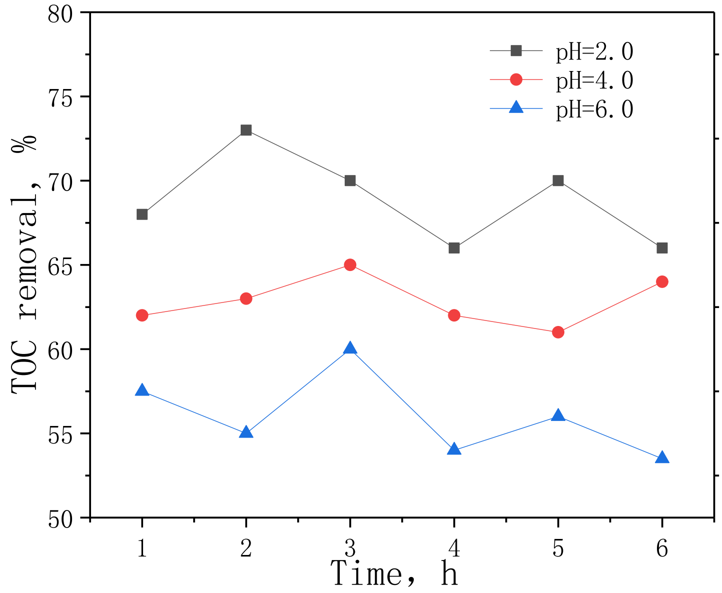

Figure S1 The influence of initial aqueous pH on the electrooxidation performance with Mn-450/ACF as particle electrodes

Figure S1 exhibited the influence of initial aqueous pH on the performance of 3-D electrode. As shown in the Figure, with the rise of aqueous pH, the average TOC removal decreased slowly. At pH=2.0, the average TOC removal was about 68%. When the aqueous pH increased to 4.0 and 6.0, the average TOC removal decreased to about 62% and 56%, respectively. So the optimal initial aqueous pH would be 2.0.

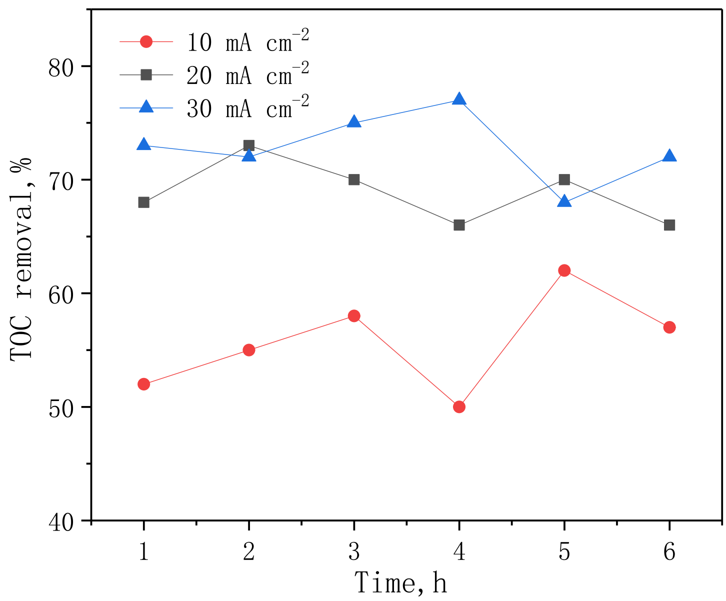

Figure S2 The influence of current density on the electrooxidation performance with Mn-450/ACF as particle electrodes

The influence of current density on the performance of 3-D electrode with Mn-450/ACF as particle electrodes was also investigated in **Figure S2**. It can be seen from Figure S2 that the average TOC removal was about 56% under the lowest current density. When the current density increased to 20 mA·cm^{-2} the average TOC removal would increase to about 68%. However, if the current density increased to 30 mA·cm^{-2}, the average TOC removal would be 70%, which was slightly higher than at 20 mA·cm^{-2}. So the optimal current density would be 20 mA·cm^{-2}.

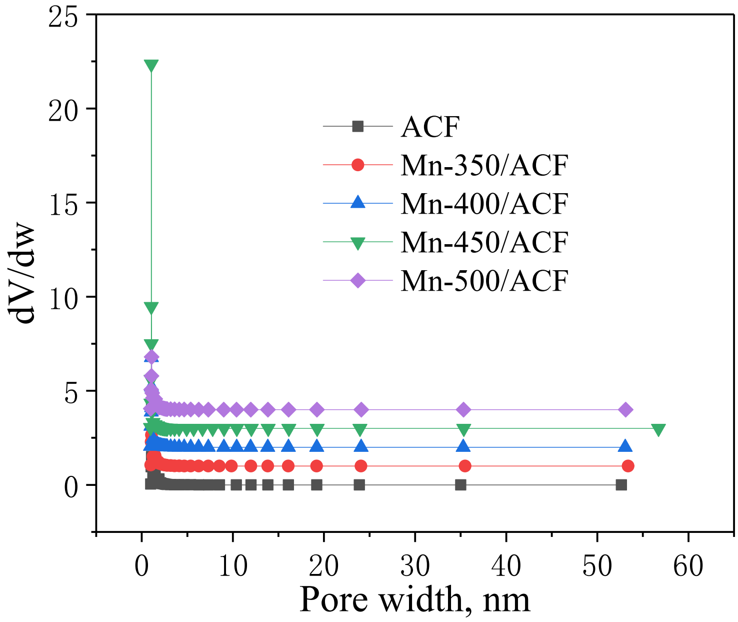

Figure S3 Pore size distribution for the Mn/ACF samples calcined at different temperatures

The pore size distribution of Mn/ACF samples calcined at different temperatures were shown in **Figure S3**. It can be seen from Figure S3 that pore size of the sample is concentrated at about 1-1.5 nm, and the pore size distribution is uniform.

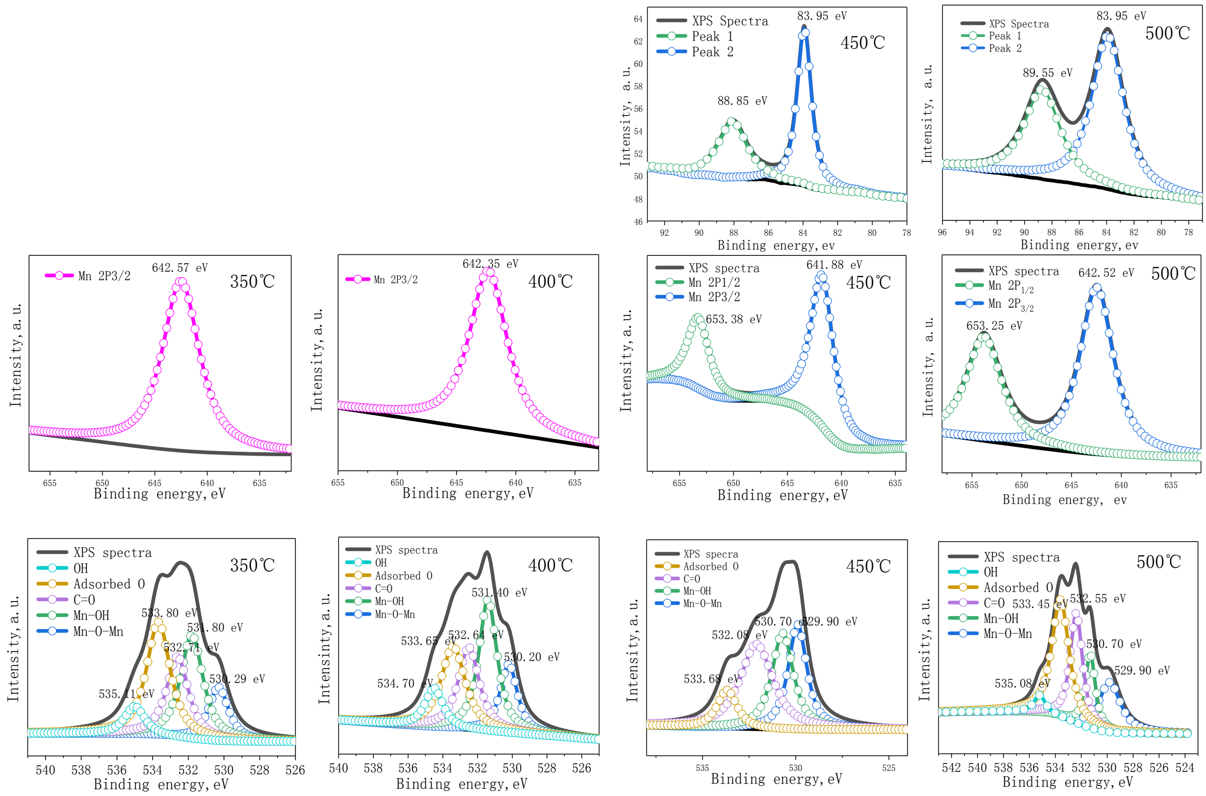

Figure S4 The XPS spectra of MnO_x/ACF sample at different calcination temperatures

Figure S4 depicted the XPS spectra of MnO_x/ACF samples calcined at different temperatures. Usually 3 types of XPS spectra could be analyzed, namely: Mn3s, Mn2p, and O1s from the top down in Figure S1. Due to some unknown reasons, the Mn3s spectra of Mn-350/ACF and Mn-400/ACF can not be detected.

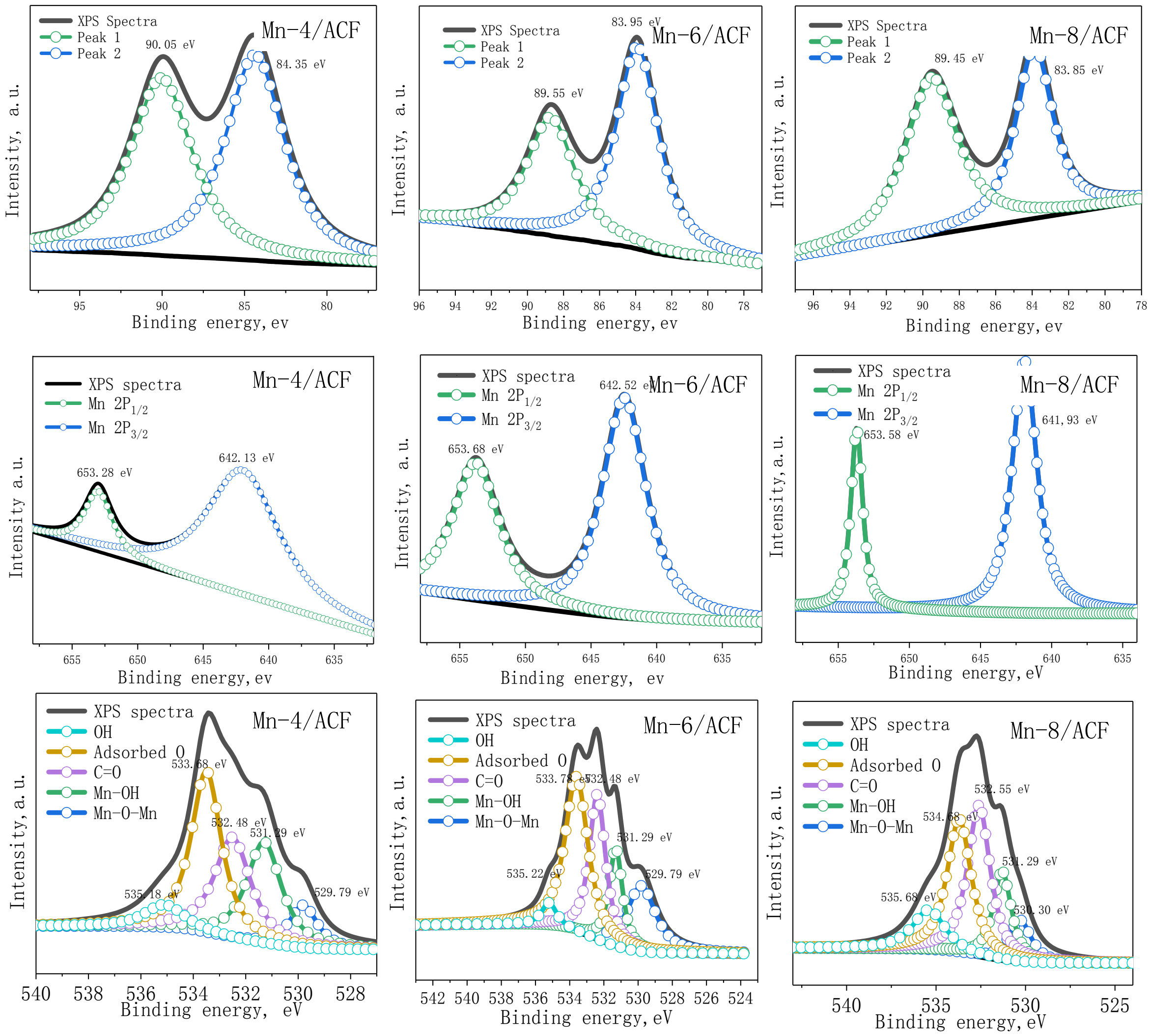

Figure S5 The XPS spectra of MnO_x/ACF samples at different Mn Loads

Figure S5 exhibited the XPS spectra of MnO_x/ACF samples loaded with different amount of Mn. Usually 3 types of XPS spectra could be analyzed, namely: Mn3s, Mn2p, and O1s from the top down in Figure S2. Due to lower Mn content, 3 XPS spectra of Mn-2/ACF can not be detected.

Table S1 The Nomenclature of Mn/ACF Samples

Factors being investigated	Naming	Other factors were kept equal
Active metal species	Mn/ACF, Cu/ACF, Fe/ACF, Sn/ACF	Calcination temperature: 500℃, the same molal weight: 0.730 mmol/g.
Mn-load	Mn-2/ACF， Mn-4/ACF， Mn-6/ACF， Mn-8/ACF	Precursor solution: $Mn(NO_3)_2$, calcination temperature: 500℃.
Calcination temperature	Mn-350/ACF, Mn-400/ACF, Mn-450/ACF, Mn-500/ACF	Mn-load: 6%，precursor solution: $Mn(NO_3)_2$

For the convenience of description, the obtained ACF-based catalysts were named according to **Table S1**. When different active metal oxides were supported onto ACF, the samples of Mn/ACF, Cu/ACF, Fe/ACF, Sn/ACF in the Table S1 represented MnO_x, CuO_x, FeO_x and SnO_2 were supported onto the ACF. Meanwhile the calcination temperature (500℃) and molar weight of metal (0.730 mmol/g.) on ACF were the same. Then as for the factor being studied: Mn-load, different amount of Mn were loaded onto the ACF. Mn-2/ACF indicated that the mass of Mn element was 2% of support mass (2g Mn/100 ACF), similar for Mn-4/ACF, Mn-6/ACF and Mn-8/ACF. And the calcination temperature of 4 samples was 500℃. The 3rd factor needed to be investigated was the calcination temperature. Mn-350/ACF represented that the sample was calcined at 350℃ with 6% Mn-load. Similarly, Mn-400/ACF, Mn-450/ACF and Mn-500/ACF standed for that they were calcined at 400 ℃, 450 ℃ and 500 ℃.