

Supporting Information

**Manganese-cerium mixed oxides supported on rice husk  
based activated carbon with high sulfur tolerance for low-  
temperature selective catalytic reduction of nitrogen oxides  
with ammonia**

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Fourier transform infrared spectroscopy (FT-IR) of the catalyst pretreated with a flow of NO-NH<sub>3</sub>-O<sub>2</sub>-SO<sub>2</sub>-H<sub>2</sub>O was performed to offer further evidence for the identification of sulfate species formed on the catalyst surface. Figure S3 shows the FT-IR spectra of fresh and pretreated catalysts. For fresh catalysts, the C-O groups at 1048 cm<sup>-1</sup> and C-H transformative vibrational groups at 1470 cm<sup>-1</sup> were observed [1,2]. According to the reported literature [3], the peak at 880 cm<sup>-1</sup> indicated that aromatic C-H outside distortion occurred for the catalysts. After the pretreatment with a flow of NO-NH<sub>3</sub>-O<sub>2</sub>-SO<sub>2</sub>-H<sub>2</sub>O, Mn-Ce/RAC-P and Mn-Ce/SAC-P catalysts showed a new absorption at 1400 cm<sup>-1</sup>, indicating the presence of NH<sub>4</sub><sup>+</sup> species, which were chemisorbed on the Brønsted acid sites [4]. Meanwhile, another new absorption appeared at 1150 cm<sup>-1</sup> for the both pretreated catalysts, which might be assigned to the characteristic frequencies of the SO<sub>4</sub><sup>2-</sup> ion [5]. Furthermore, for the Mn-Ce/RAC-P catalyst, the absorption intensities at 1150 and 1400 cm<sup>-1</sup> were lower than those of the Mn-Ce/SAC-P catalyst. These results demonstrated that during the pretreatment, there

was little ammonium-sulfate salts deposited on the surface of the Mn-Ce/RAC-P catalyst compared to that of the Mn-Ce/SAC-P catalyst.

Table S1 Characteristics of raw biomasses

samples	rice husk
proximate analysis (wt%, as air dried)	
moisture	4.01
ash	15.48
volatile matter	64.43
fixed carbon	16.08
ultimate analysis (wt%, as air dried)	
C	39.47
H	4.85
O	35.02
N	0.48
S	0.04
LHV (MJ/kg)	15.06

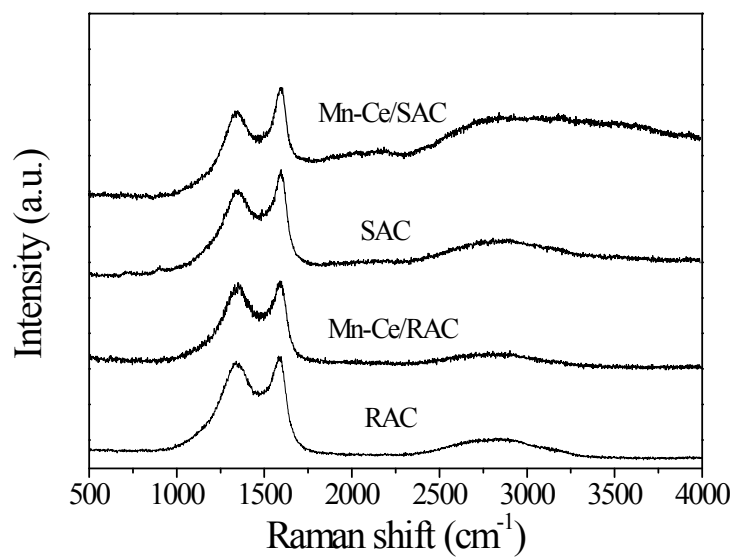


Figure S1 Raman spectra of different samples

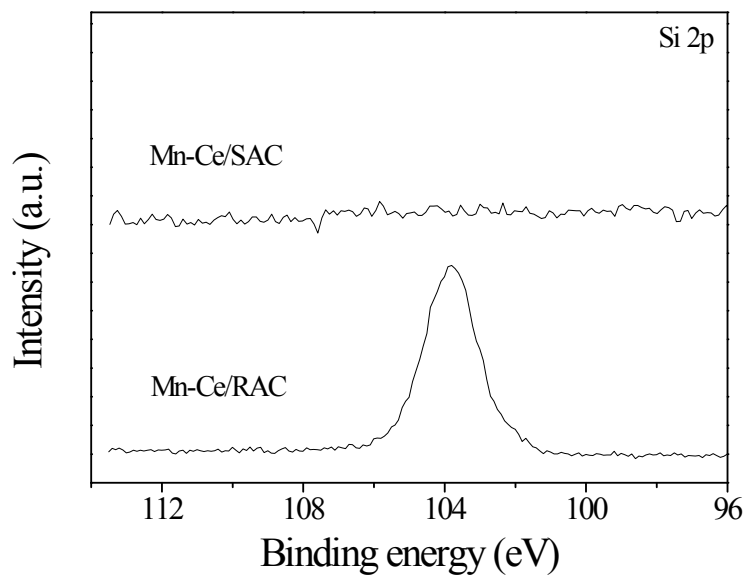


Figure S2 Si 2p XPS spectra of Mn-Ce/RAC and Mn-Ce/SAC catalysts

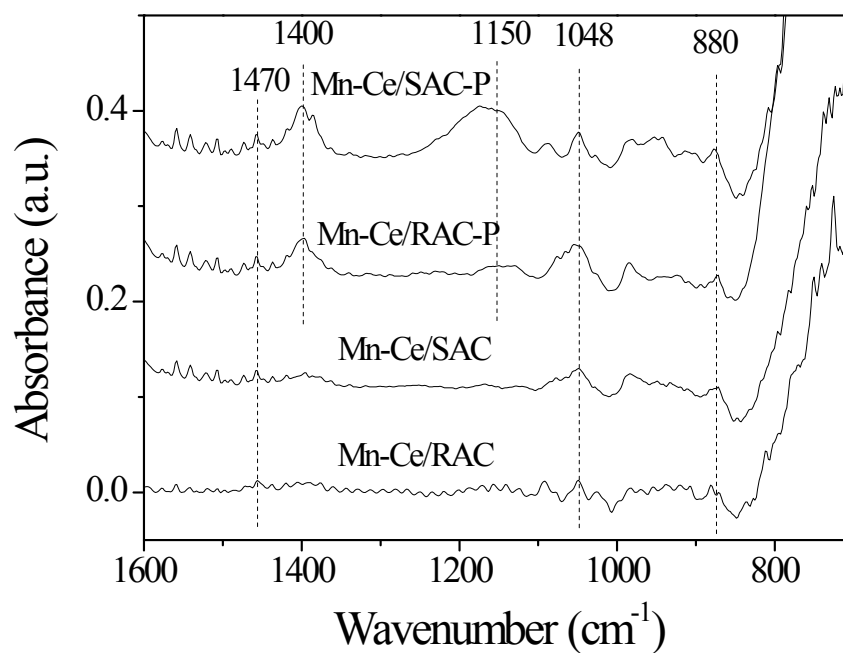


Figure S3 FT-IR spectra of Mn-Ce/RAC and Mn-Ce/SAC catalysts before and after pretreatment with a flow of 800 ppm NO-800 ppm NH<sub>3</sub>-3% O<sub>2</sub>-300 ppm SO<sub>2</sub>-10 vol.% H<sub>2</sub>O

### References

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