

Supplementary Information for
Adsorption dynamics and rate assessment of volatile organic
compounds in active carbon

Experimental procedures

The active carbon is mainly composed of a carbon, hydrogen and oxygen elements. In our case the active carbon fiber cloth (ACFC), where the active carbon pellets adhered tightly onto the fiber cloth, was used to perform the adsorption experiment. As shown in the Fig. 1, the scanning electron microscope (SEM) image confirmed the porous structure of ACFC. In the Figure 1, the green lines and numbers was used to quantify the size of pores in active carbon, and the red lines randomly marked a region which was enlarged to confirm the morphology more clearly. The adsorption behaviors of isooctane, ethanol, and butyl acetate with a purity of more than 99.9% onto ACFC were carried out by a typical THz-TDS setup with transmission geometry, respectively.¹⁻³ The polyethylene (PE) slices have little absorption in THz range and were used to seal the ACFC with a single drop of chemical reagent on the middle of the ACFC.⁴ The experimental setup was comprised of a conventional THz-TDS system. The THz pulse carried sample's information including the intermolecular and intramolecular vibration modes. The THz pulses of the reference and the sample were measured by scanning the nitrogen and the ACFC with a droplet, respectively, at room temperature.

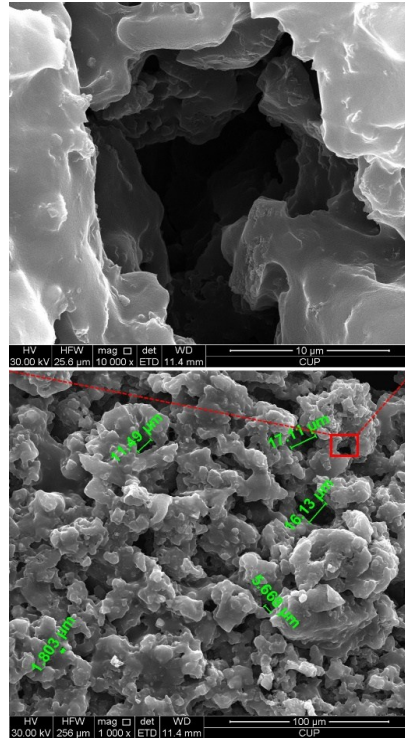


Fig. 1 SEM image of ACFC.

- 1 H. L. Zhan, S. X. Wu, R. M. Bao, L. Ge and K. Zhao, *Fuel*, 2015, 143, 189.
- 2 W. Leng, H. Zhan, L. Ge, W. Wang, K. Zhao, S. Y. Li and L. Z. Xiao, *Fuel*, 2015, 159, 84.
- 3 X. Feng, S. X. Wu, K. Zhao, W. Wang, H. L. Zhan, C. Jiang, L. Z. Xiao and S. H. Chen, *Opt. Express*, 2015, 23, 1693.
- 4 Y. S. Jin, G. J. Kim and S. G. Jeon, *Korean Phys. Soc.*, 2006, 49, 513.

The theoretical model

There was a known pseudo-second order model to explore sorption mechanisms. The pseudo-second-order equation was defined as

$$\frac{t}{q(t)} = \frac{1}{k_0 q_0^2} + \frac{t}{q_0}, \quad (1)$$

where k_0 was the constant, q_0 and $q(t)$ were the amount of samples adsorbed onto active carbon at equilibrium state and time t , respectively. In order to characterize the adsorption rate by THz signal, it was assumed that the relationship between the adsorbed amount q and E_p were linear as

$$q = a \cdot E_p, \quad (2)$$

where the parameter a was a constance.

What's more, it was noteworthy that the pseudo-second-order model originating from chemical reaction kinetics were based on the whole process of adsorption other than volatilization or diffusion. Therefore, only the adsorption was considered. Thus the equation (1) could be transformed as

$$\frac{t'}{E_p(t')} = \frac{1}{kE_{p0}^2} + \frac{t'}{E_{p0}}, \quad (5)$$

where $t'=t-t_{Ads}$, k was the adsorption rate constant which equalled a^2k_0 , and E_{p0} and $E_p(t')$ were the values of E_p of samples adsorbed onto active carbon at equilibrium state and t' , respectively.