

## Supporting information

# Three dimensionally ordered macroporous (3DOM) SiOC on cordierite monolith inner wall and its properties for soot combustion

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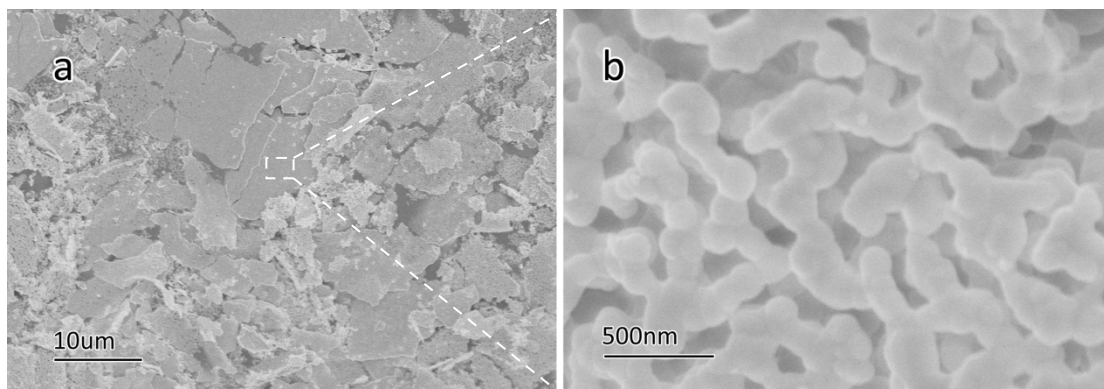
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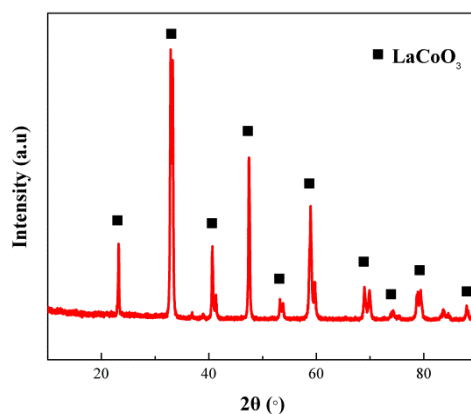
### Catalysts characterization

The morphology of LCO was investigated by means of SEM. Fig. S1 shows the SEM of LCO, Fig. S1b is the enlarged image of Fig. S1a. SEM photographs exhibit that the catalysts prepared by the sol-gel method have spongy structure, the size of the basic particles is range from 50 to 150nm, which is good for the catalytic activity as it is suitable for the contact of soot and catalysts. However, as Fig. S1b showed, the basic catalysts particles aggregate to a larger one, exhibiting a rod-like structure, which is much larger than that of soot (10-50nm).<sup>1</sup> The larger particles have a small specific surface area and against the contact condition with soot as well as gas diffusion, and thus affecting the catalytic activity for soot combustion.



**Fig. S1** SEM images of LCO: (a) LCO, (b) enlarged images of LCO.

The XRD patterns of the LCO perovskite-type oxides catalyst calcined at 800°C are shown in Fig. S2. The diffraction peaks of LCO catalyst are in great agreement with the JCPDS card: PDF 48-0123 file, which corresponds to a rhombohedral system. The characteristic diffraction peaks with  $2\theta$  values at 23.3°, 32.9°, 40.7°, 47.5°, 58.7°, 69.0°, and 78.8° correspond to (012), (110), (202), (024), (300), (220), and (134) lattice faces of rhombohedral perovskite-type LCO, respectively. **The average crystallite size ( $D$ ) of LCO was estimated by the Debye-Scherrer equation using the XRD data of the most prominent line:  $D(hlk)=0.89\lambda/(\beta\cos\theta)$ , where  $\lambda$  is the X-ray wavelength corresponding to the  $\text{CuK}\alpha$  radiation,  $\beta$  is the half-height width of the diffraction peak of the catalyst, and  $\theta$  is the diffraction angle. The lattice parameter of catalyst was calculated using the intensity of the most prominent peak, (110). The average crystallite size of LCO determined by the Scherrer equation is 16.4nm.**



**Fig. S2** XRD of LCO calcined at 800°C

FT-IR results support the above structure analysis by XRD. Fig. S3 depicts the FT-IR spectrum of LCO. As obviously seen from Fig. S3, there are two strong spectra at  $598\text{cm}^{-1}$  and  $423\text{cm}^{-1}$ , and a broad spectra at  $563\text{cm}^{-1}$ . According to the inference,<sup>2</sup> perovskite-type cobalt salts will show strong spectra at around  $560\text{cm}^{-1}$ ,  $596\text{cm}^{-1}$  and  $425\text{cm}^{-1}$ , and in the structure of perovskite-type metal oxides, the stretching vibration of Co-O of  $\text{BO}_6$  are stronger than the stretching vibration of La-O, so the characteristic absorption peak are determined by the Co-O. As the image shows, the strong spectra at  $560\text{cm}^{-1}$  and  $596\text{cm}^{-1}$  are attributed to two types of stretching vibration of Co-O of  $\text{BO}_6$  octahedra, and the spectra at  $423\text{cm}^{-1}$  is attributed to the bending vibration of Co-O. Compared with the inference, we draw the conclusion that the products are perovskite-type metal oxides.

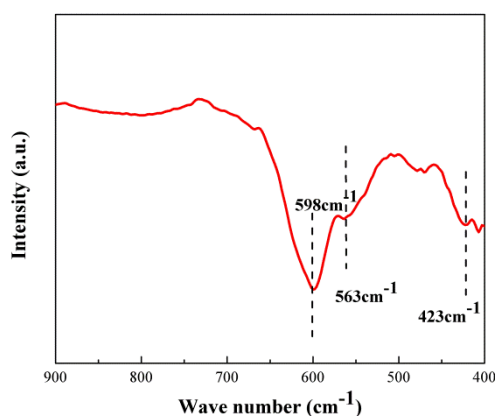
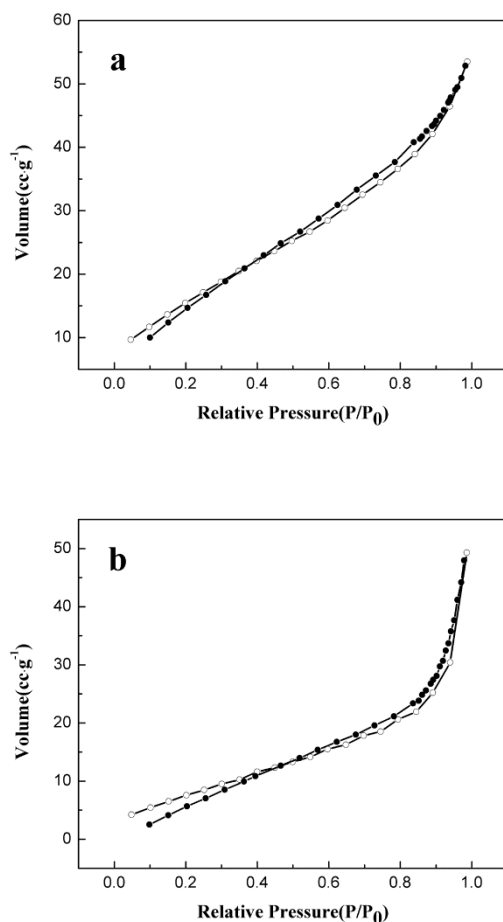


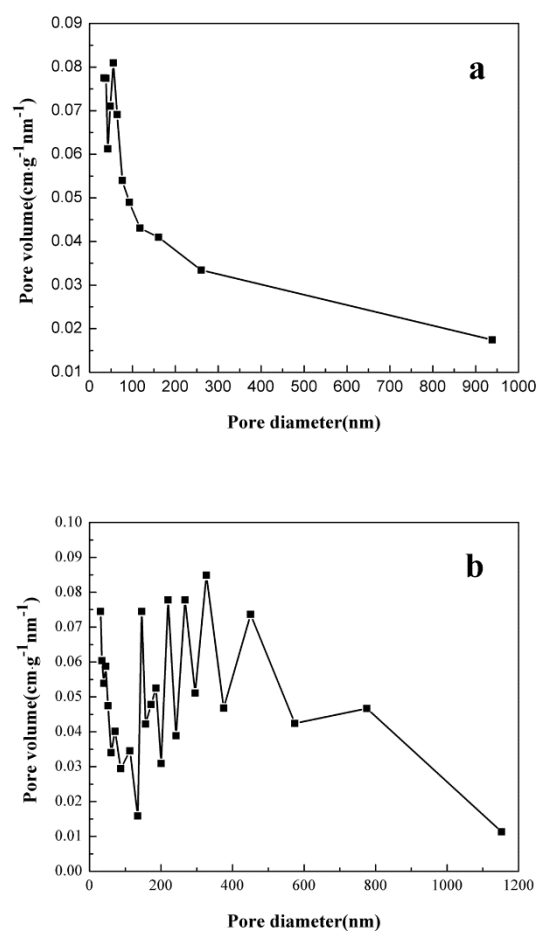
Fig. S3 FTIR spectra of LCO.

### Micropores characterization of 3DOM samples



**Fig. S4** Nitrogen adsorption-desorption isotherms: (a) 3DOM structure, (b) LCO/3DOM SiOC.

**Fig. S4** shows nitrogen adsorption-desorption isotherms of 3DOM samples at 77K. The nitrogen isotherm patterns of 3DOM samples are classified as Type-III with a type H3 hysteresis loop (IUPAC classification)<sup>3</sup>. The type H3 loop, which does not show a clear adsorption plateau at  $p/p_0$  close to unity, is usually related to the existence of macropores. The amount of adsorbed  $N_2$  of two samples linearly increased in the low and middle  $p/p_0$  and increased faster in the region of high  $p/p_0$ , such as  $>0.8 p/p_0$ . The adsorption behavior can be attributed to the present of mono- or multi- layer adsorption on the mesopores and macropores, as confirmed by the pore-size distribution. Fig. S5a shows the pore size distribution of 3DOM SiOC, there is a wide pore-size distribution from 30 to 300nm. These pores are mainly produced by the sintering of PS spheres, and because of the local collapse, the pore-size distribution is larger than that of PS spheres. Fig. S5b shows the pore-size distribution of LCO/3DOM SiOC, the pore-size distribution is wider and more complex than that of 3DOM SiOC, mainly at a range of 100 to 600nm. The space produced by catalysts coating on the 3DOM SiOC is one reason for the complex pore-size distribution, and the main reason is that 3DOM SiOC collapsed more seriously after several times of sintering.



**Fig. S5** The pore-size distribution: (a) 3DOM structure, (b) LCO/3DOM SiOC.

#### Reference

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