



Ceria-boosted Ni/Al₂O₃ catalysts for enhanced H₂ production via acetic acid dry reforming

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ABSTRACT

Acetic acid dry reforming (ADR) is a promising route for sustainable H₂ generation. However, coke inhibition during ADR is the main challenge and not resolved by using suitable promoted catalysts. In this work, Ce promotion on 10%Ni/Al₂O₃ catalysts with 1–5 wt%Ce was evaluated for ADR at varied temperatures of 923–998 K and stoichiometric feed in a fixed-bed rig. CeO₂ addition of 1–3% enhanced metal dispersion, and surface area whilst basic CeO₂ character significantly boosted the concentration and density of basic sites on catalysts. Particularly, the CO₂ uptake of promoted catalysts was about 2.49–3.73 times greater than that of counterpart sample. CH₃COOH and CO₂ conversions were enhanced with rising Ce loading and the highest reactant conversions were observed at 3 wt%Ce. The improved adsorption of acidic CH₃COOH and CO₂ molecules due to increasing amount of basic sites as well as redox attributes of CeO₂ promoter could be responsible for the enhancement in ADR activity and yield of H₂ and CO. The mechanistic two-step pathway for coke suppression induced by CeO₂ promotion was elaborated in this work. Generally, carbonaceous species formation on 3% Ce–10%Ni/Al₂O₃ was considerably reduced about 1.6–2.0 times. H₂/CO ratio varied from 0.59 to 0.65 relying on ADR temperature over 3%Ce–10%Ni/Al₂O₃. These H₂/CO values, two times higher than theoretical H₂/CO ratio in ADR, are compatible for downstream gas-to-liquid processes to selectively yield high molecular weight olefins. Water formation rate increased from 8.67 × 10⁻⁶ to 4.71 × 10⁻⁵ mol_{H₂O} g_{cat}⁻¹ s⁻¹ with rising temperature within 923–998 K on 3%Ce–10%Ni/Al₂O₃.

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