

# Supplementary Material

## Acetylene abatement over micro / mesoporous active carbon supported low mercury catalysts

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**Table S1** Element composition of the carbon powder (TX and HM)

| Sample | Element composition / wt.% |      |       |      |      |
|--------|----------------------------|------|-------|------|------|
|        | C                          | H    | O     | N    | S    |
| TX     | 93.78                      | 4.11 | 1.17  | 0.80 | 0.14 |
| HM     | 71.88                      | 8.12 | 17.47 | 1.48 | 1.05 |

**Table S2** Structure parameters of the AC substrates based on N<sub>2</sub> adsorption / desorption

| Samples  | <sup>a</sup> S <sub>BET</sub> /<br>m <sup>2</sup> g <sup>-1</sup> | <sup>b</sup> V <sub>total</sub> /<br>cm <sup>3</sup> g <sup>-1</sup> | <sup>c</sup> V <sub>micro</sub> /<br>cm <sup>3</sup> g <sup>-1</sup> | <sup>d</sup> V <sub>meso</sub> /<br>cm <sup>3</sup> g <sup>-1</sup> | V <sub>meso</sub> (V <sub>total</sub> ) <sup>-1</sup><br>/ % | <sup>e</sup> D /<br>nm |
|----------|-------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------------|------------------------|
| TX-AC    | 1623                                                              | 0.91                                                                 | 0.598                                                                | 0.312                                                               | 34.2                                                         | 1.42                   |
| S20-AC   | 1737                                                              | 0.92                                                                 | 0.435                                                                | 0.485                                                               | 52.7                                                         | 2.35                   |
| S40-AC   | 2054                                                              | 1.39                                                                 | 0.453                                                                | 0.937                                                               | 67.4                                                         | 5.17                   |
| WG-AC    | 2259                                                              | 1.38                                                                 | 0.992                                                                | 0.388                                                               | 28.1                                                         | 1.02                   |
| Fe0.8-AC | 2195                                                              | 1.52                                                                 | 0.421                                                                | 1.099                                                               | 72.3                                                         | 5.93                   |

<sup>a</sup>S<sub>BET</sub>: BET surface area;

<sup>b</sup>V<sub>total</sub>: total pore volume;

<sup>c</sup>V<sub>micro</sub>: micropore volume;

<sup>d</sup>V<sub>meso</sub>: mesopore volume;

<sup>e</sup>D: mean pore diameter

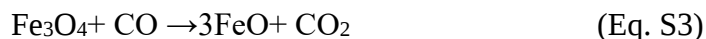
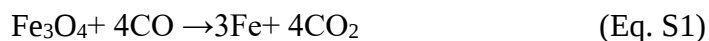
## Characterization results of the AC substrates

The characterization results of the five types of substrates (TX-AC, S20-AC, S40-AC, Fe0.8-AC and WG-AC) were discussed in this part, wherein the WG-AC was a commercial product and utilized as a reference sample.

Table S2 listed the texture properties of the synthesized (TX-AC, S20-AC, S40-AC, Fe0.8-AC) and commercial (WG-AC) AC substrate. It can be found that the BET surface area decreased following the order of WG-AC > Fe0.8-AC > S40-AC > S20-AC > TX-AC. The related pore size distributions were further profiled in Figs. S1a-S1e. It can be found that (i) the micropores predominate on the substrate of WG-AC; (ii) the micropore and mesopore co-existed on TX-AC and S20-AC; (iii) while the mesopores predominately emerge on S40-AC and Fe0.8-AC displaying the  $V_{\text{meso}}$  values of 0.937 and 1.099  $\text{cm}^3 \text{g}^{-1}$ , respectively. As for the synthesized AC substrates, the related specific surface area decreased following the order of Fe0.8-AC > S40-AC > S20-AC > TX-AC, which is consistent with the pore size distribution results of Figs. S1a-S1d suggesting that the synthesized AC substrate possessing much larger amounts of mesopores would also exhibited much higher specific surface area. However, as noted the highest specific surface area of WG-AC ( $S_{\text{BET}} = 2259 \text{ g m}^{-2}$ ) can be related to its strong microporous texture system displaying a greatly high micropore volume ( $V_{\text{micro}}$ ) of 0.992  $\text{g cm}^{-3}$  (as listed in Table S2).

The SEM images of these substrates were shown in Fig. S2. It can also be obviously found that the surface morphologies of Fe0.8-AC and S40-AC were much more rough than other substrates. This can be mainly related to formation of large amounts of mesopores. In addition to that, it is worth noticing that as for the substrates of Fe0.8-AC and S40-AC the related synthesis procedures were the similar to each other, except that small amounts of  $\text{Fe}_3\text{O}_4$  were additionally added during synthesis of Fe0.8-AC. Further comparing the pore size distribution profiles of Fig. S1c and Fig. S1d, it can be revealed that the addition of  $\text{Fe}_3\text{O}_4$  facilitated generations of the mesopores, resulting in the pore sizes being mainly located at the range of 6.3-8.4 nm of Fe0.8-AC substrate.

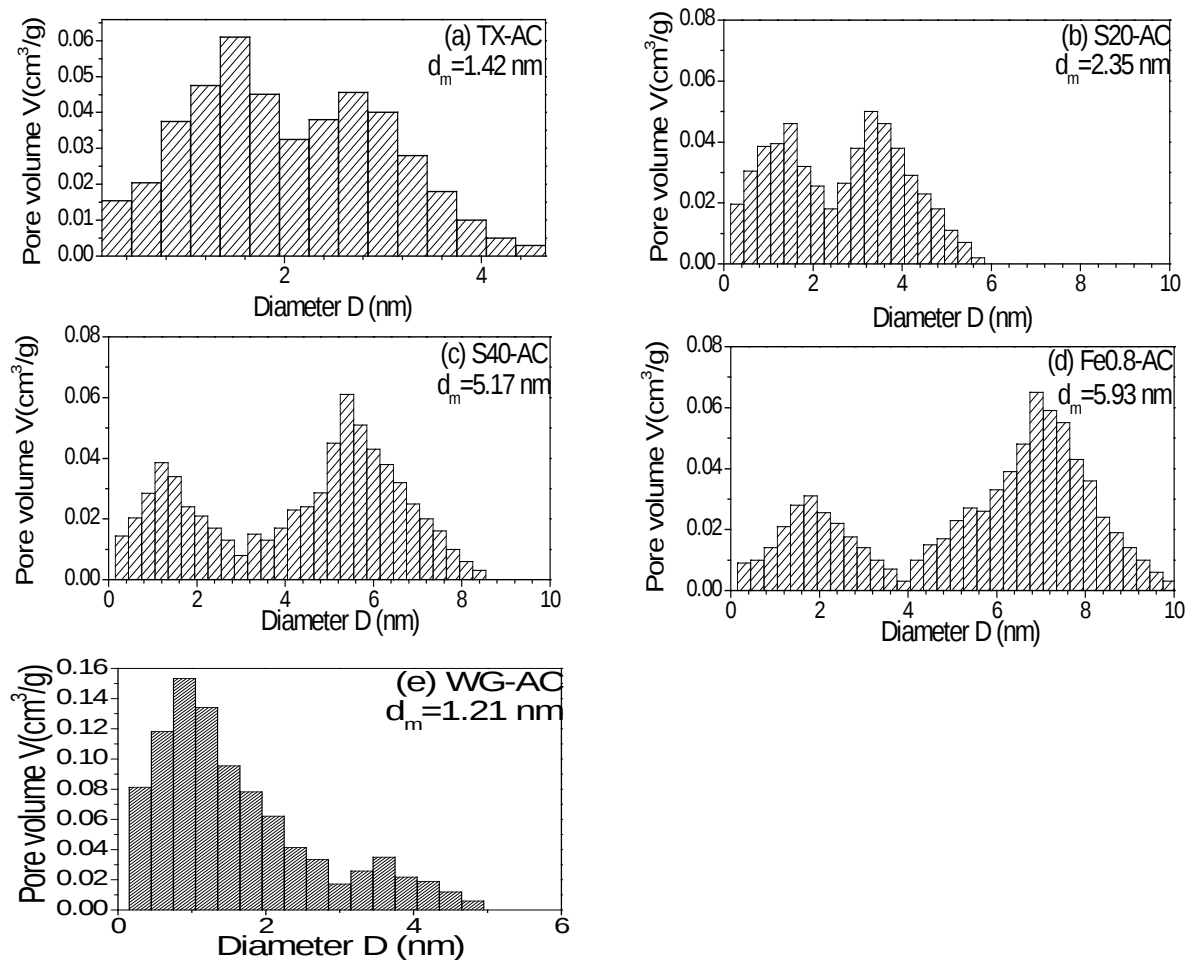
In order to shed more light on the effect of the Fe<sub>3</sub>O<sub>4</sub> during mesopore generation process, the XRD was further conducted over Fe<sub>0.8</sub>-AC and S40-AC and with the results being profiled in Fig. S3. It can be found that some additional XRD patterns of 22.2°, 30.1°, 35.4°, and 44.7° emerged on Fe<sub>0.8</sub>-AC with respect to that of S40-AC: i) the peaks centered at 22.2° and 44.7° can be assigned to the characteristic XRD patterns of Fe<sup>0</sup> respectively belonging to body-centered cubic lattice Fe and hexagonal Fe [R1]; ii) the peaks centered at 30.1° and 35.4° can be assigned to be the XRD patterns of Fe<sub>3</sub>O<sub>4</sub> [R2]; and the peaks centered at 36.1° is related to the XRD patterns of FeO. According to the literature report [R3], these Fe species can be generated during Fe<sub>0.8</sub>-AC activation process through following reactions of Eqs. S1-S4, wherein the CO and H<sub>2</sub> was produced through C + H<sub>2</sub>O → CO + H<sub>2</sub> reaction. This activation process will consume certain amounts of C, which thereby facilitated formation of the mesopore on Fe<sub>0.8</sub>-AC.



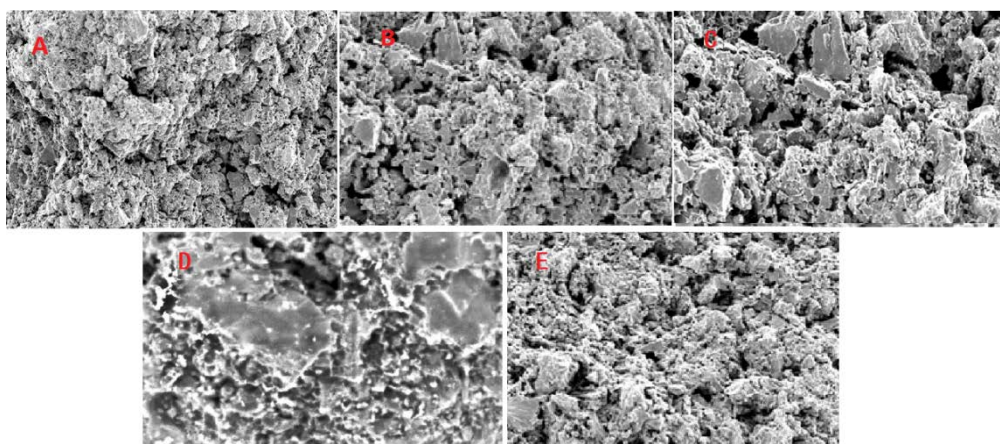
[R1]. Zhang, J.; Liu, J.; Yang, M.S.; Jiang, Y.; Zhang, Z.H.; Yao, X.; Xie, Q. Fe<sub>3</sub>O<sub>4</sub> added affected of pore structure of coal based activated carbon. *Coal Sci. Technol.* **2010**, 38, 118-121.

[R2]. Zhu, Y.X.; Chai, Y.Z.; Liu, Z.Y.; Huang, S.M. XRD Characterization of interaction between potassium promoter and magnetite. *Acta. Phys. Chim. Sin.* **2000**, 16, 126-132.

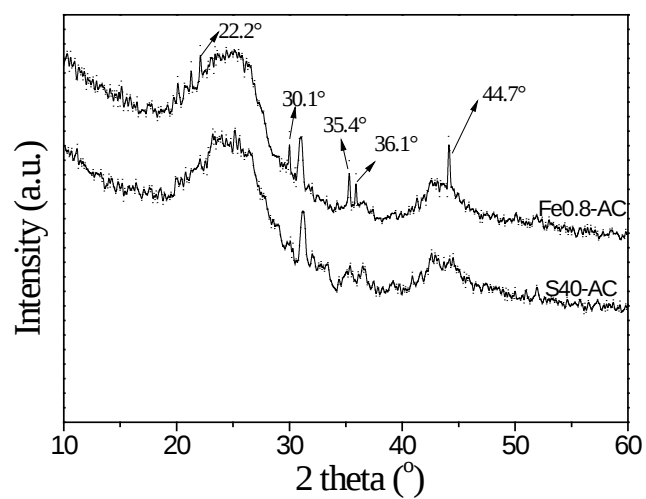
[R3]. Jozwiak, W.K.; Kaczmarek, E.; Maniecki, T.P.; Ignaczak, W.; Maniukiewicz, W. Reduction behavior of iron oxides in hydrogen and carbon monoxide atmospheres. *Appl. Catal. A: Gen.* **2007**, 326, 17-27.



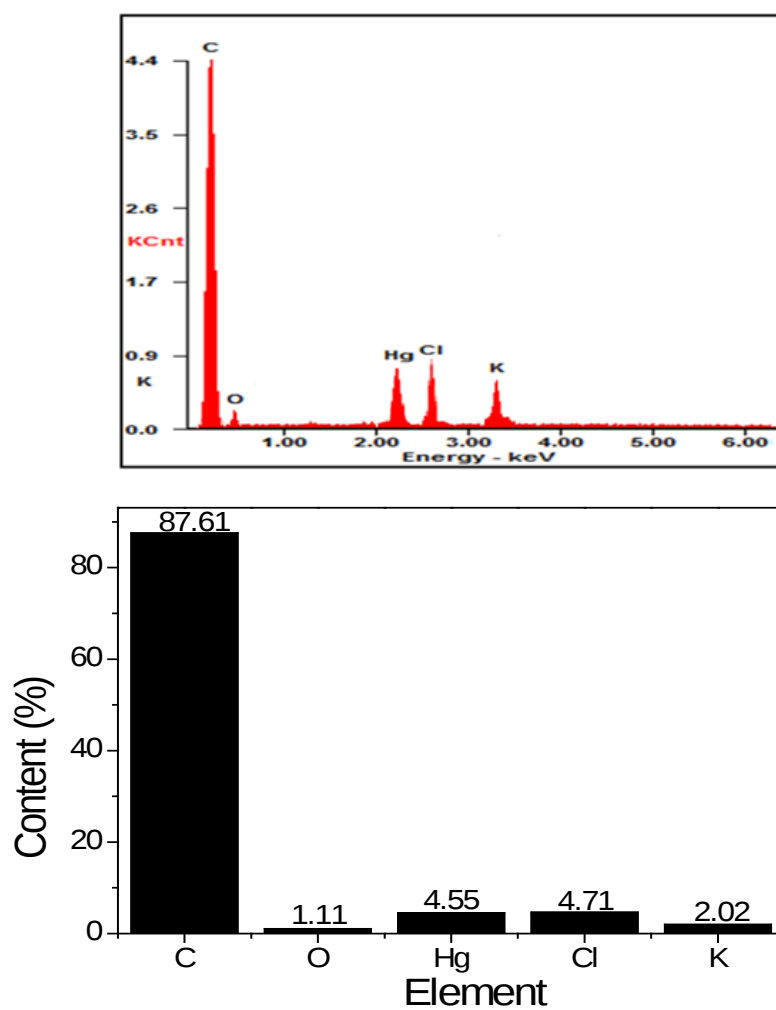
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**Fig. S2** SEM images of the AC substrates: (A) TX-AC (B) S20-AC (C) S40-AC (D) Fe0.8-AC (E) WG-AC



**Fig. S3** XRD patterns of the substrates of Fe0.8-AC and S40-AC



**Fig. S4** EDS element analysis for the sample of ZS-SD1-Fe<sub>0.8</sub>-M, treated by HCl at T = 220 °C for 60 h.