Electronic Supplementary Information (ESI)

In-situ decorated MOFs-derived Mn-Fe oxides on Fe mesh as novel monolith catalysts for NO_x reduction

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Catalyst preparation

Mn-Fe-coprecipitation catalysts

The Mn-Fe-coprecipitation monolith catalysts were obtained by “classical urea assist method”, which was listed as following: 0.337g $MnCl_2 \cdot 4H_2O$, 0.229g $Fe(NO_3)_3. \cdot 9H_2O$ and 0.60g $CO(NH_2)_2$ were dissolved in 56 mL deionized water. After stirring for 20 minutes, the homogeneous solution was transferred to a 100 mL Teflon-lined stainless steel autoclave with the pretreated iron meshes, sealed and maintained at 120 °C for 24 hours. Then, the products were cooled down to room temperature naturally and washed by absolute ethanol and deionized water. Subsequently, the sample was dried in a vacuum oven 60 °C for 12 hours. Finally, the obtained products were calcined in air at 450 °C for 2 h with a ramping rate of 1 °C / min.

Mn-Fe@ceramics catalysts

The Mn-Fe@ceramics catalysts were obtained by a impregnation method: 0.337g $MnCl_2.4H_2O$, 0.229g $Fe(NO_3)_3.9H_2O$ and 0.60g $CO(NH_2)_2$ were dissolved in 56 mL deionized water. After stirring for 20 minutes, the honeycomb ceramics were transferred to a homogeneous phase. Then, the obtained honeycomb ceramics coated with Mn-Fe mixture were dried in a vacuum oven 120 °C for 24 hours. Finally, the products were calcined in air at 450 °C for 2 h with a ramping rate of 1 °C/min and then cooled down to room temperature naturally. The products were donated as Mn–Fe@ceramics catalysts.

Catalyst Characterization

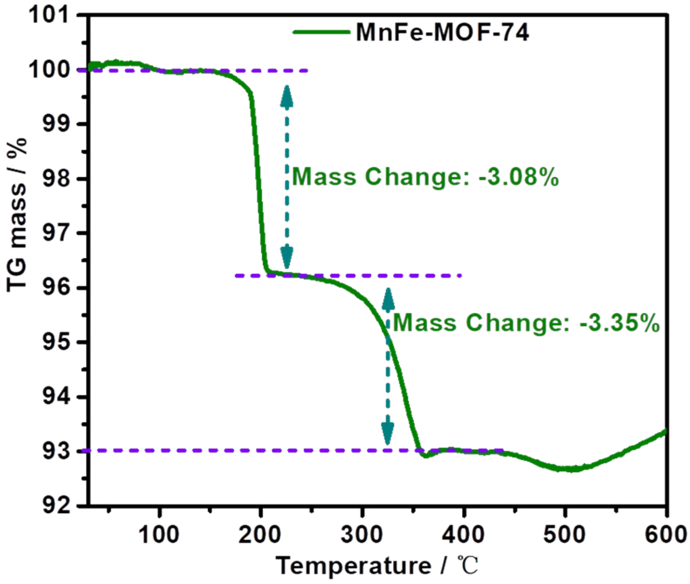

Fig. S1 TG profiles of MnFe-MOF-74 precursors on Fe mesh in air flow with a ramp of 10 °C / min.

The decomposition process of the MnFe-MOF-74 precursor on Fe mesh presented two different weight-loss steps, which was corresponded to the evaporation of crystal water (20-250 °C) and the oxidation of the precursor (300-400°C), respectively. According to the TGA curve, the MnFe-MOF-74 precursor was annealed to convert into Mn-Fe-in situ catalysts at 450 °C for 2 h.

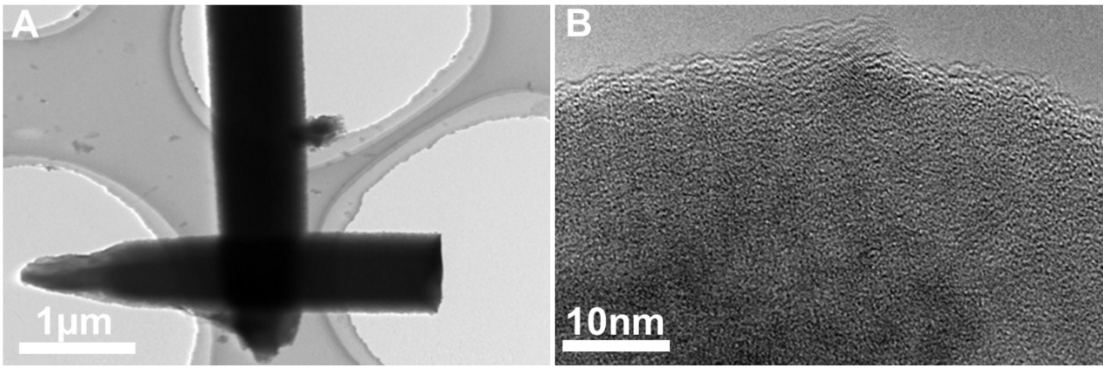

Fig. S2 (A) TEM and (B) HR-TEM images of MnFe-MOF-74 precursors on Fe mesh.

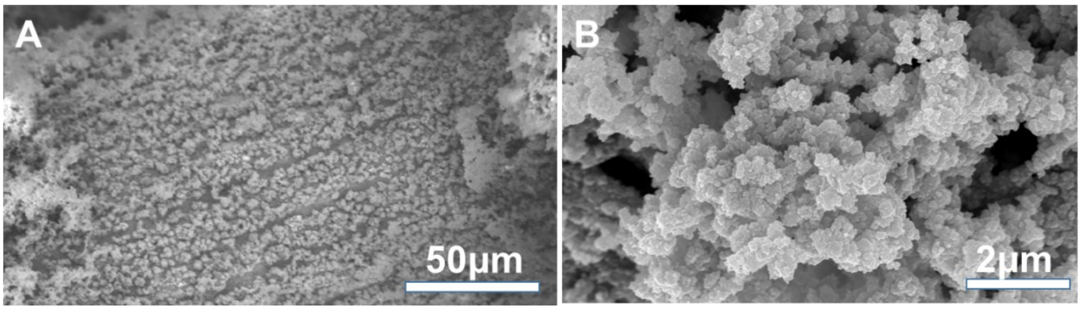

Fig. S3 SEM images of Mn-Fe-coprecipitation catalysts at (A) low magnification and (B) high magnification.

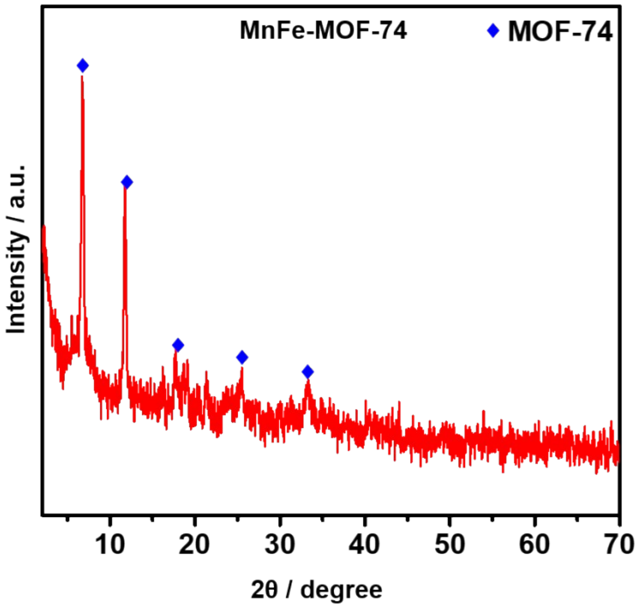

Fig. S4 XRD patterns of MnFe-MOF-74 precursors on Fe mesh.

We scraped the MnFe-MOF-74 power from Fe mesh to do the XRD test due to the convenient test in XRD machine. Therefore, no peaks of Fe mesh were observed in Fig. S4.

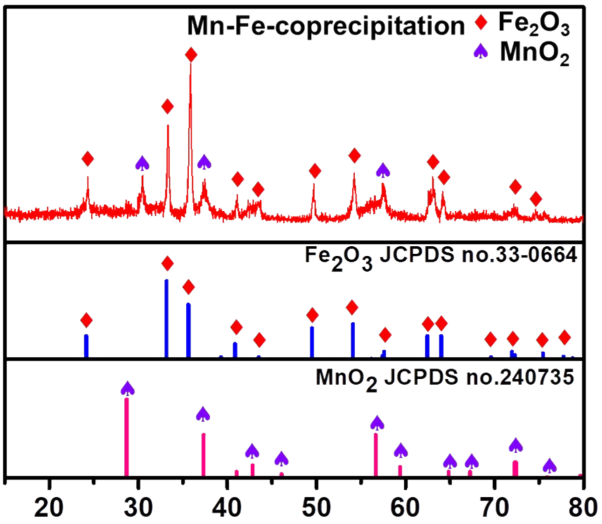

Fig. S5 XRD patterns of Mn-Fe-coprecipitation catalysts.

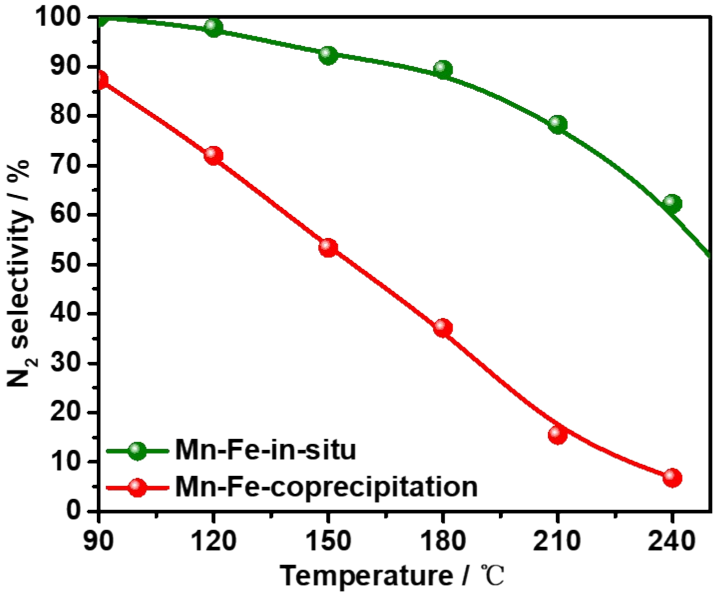

Fig. S6 Plots of N_2 selectivity *versus* temperature for Mn-Fe-in-situ and Mn-Fe-coprecipitation catalysts. Reaction conditions: 500 ppm NO, 500 ppm NH_3, 5 vol % O_2, N_2 as the balance gas, GHSV: 10 000 h^{-1}.

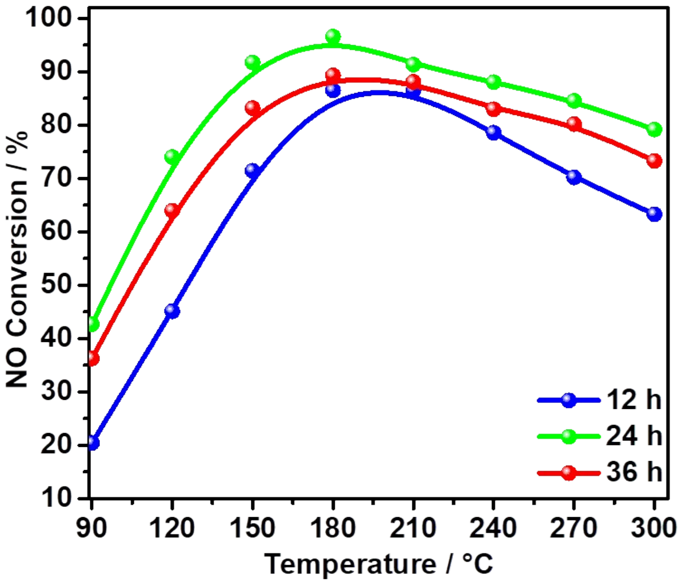

Fig. S7 Plots of NO conversion *versus* temperature for Mn-Fe-in-situ catalysts with different hydrothermal reaction time. Reaction conditions: 500 ppm NO, 500 ppm NH_3, 5 vol % O_2, N_2 as the balance gas, GHSV: 10000 h^{-1}.

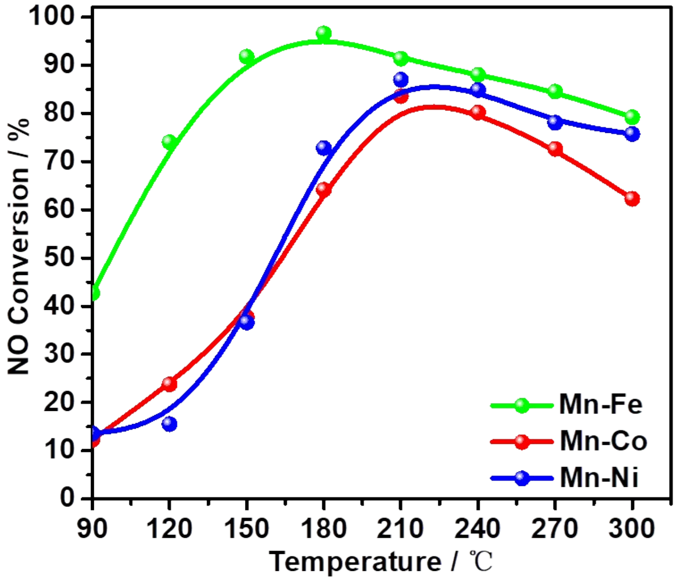

Fig. S8 Plots of NO conversion *versus* temperature of catalysts with different metal reactants: Fe, Co and Ni. Reaction conditions: 500 ppm NO, 500 ppm NH_3, 5 vol % O_2, N_2 as the balance gas, GHSV: 10 000 h^{-1}.

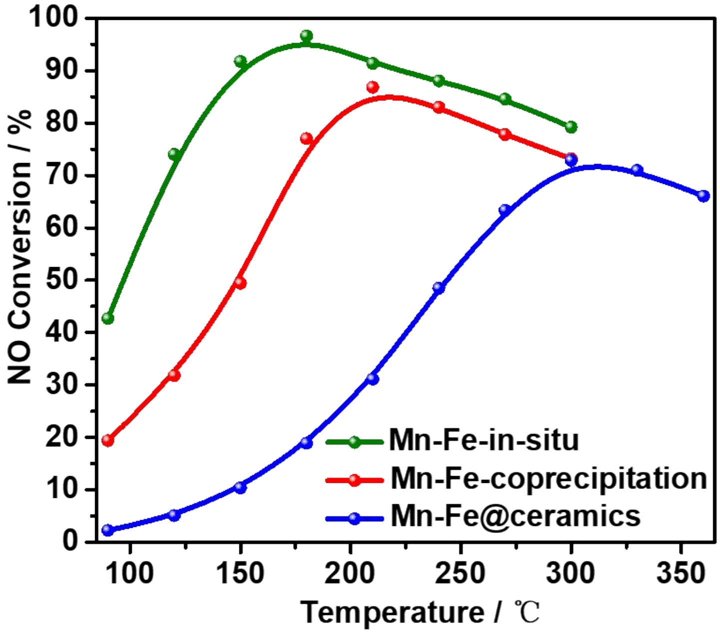

Fig. S9 Plots of NO conversion *versus* temperature of Mn-Fe-in-situ, Mn-Fe-coprecipitation and Mn-Fe@ceramics monolith catalysts. Reaction conditions: 500 ppm NO, 500 ppm NH_3, 5 vol % O_2, N_2 as the balance gas, GHSV: 10 000 h^{-1}.

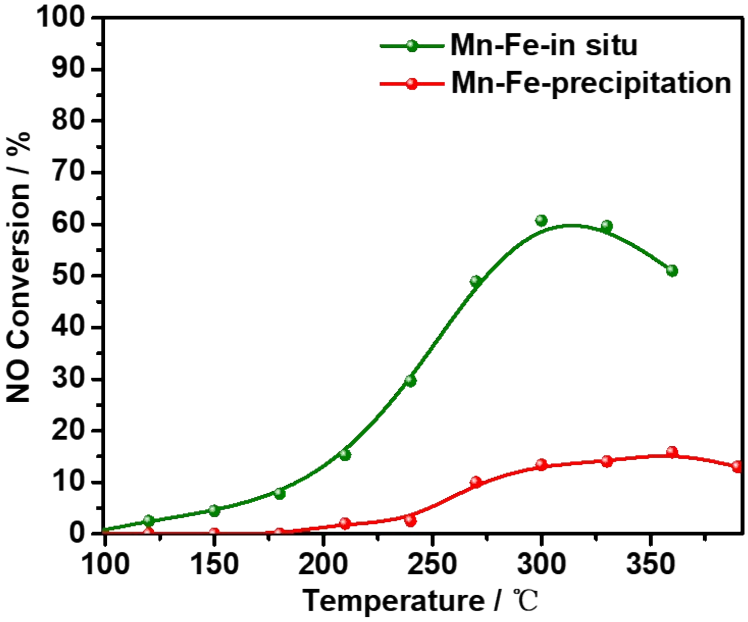

Fig. S10 NO oxidation *versus* temperature of Mn-Fe-in-situ and Mn-Fe-coprecipitation monolith catalysts. Reaction conditions: 500 ppm NO, 5 vol % O_2, N_2 as the balance gas, GHSV: 10 000 h^{-1}.

As shown in Fig. S10, the Mn-Fe-in-situ catalysts showed a better NO oxidation capacity than Mn-Fe-coprecipitation catalysts, which resulted from the strong synergy effect of the Mn-Fe active sites. The strong NO oxidation capacity was beneficial to the formation of NO_2 species that enabled the “Fast-SCR” reaction.