Catalytic oxidation of NO over MnOx-CoOx/TiO_2 in presence of low ratio of O_3/NO: the activity and mechanism

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1 Experimental system

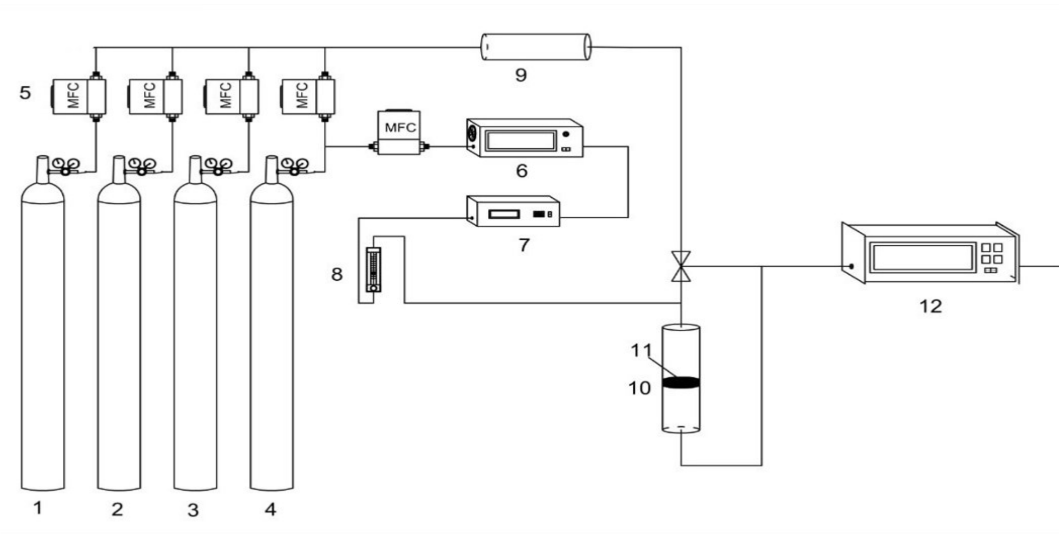

Fig. S1. Schematic diagram of experimental system for NO oxidation.

1-NO 2-SO_2 3-N_2 4-O_2 5-MFC 6-Ozone generator 7-Ozone Detector 8-Rotameter 9-Mixer

10-Reactor 11-catalyst 12-Flue gas analyzer

2 NO oxidation properties

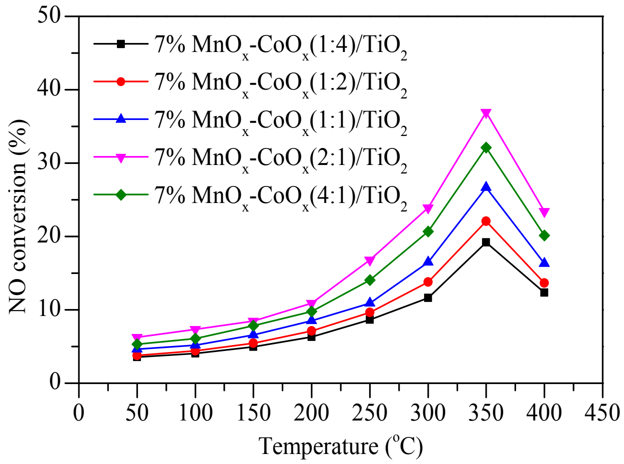

Fig. S2. NO conversion of 7%MnO_x-CoO_x/TiO_2 with different molar ratio of Mn to Co. Reaction condition: Flow=400 ml/min, NO=500 ppm, O_2=4%, GHSV=24000 h^{-1}.

Fig. S2 shows the NO conversion by using 7%MnO_x-CoO_x/TiO_2 with different molar ratio of Mn and Co in presence of O_2. The conversion of NO increased with the increase of temperature, reaching the maximum at 350 °C and then decreased. With the increase of manganese content, NO conversion increased, but the NO conversion by 7%MnO_x-CoO_x(4:1)/TiO_2 was lower than by 7%MnO_x-CoO_x(2:1)/TiO_2. 7%MnO_x-CoO_x(2:1)/TiO_2 showed the highest catalytic efficiency than other molar ratios. Therefore, MnO_x-CoO_x(2:1)/TiO_2 was chosen in the following studies.

3 H_2-TPR analysis

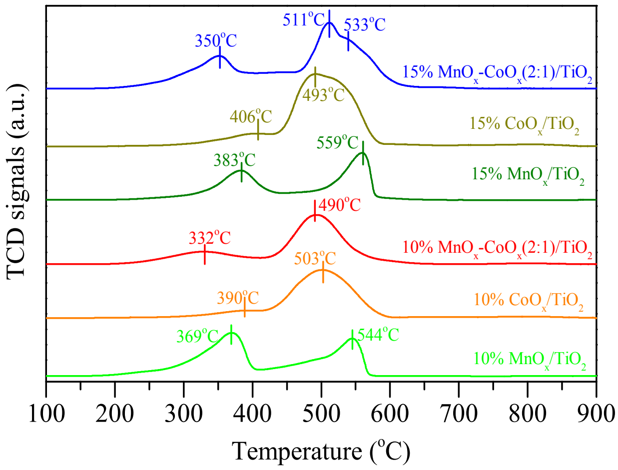

Fig. S3. H_2-TPR comparison of single load and MnO_x-CoO_x load.

H_2-TPR experiments on supported single MnO_x and single CoO_x are added in supplementary material, as shown in Fig. S3. For 10%MnO_x/TiO_2 and 15%MnO_x/TiO_2, there were two obvious reduction peaks. The peaks at 369 °C and 3833 °C could be assigned to the reduction of MnO_2 to Mn_2O_3 [1], and the peaks at 544 °C and 559 °C could be assigned to the reduction of Mn_2O_3 occurred through Mn_3O_4 to MnO [2]. For 10%CoO_x/TiO_2 and 15%CoO_x/TiO_2, there were also two reduction peaks. The peaks at 390 °C and 406 °C could be assigned to the reduction of Co_3O_4 to CoO, and the peaks at 503 °C and 493 °C could be assigned to the reduction of CoO to Co [3]. For 10%MnO_x-CoO_x(2:1)/TiO_2, there were two reduction peaks. According to the reduction peaks of 10%MnO_x/TiO_2 and 10%CoO_x/TiO_2, the reduction peak at 332 °C contains the reduction of MnO_2 to Mn_2O_3

and Co_3O_4 to CoO, and the reduction peak at 490 °C contains the reduction of Mn_2O_3 occurred through Mn_3O_4 to MnO and the reduction of CoO to Co. Compared to 10%MnO_x/TiO_2 and 10%CoO_x/TiO_2, the reduction peak temperatures of 10%MnO_x-CoO_x(2:1)/TiO_2 was reduced. For 15%MnO_x-CoO_x(2:1)/TiO_2, there were obvious reduction peaks at 350 °C and 511 °C with a shoulder peak at 533 °C. According to the reduction peaks of 15%MnO_x/TiO_2 and 15%CoO_x/TiO_2, the reduction peak at 350 °C contains the reduction of MnO_2 to Mn_2O_3 and Co_3O_4 to CoO, and the reduction peak at 511 °C with a shoulder peak at 533 °C represented the reduction of Mn_2O_3 occurred through Mn_3O_4 to MnO and the reduction of CoO to Co.

References

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