SUPPORTING INFORMATION

Promotion of hydrogenation activity and sulfur resistance over Ni/ASA catalyst by support modification simultaneously with P and USY

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Hydrogenation activities of the Cat-IM and Cat catalysts

Figure S1. Naphthalene hydrogenation activities of Cat and Cat-IM.

Reaction conditions: \( P = 4 \) MPa, \( GHSV = 16\text{h}^{-1} \), \( \text{H}_2/\text{oil} = 600 \) (v/v).

TEM

Figure S2. TEM results of the reductive Cat-IM and Cat catalysts.

\( \text{H}_2\text{-TPR} \)
FT-IR

To confirm that the cis-9-octadecenylamine assistant was indeed participated in the preparation of Cat catalyst, the FT-IR experiment was performed and the results were listed in Figure S4. The identical bands at 3392 cm⁻¹ and 1635 cm⁻¹ represent the stretching vibration of structural OH groups derived from the water in the air and the another identical band at about 1095 cm⁻¹ is assigned to the antisymmetric stretching vibration of Si-O-Al structures that originate from the ASA support. The new IR band at 1376 cm⁻¹ in Ni-OA/ASA (composite prior to calcination of the Cat catalyst) is designated to the symmetric deformation of -CH₃ and the rocking vibration of -CH₂- which belong to cis-9-octadecenylamine. Besides, compared with ASA and Cat-IM, Ni-OA/ASA also displays peaks at 957 cm⁻¹, 796 cm⁻¹ and 722 cm⁻¹, which are the typical adsorption peak of cis-9-octadecenylamine. Due to the decomposition of cis-9-octadecenylamine by calcining the Ni-OA/ASA sample, Cat presents only a peak at about 796 cm⁻¹ that should be residual cis-9-octadecenylamine. The above results confirm that cis-9-octadecenylamine is participated in the preparation of catalysts.
Cis-9-octadecenylamine as a lipophilic complexing agent could release OH\(^{-}\) ions under high temperature and high pressure hydrothermal environment which furtherance the hydrolysis of nickel nitrate and form Ni(OH)\(_2\) crystal particles. And the hydrothermal method makes for the decrease of preparation system viscosity that promotes the dispersion to obtain NiO particles with smaller size. The previous literature\(^1\) also reported that long alkyl chains of organic could stop from the aggregation of particles and made the metal oxides mutual separate.

![Figure S4. FT-IR spectra of the samples.](image-url)
The XRD patterns of the samples are displayed in Figure S5. From Figure S5a, it could be observed that Ni-OA/ASA presents the characteristic peaks of Ni(OH)$_2$. As seen in Figure S5b, the diffraction patterns of the oxidic catalysts display the Ni oxide lines at $2\theta = 37.5$, 43.4 and 62.7°, implying the presence of NiO. For the reductive catalyst, Cat holds Ni° characteristic peak: 44.4 and 51.7°. The above results imply that the cis-9-octadecenylamine-assisted catalyst is formed by the following process: Ni-cis-9-octadecenylamine complex/ASA (mixture process) $\rightarrow$ Ni(OH)$_2$/ASA (hydrothermal process) $\rightarrow$ NiO/ASA (calcination process) $\rightarrow$ Ni/ASA (reduction process).

Figure S5. XRD patterns of the Ni-OA/ASA sample (a) and the support and oxidic and reductive Cat catalyst (b).
Figure S6. N₂ adsorption-desorption isotherms of ASA, Cat and Cat-IM.

References: