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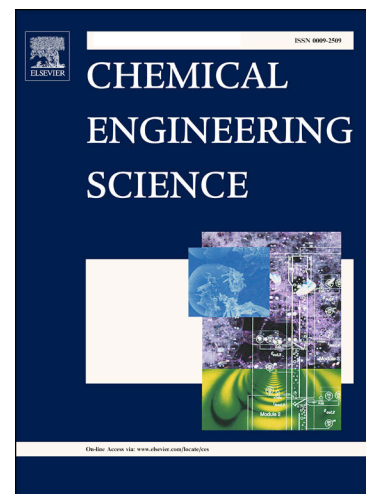
Elucidating the Mechanism of Fast Cycling NO_x Storage and Reduction Using C₃H₆ and H₂ as Reductants

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Elucidating the Mechanism of Fast Cycling NO_x Storage and Reduction Using C₃H₆ and H₂ as Reductants

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Abstract

A focused experimental study describes fast cycling NO_x storage and reduction (NSR) with H₂ and C₃H₆ as reductants on a Pt/BaO/CeO₂/Al₂O₃ lean NO_x trap (LNT) catalyst for emission control of lean burn vehicles. The results provide insight and deeper understanding of the impact of cycle frequency on the LNT performance and underlying NSR mechanism, with particular focus on whether a new NO_x reduction pathway emerges when hydrocarbon reductant is used. Differentiation is made between two NO_x conversion enhancement mechanisms — the conventional NSR mechanism with improved NO_x storage utilization and a hydrocarbon-intermediate mechanism. A comparison of cycle-average NO_x conversion using H₂ and C₃H₆ as reductants at the same lean/rich stoichiometry level provides revealing information. Both aerobic + anhydrous and anaerobic + anhydrous propylene-containing feeds enable an estimate of the contribution of H₂-generating water-gas shift and propylene steam reforming. The observed NO_x conversion enhancement of up to 45% (absolute) with 10x faster cycling is independent of reductant type and is attributed to improved NO_x storage utilization. Exothermic heat effects with temperature rise as high as 275 °C and significant temperature spatial gradients are encountered with H₂ during slow cycling, which makes H₂ an unexpectedly less effective reductant than C₃H₆. The hydrocarbon-intermediate pathway is shown to be responsible for a smaller fraction of the NO_x conversion enhancement encountered during fast cycling.

Keywords: Propylene; NO_x Reduction; NO_x Storage; Lean NO_x trap; Platinum

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