Electronic Supplementary Information

Improved NH_3-SCR activity by the cooperation of $FeVO_4$ and CeO_2 nanosheets catalyst: Structure and mechanism

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1. Preparation steps of $FeVO_4$, CeO_2-S and CeO_2-P

$FeVO_4$ was synthesized by a modified hydrothermal method. In a typical procedure, 6 mmol NH_4VO_3 and 6 mmol $Fe(NO_3)_3\cdot 9H_2O$ were dissolved in 30 ml deionized water respectively, and NH_4VO_3 solution was heated to 80 °C to accelerate its dissolving. NH_4VO_3 solution was added to the $Fe(NO_3)_3$ solution at a constant stirring rate of 800 rpm. The pH of the above solution was adjusted to 2 by dropping dilute nitric acid or ammonia water and it was filled to 75 mL with deionized water. After 3 h of stirring, the solution was transferred to a Teflon-lined stainless-steel autoclave and remained for 6 h at 180 °C. After cooling to room temperature, the precipitates were centrifuged and then dried at 60 °C for 12 h, the dried mixtures were calcined at 500 °C in air for 5 h.

CeO_2 nanosheets (named as CeO_2-S) were prepared by precipitation method. 1.39 g $Ce(NO3)_3\cdot 6H_2O$ and 0.75 g NH_4HCO_3 were dissolved in 200 mL deionized water, respectively. Then, the NH_4HCO_3 solution was quickly poured into the $Ce(NO_3)_3$

solution, and the mixed solution was stirred for 30 min. After that, it was left at room temperature for 15 h. After centrifugation, the sample was dried at 60 °C for 12 h. The dried sample was heated to 450 °C at a rate of 2 °C/min in muffle furnace, and kept at 450 °C for 4 h. CeO_2 nanoparticles (named as CeO_2-P) as comparison samples were also prepared by precipitation method. 1 mol/L $Ce(NO_3)_3$ solution and 1 mol/L ammonia solution were prepared, and the ammonia solution was dropped into the $Ce(NO_3)_3$ solution at a rate of 3 mL/min under intense stirring until pH = 10. After 1.5 h of stirring, the solution was left standing for 3 h. The precipitate was collected by centrifugation, then dried and calcined as described above.

2. Tables

Table S1. Specific surface area and S content of fresh and used 10%FeV/CeO_2-S after SO_2 resistance test.

	S_{BET}	S element content detected by XRF
Fresh	53.6 m^2/g	——
Used	7.9 m^2/g	0.5 wt.%

Table S2. The average grain size of the prepared catalysts calculated by Scherrer equation.

Sample	Grain size (nm)
CeO_2-P	12.1
CeO_2-S	7.1
CeO_2-S-500	8.5
5%FeV/CeO_2-S	7.4
10%FeV/CeO_2-S	8.1
10%FeV/CeO_2-P	11.6
15%FeV/CeO_2-S	8.0
20%FeV/CeO_2-S	9.5

3. Figures

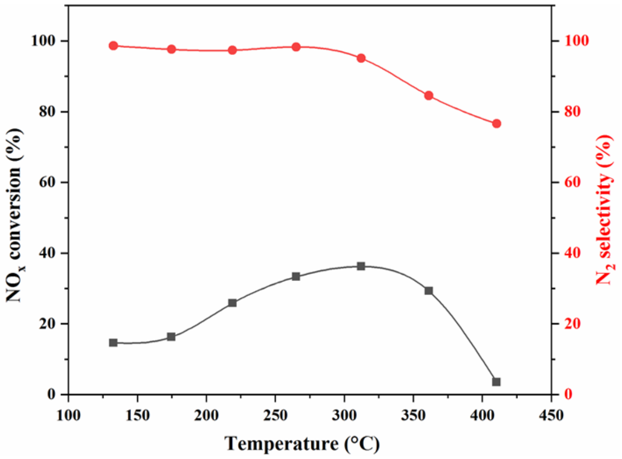

Fig. S1 NO$_x$ conversion and N$_2$ selectivity of CeO$_2$-S. Reaction conditions: [NO] = 500 ppm, [NH$_3$] = 500 ppm, [O$_2$] = 5 vol.%, balance N$_2$, 150 mg catalyst, GHSV = 80,000 mL ·g^{-1}·h^{-1}.

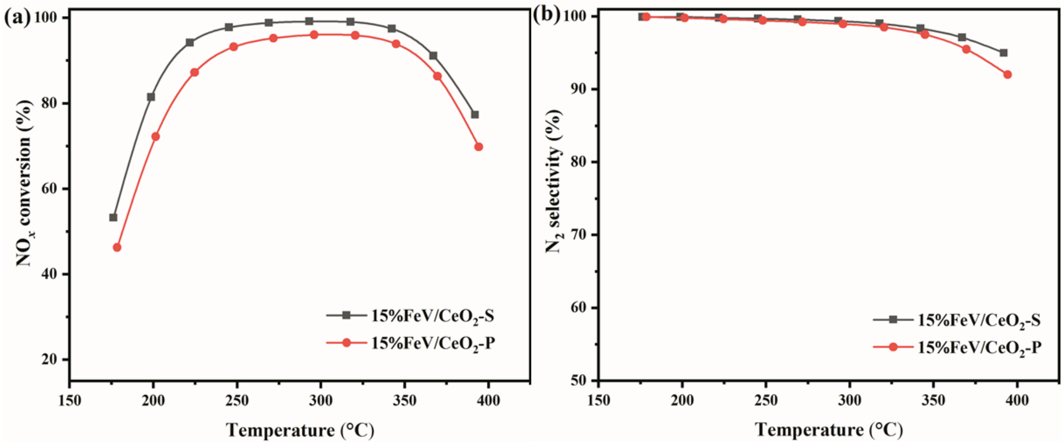

Fig. S2 (a) NO$_x$ conversion and (b) N$_2$ selectivity of 15%FeV/CeO$_2$-S and 15%FeV/CeO$_2$-P. Reaction conditions: [NO] = 500 ppm, [NH$_3$] = 500 ppm, [O$_2$] = 5 vol.%, balance N$_2$, 150 mg catalyst, GHSV = 80,000 mL ·g^{-1}·h^{-1}.

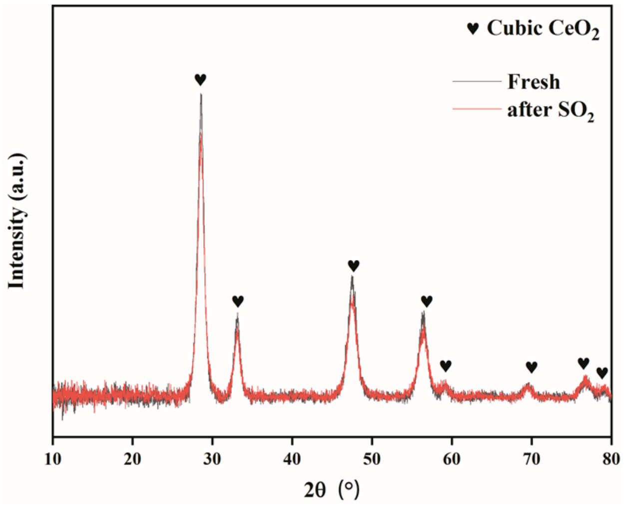

Fig. S3 XRD patterns of fresh 10%FeV/CeO_2-S and 10%FeV/CeO_2-S poisoned by SO_2.

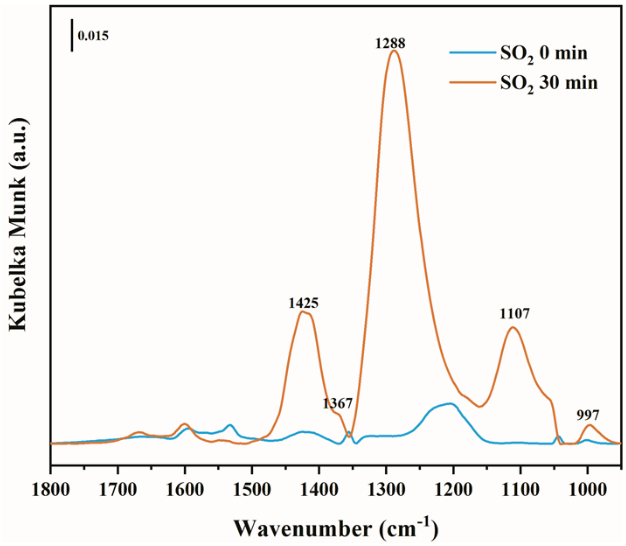

Fig. S4 In situ DRIFTS spectra of SO_2 + O_2 adsorption after the reaction between NO_x species and NH_3 over 10%FeV/CeO_2-S catalyst.

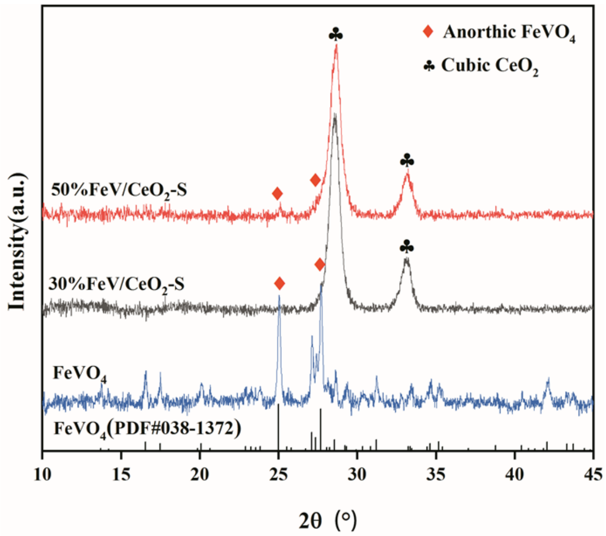

Fig. S5 XRD patterns of $FeVO_4$, 30%FeV/CeO_2-S and 50%FeV/CeO_2-S catalysts.

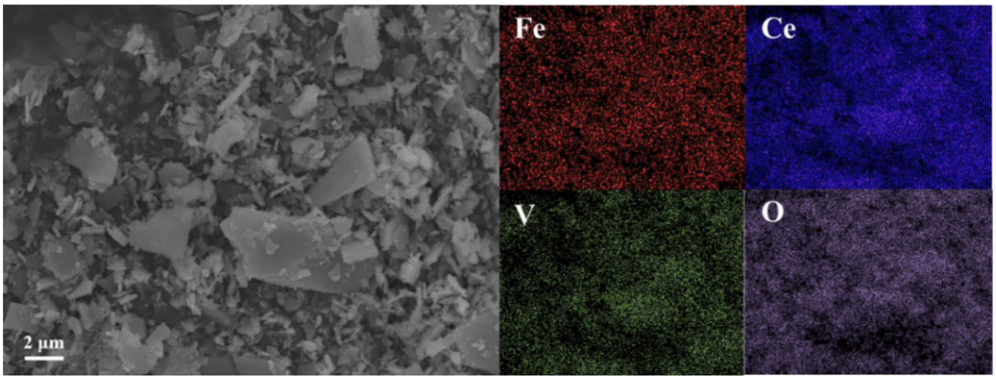

Fig. S6 EDS-mapping images of 10%FeV/CeO_2-S.

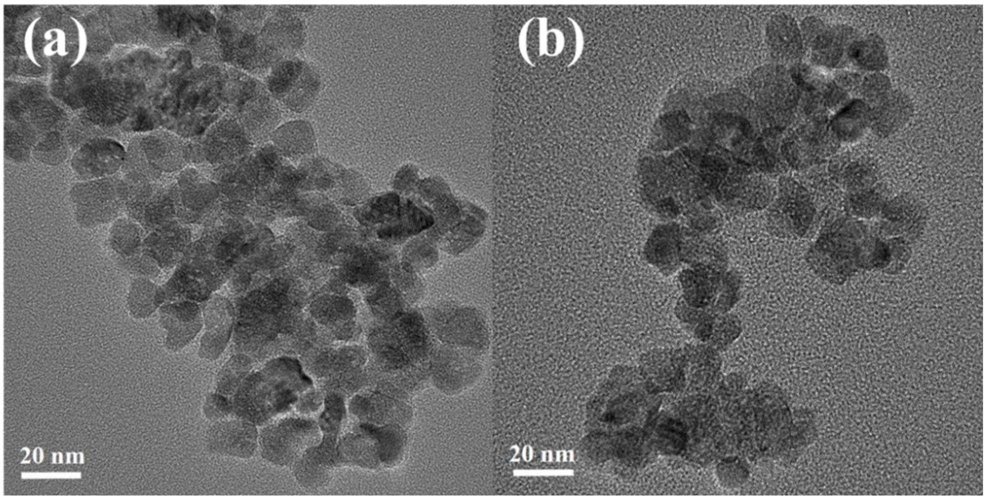

Fig. S7 TEM images of (a) CeO_2-P and (b) 10%FeV/CeO_2-P catalysts.

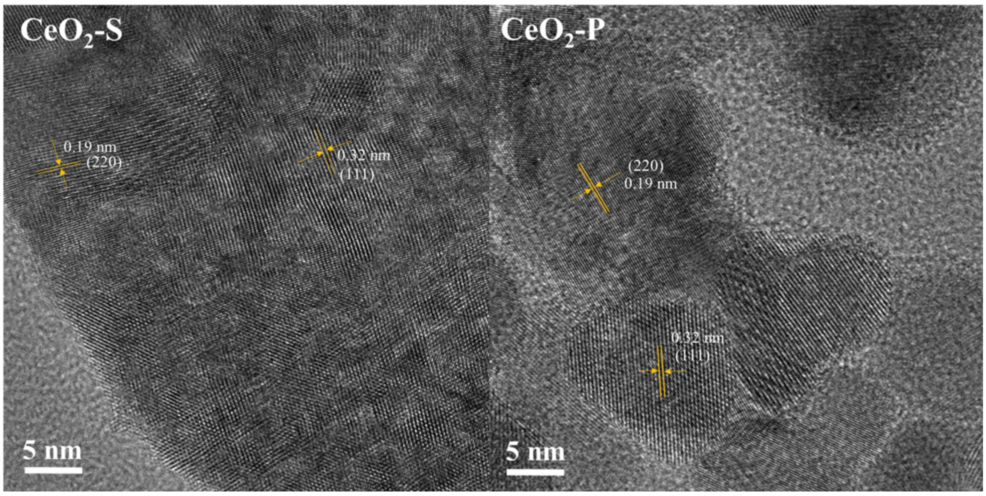

Fig. S8 HR-TEM images of CeO$_2$-S and CeO$_2$-P catalysts.

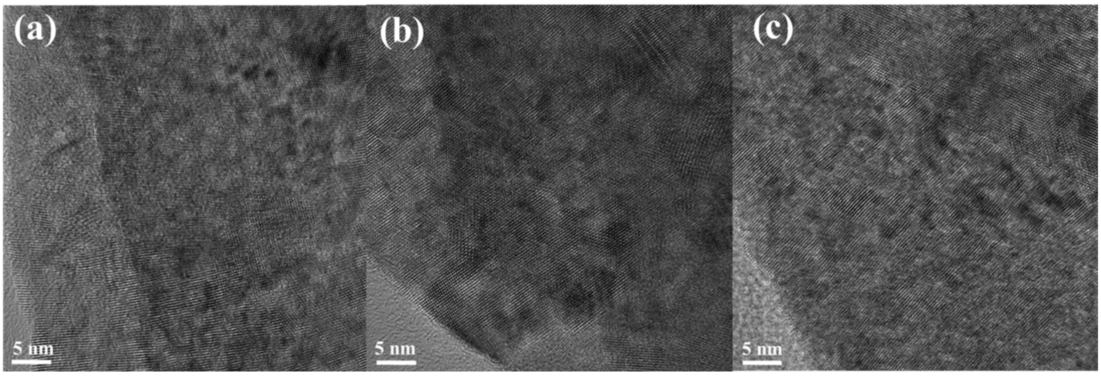

Fig. S9 HR-TEM images of CeO$_2$-S catalysts.

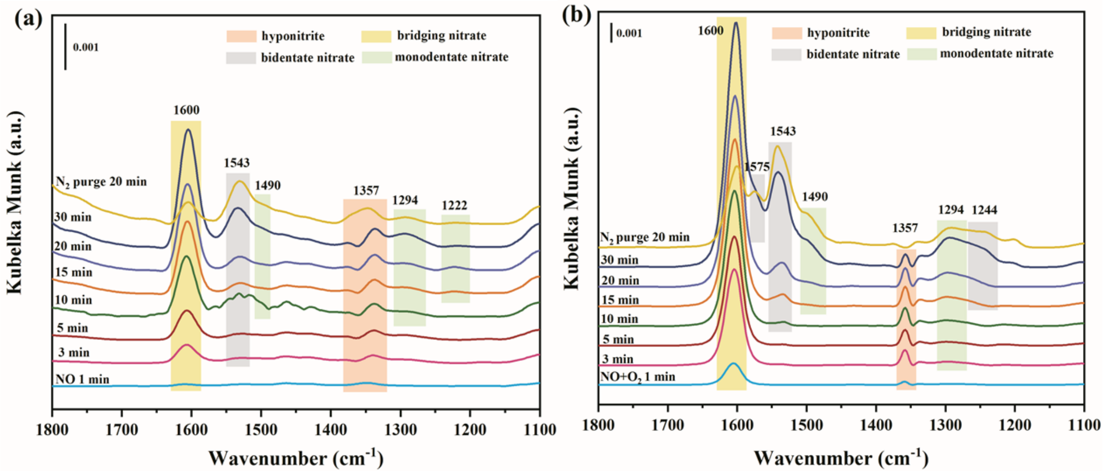

Fig. S10 *In situ* DRIFT spectra of 10%FeV/CeO$_2$-S obtained during exposure to (a) 500 ppm NO for 30 min followed by 20 min N$_2$ purge, and (b) 500 ppm NO + 5% O$_2$ for 30 min followed by 20 min N$_2$ purge at 250 °C.

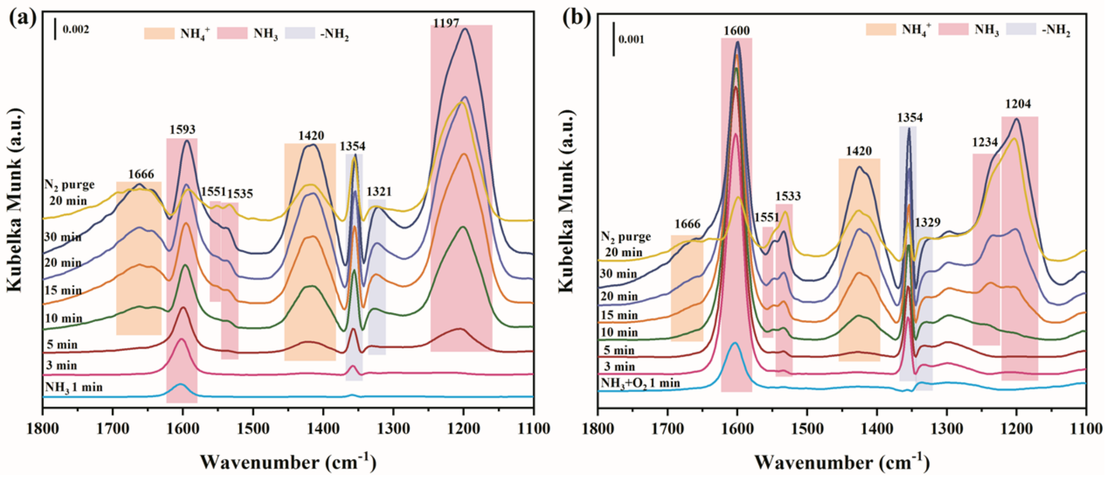

Fig. S11 *In situ* DRIFT spectra of 10%FeV/CeO$_2$-S obtained during exposure to (a) 500 ppm NH$_3$ for 30 min followed by 20 min N$_2$ purge, and (b) 500 ppm NH$_3$ + 5% O$_2$ for 30 min followed by 20 min N$_2$ purge at 250 °C.

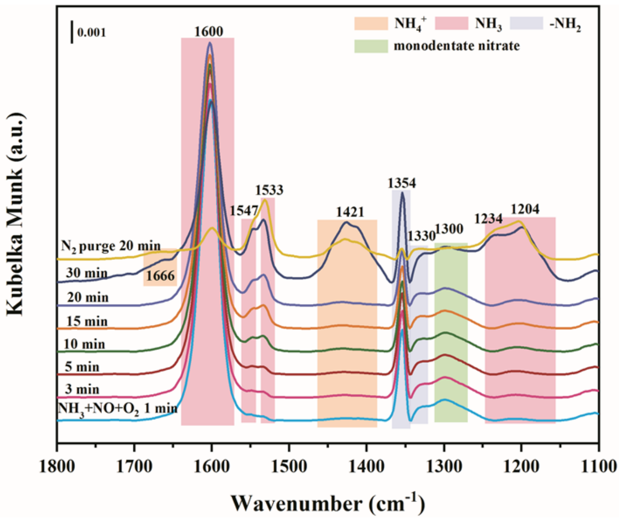

Fig. S12 *In situ* DRIFT spectra of 10%FeV/CeO$_2$-S obtained during exposure to 500 ppm NH$_3$ + 500 ppm NO + 5% O$_2$ for 30 min followed by 20 min N$_2$ purge at 250 °C.

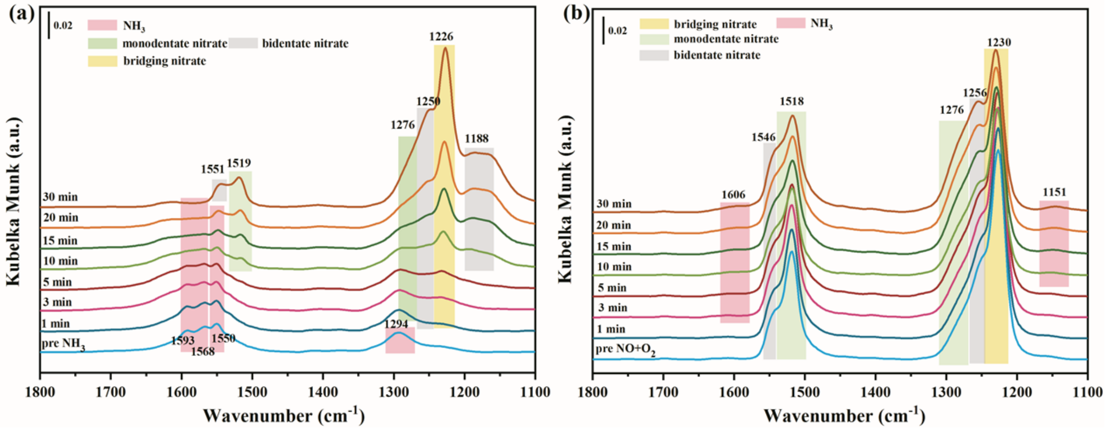

Fig. S13 *In situ* DRIFT spectra of CeO_2-S obtained during exposure to (a) 500 ppm NO + 5% O_2 after pre-adsorption of 500 ppm NH_3 for 30 min followed by 20 min N_2 purge, and (b) 500 ppm NH_3 after pre-adsorption of 500 ppm NO + 5% O_2 for 30 min followed by 20 min N_2 purge at 250 °C.

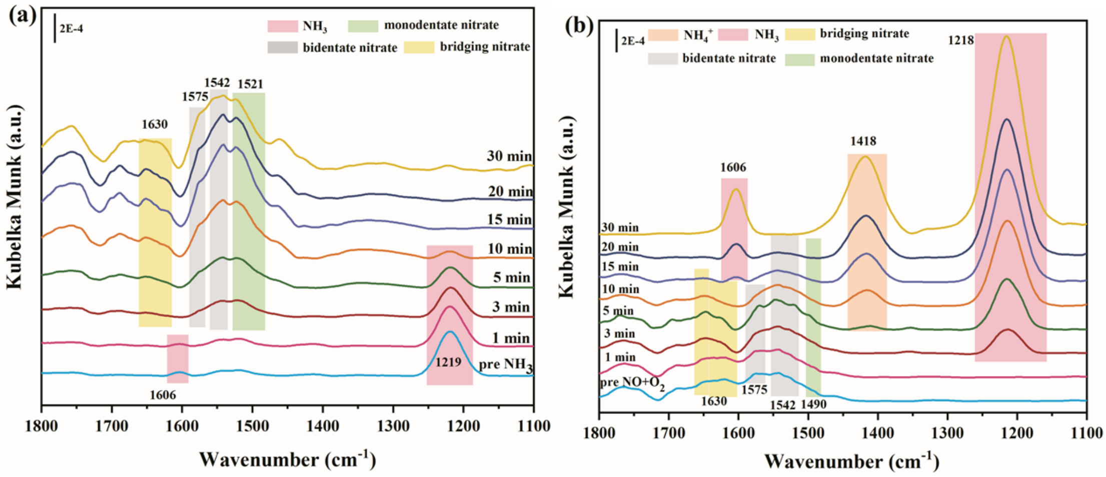

Fig. S14 *In situ* DRIFT spectra of $FeVO_4$ obtained during exposure to (a) 500 ppm NO + 5% O_2 after pre-adsorption of 500 ppm NH_3 for 30 min followed by 20 min N_2 purge, and (b) 500 ppm NH_3 after pre-adsorption of 500 ppm NO + 5% O_2 for 30 min followed by 20 min N_2 purge at 250 °C.

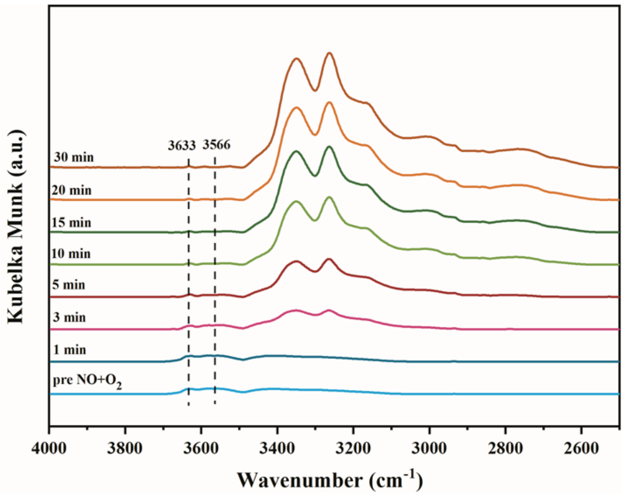

Fig. S15 *In situ* DRIFT spectra at 4000-2500 cm^{-1} of reaction between NH_3 and pre-adsorbed NO + O_2 over 10%FeV/CeO_2-S at 250 °C.