Electronic Supplementary Material (ESI) for Catalysis Science & Technology.

Supporting Information

CO oxidation over MO_x (M = Mn, Fe, Co, Ni, Cu) supported on $SmMn_2O_5$ composite catalysts

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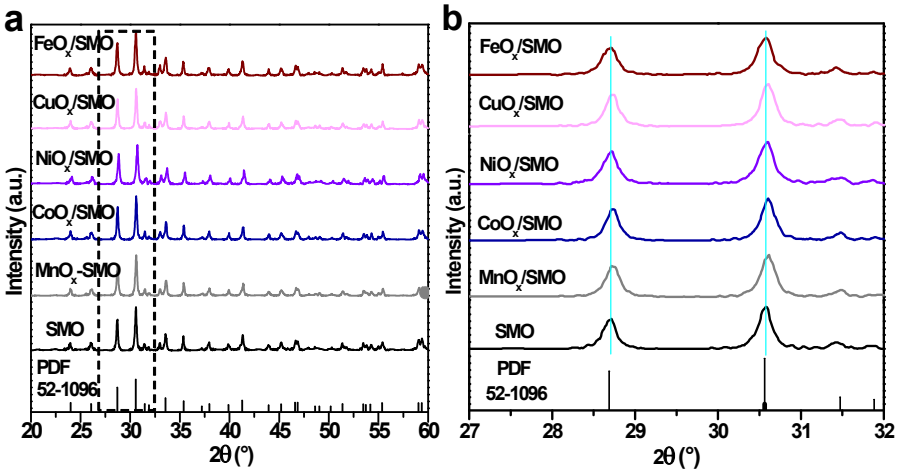

Fig. S1 (a) XRD patterns of all MO_x/SMO samples; (b) corresponding enlarged figures.

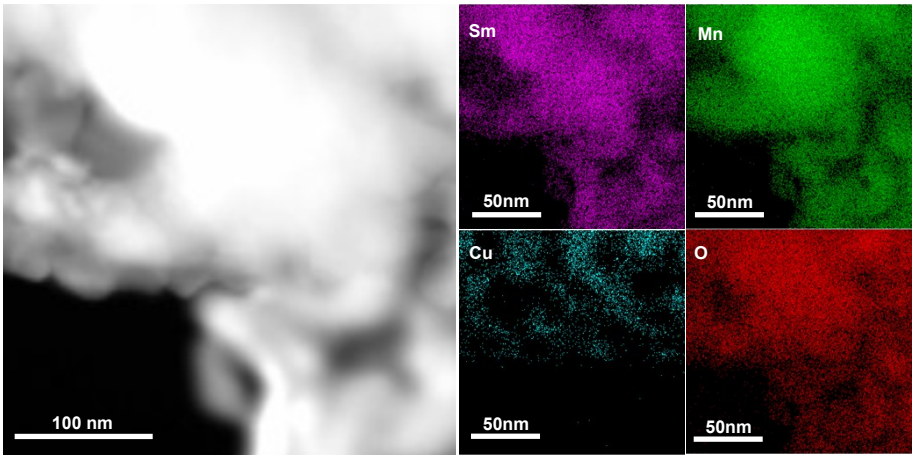

Fig. S2 Dark field STEM and EDX-mapping images of CuO_x/SMO sample.

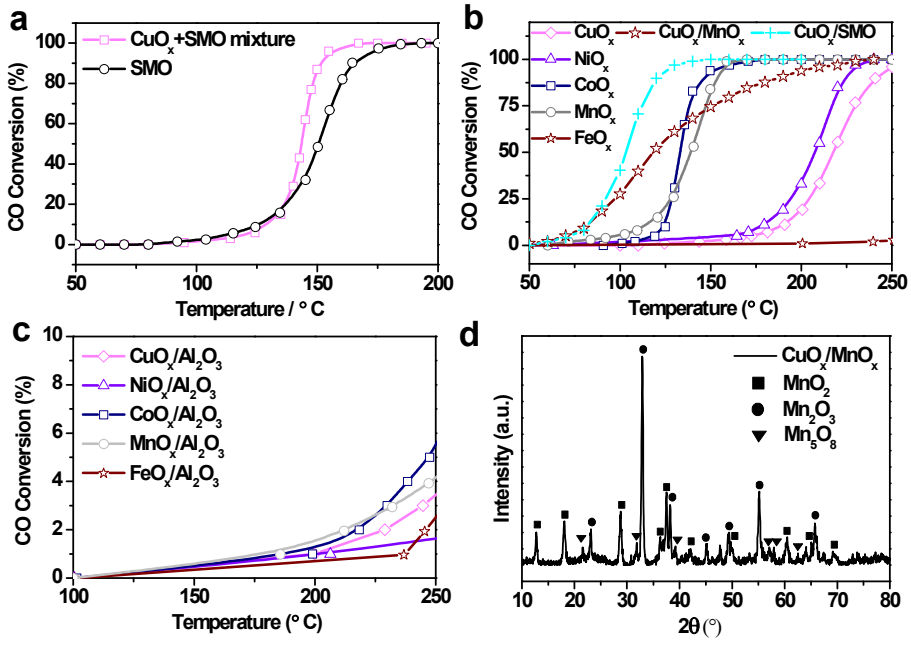

Fig. S3 Light off CO oxidation curves of (a) 1 wt.% CuO_x + SMO mechanical mixture and pure SMO; (b) pure MO_x, 1 wt% CuO_x/MnO_x and 1 wt% CuO_x/SMO; (c)1 wt% MO_x/Al_2O_3 samples, below 200 °C, CO conversion of MO_x/Al_2O_3 samples is negligible (<2%), which suggests that MO_x surface is not the active center for CO oxidation over MO_x/SMO composites; (d) XRD pattern of 1 wt% CuO_x/MnO_x sample, the peaks of CuO or Cu_2O can't be detected in the pattern, as the same as the MO_x/SMO samples.

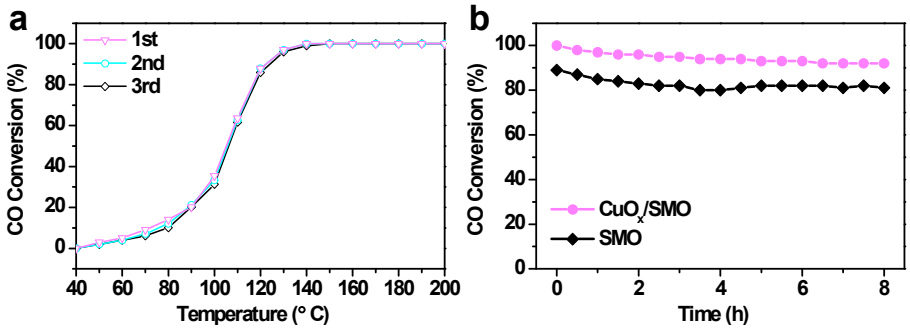

Fig. S4 (a) Reusability test for CO oxidation over CuO_x/SMO, the sample had been repeatedly tested for three times; (b) catalytic performance at 160 °C for CO oxidation versus time on line over the CuO_x/SMO and bare SMO, the feed gas was the same with that in the activity tests (1.3 %CO/10 $\%O_2/N_2$ at 100 ml min^{-1}, with a space velocity of 120000 ml g^{-1} h^{-1}).

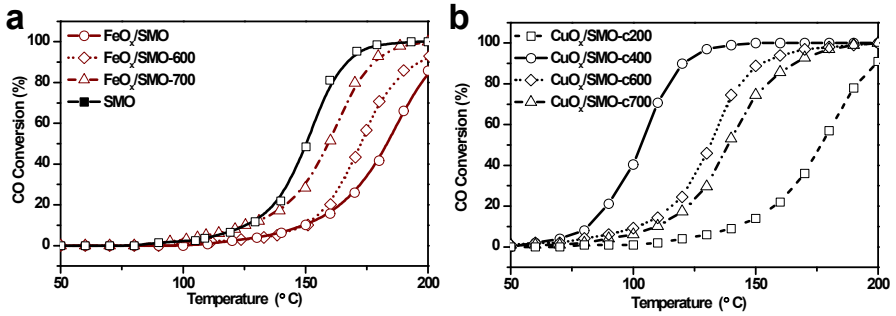

Fig. S5 Light off CO oxidation curves of (a) FeO_x/SMO, FeO_x/SMO-600, FeO_x/SMO-700 and bare SMO, where FeO_x/SMO-600 and FeO_x/SMO-700 are ascribed to FeO_x/SMO samples annealed at 600 and 700 °C in static air for 2h; (b) CuO_x/SMO samples which were calcined at 400, 600 and 700 °C for 4h after the precipitation process (in the catalysts preparation).

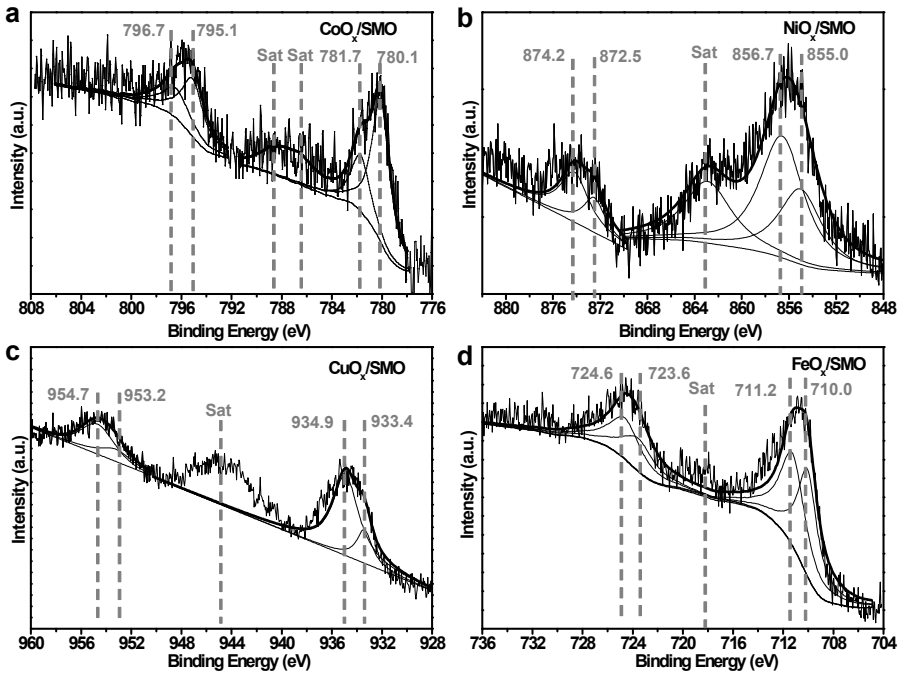

Fig. S6 XPS patterns of (a) Co 2p (b) Ni 2p (c) Cu 2p (d) Fe 2p over MO_x/SMO samples. Sat stand for the satellite peak.

The XPS pattern of Co, Ni and Cu in MO_x/SMO is given in Fig. S4. For Co 2p core levels, peak at 780.1 and 795.1 eV is assigned to Co^3, the 781.7 and 796.7 eV is assigned to Co^{2+}.[1] For Ni 2p core levels, peak at 855.0 and 872.5 eV is assigned to Ni^{2+}, the 856.7 and 874.2 eV is assigned to Ni^{3+}.[2,3] For Cu 2p core levels, peak at 933.4 and 953.2 eV is assigned to Cu^{+}, the 934.9 and 954.7 eV is assigned to Cu^{2+}.[4,5] For Fe 2p core levels, peak at 710.0 and 723.6 eV is assigned to Fe^{2+}, the 711.2 and 724.6 eV and is assigned to Fe^{3+}.[6,7]

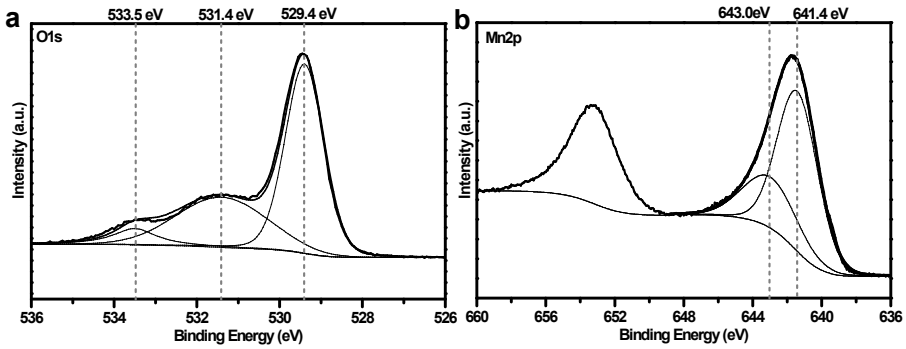

Fig. S7 XPS patterns of pure MnO_x.

The XPS pattern of Mn 2p and O 1s over pure MnO_x is shown in Fig. S5. Peak at 641.4 eV is identified as Mn^{3+} and the 643.0 eV is referred to Mn^{4+}, The atomic ratio of Mn^{4+}/Mn^{3+} in MnO_x is 0.43, the molar ratio of O_{ads}/O_{latt} is 0.59. For either MnO_x or bare SMO, their Mn^{4+}/Mn^{3+} atomic ratio is much lower than that of MnO_x/SMO catalyst.

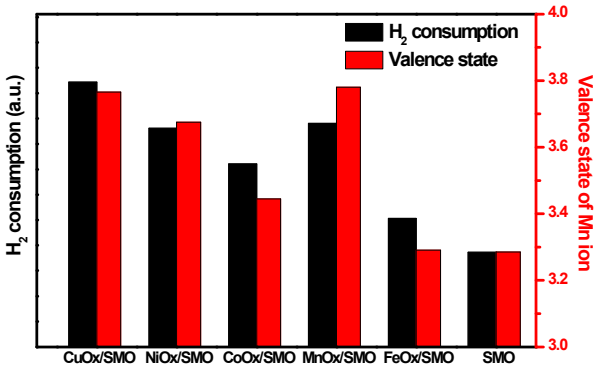

Fig. S8 H_2 consumptions in the reduction process of "Mn^{4+} to Mn^{3+}" and the average valence states of Mn ion over the MO_x/SMO composites and pure SMO sample.

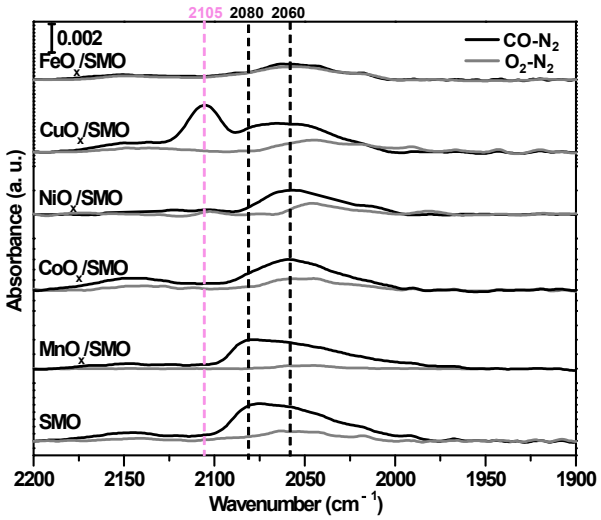

Fig. S9 linear CO adsorption spectra of MO_x/SMO and SMO.

Linear CO adsorption spectrum of MOx/SMO series catalysts is shown in Fig. S6. The CO adsorption band on Mn can be observed over all SMO samples, which is located around 2080 [1] and 2060 cm^{-1} [8,9]. Among loaded MO_x/SMO, additional lineal CO adsorption only appears over CuO_x-SMO catalyst at 2105 cm^{-1}, it's indicated by CO adsorption on Cu^+ [10,11].

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