

Supporting Information

1. Mass transfer impact

Generally, it is believed that interphase mass transfer is much less significant than the intraphase (Scott Fogler, 1987), herein, intraphase mass transfer will be discussed here to evaluated its impact.

A common criterion is based on Weisz-Prater number N_{W-P} , which is used to evaluate the impact of intraphase(Scott Fogler, 1987). The criterion is as below:

$$N_{W-P} = \frac{rR_p^2}{C_s D_{\text{eff}}} \leq 0.3 \quad (\text{S1})$$

where r is the reaction rate, R_p is the particle size, C_s is the surface concentration of the reactant, and D_{eff} is the effective diffusion coefficient. In this case, R_p is 4.25×10^{-4} m which corresponds to 40-mesh.

On the assumption that interphase mass transfer is fast enough compared with intraphase mass transfer, $C_s = C_{\text{in}}$. Effective diffusion coefficient is usually composed with bulk diffusion coefficient D_b and Knudson diffusion coefficient D_{Kn} :

$$D_{\text{eff}}^{-1} = D_b^{-1} + D_{Kn}^{-1} \quad (\text{S2})$$

In our case, the mean free path λ_g is far less than the length of the pores, which results in $D_b \gg D_{Kn}$, simplifying Equation S2 to $D_{\text{eff}} \sim D_{Kn}$. Knudson diffusion coefficient can be calculated as below:

$$D_{Kn} = v \frac{d_p}{3} \quad (\text{S3})$$

where v is the average velocity of the molecular, and d_p is the pore diameter. v can be calculated as below:

$$v = \sqrt{\frac{8k_B T}{\pi m}} \quad (\text{S4})$$

where k_B is the Boltzmann's constant, and m is the weight of the molecular.

As in Table S1, N_{W-P} is smaller than 0.3, proving that observed reaction rate constant is equal to the real reaction rate constant, due to which it can be conceived that the determination of k is free from the impact of mass transfer.

Table S1 Parameters for Weisz-Prater number of VO(acac)₂-VTi.

		r (mol/(m ³ s))	d_p (m)	D_{Kn} (m ² /s)	N_{W-P}
NO	Without CB	1.3×10^{-2}	1.7×10^{-8}	3.1×10^{-6}	3.5×10^{-2}
	With CB	1.1×10^{-2}	9.5×10^{-9}	1.6×10^{-6}	5.2×10^{-2}
CB	Without NO+NH ₃	1.1×10^{-2}	1.7×10^{-8}	1.7×10^{-6}	2.4×10^{-1}
	With NO+NH ₃	3.3×10^{-3}	9.5×10^{-9}	9.8×10^{-7}	1.4×10^{-1}

Reference

Scott Fogler H (1987). Elements of chemical reaction engineering. Chemical Engineering Science, 42(10): 2493

2. SI Figure captions

Fig. S1. CO_x selectivity of the NH₄VO₃-VTi and VO(acac)₂-VTi granular catalysts. Reaction conditions: NO 500 ppm, CB 50 ppm, NH₃ 500 ppm, O₂ 10 vol.%, N₂ as balance gas, GHSV 60,000 mL/(g·h).

Fig. S2. XRD patterns of the NH₄VO₃-VTi and VO(acac)₂-VTi granular catalysts.

Fig. S3. (a) The N₂ adsorption/desorption isotherms and (b) pore size distributions of TiO₂, NH₄VO₃-VTi and VO(acac)₂-VTi granular catalysts.

Fig. S4. NH₃-TPD profiles of NH₄VO₃-VTi and VO(acac)₂-VTi granular catalysts in the temperature range of 100-700 °C.

Fig. S5. Dependences of CB conversion on CB concentration (a) and (c) without NO+NH₃, (b) and (d) with NO+NH₃. Reaction conditions: CB 20-100 ppm, NO 500 ppm (when used), NH₃ 500 ppm (when used), O₂ 10 vol.%, N₂ as balance gas, GHSV 240,000-960,000 mL/(g·h).

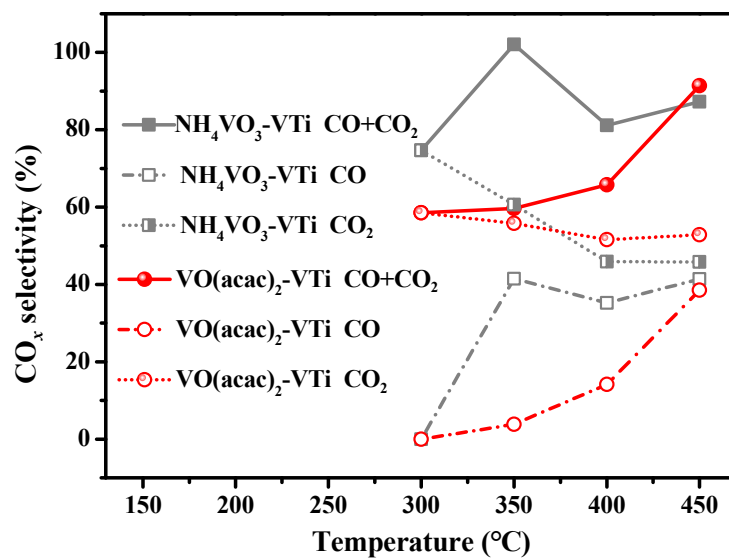


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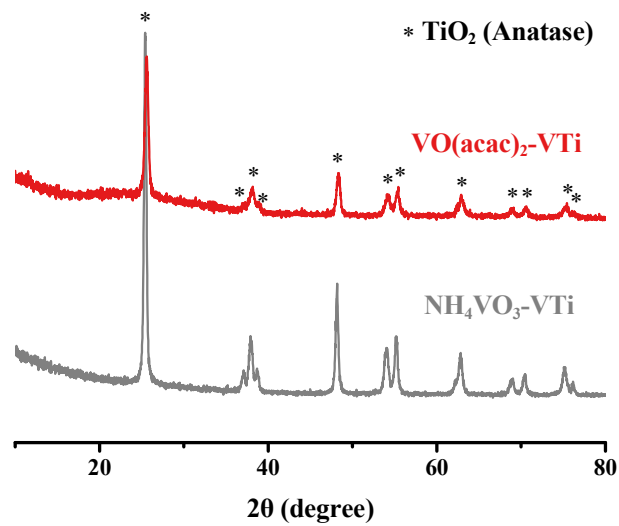


Fig. S2. XRD patterns of the $\text{NH}_4\text{VO}_3\text{-VTi}$ and $\text{VO}(\text{acac})_2\text{-VTi}$ granular catalysts.

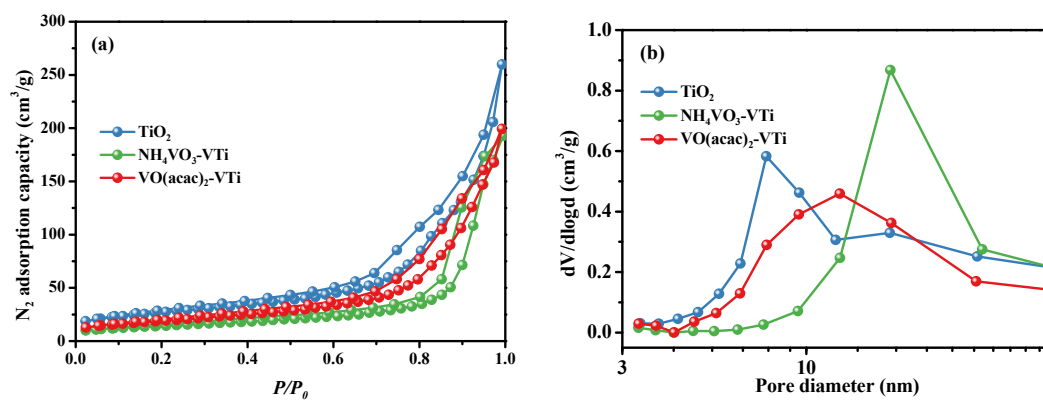


Fig. S3. (a) The N_2 adsorption/desorption isotherms and (b) pore size distributions of TiO_2 , NH_4VO_3-VTi and $VO(acac)_2-VTi$ granular catalysts.

The NH_3 temperature-programmed desorption (TPD) was used to study the species and adsorption capacity of NH_3 on the catalyst surface. The catalyst was placed in the quartz reactor and pretreated in N_2 flow at $350\text{ }^\circ\text{C}$ for 1 h. When the temperature dropped to $100\text{ }^\circ\text{C}$, $500\text{ ppm NH}_3/\text{N}_2$ was injected for 1 h with a flow rate of 100 mL/min , followed by N_2 purging for 1 h. The temperature was raised to $700\text{ }^\circ\text{C}$ at a rate of $10\text{ }^\circ\text{C/min}$. The concentration of NH_3 was detected using the Gaset DX-4000.

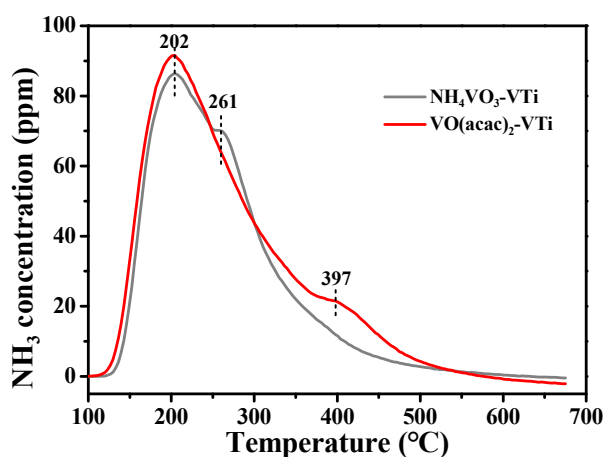


Fig. S4. NH_3 -TPD profiles of $\text{NH}_4\text{VO}_3\text{-VTi}$ and $\text{VO}(\text{acac})_2\text{-VTi}$ granular catalysts in the temperature range of $100\text{-}700\text{ }^\circ\text{C}$.

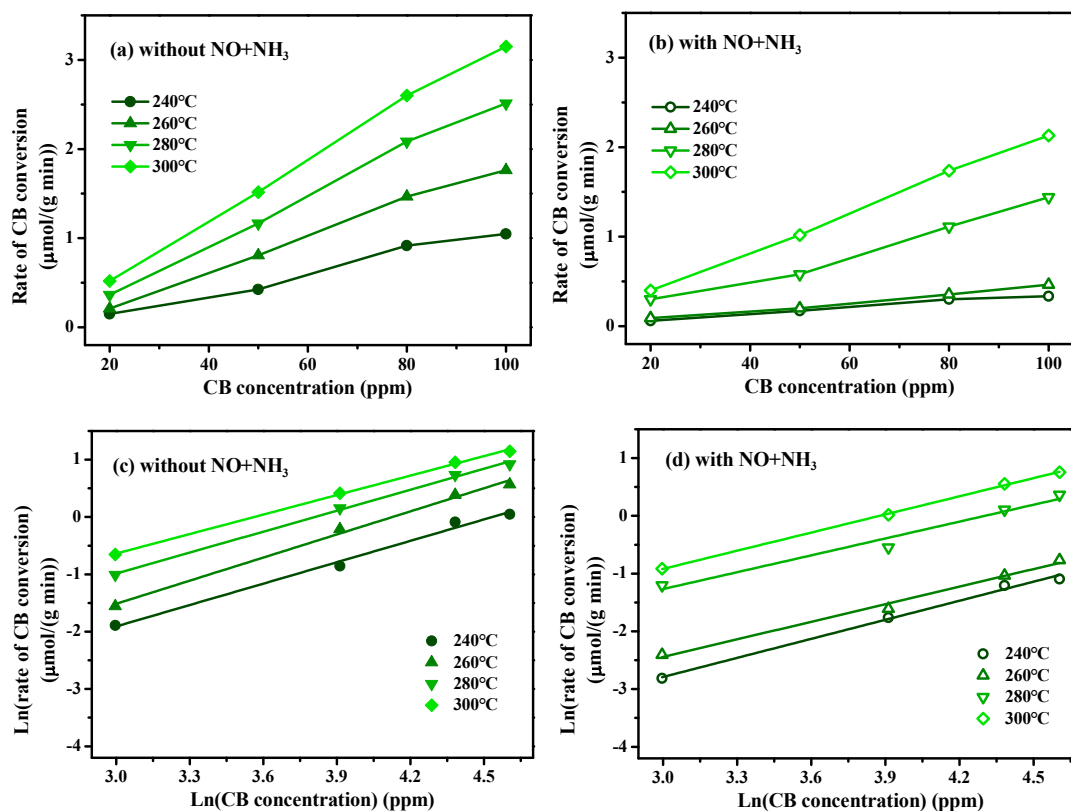


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