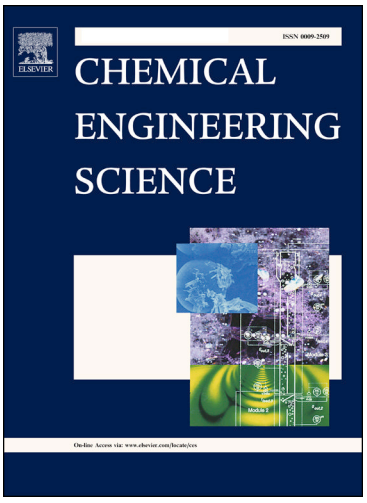

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PII: S0009-2509(18)30318-X
DOI: https://doi.org/10.1016/j.ces.2018.05.021
Reference: CES 14230

To appear in: *Chemical Engineering Science*

Received Date: 18 December 2017
Revised Date: 7 May 2018
Accepted Date: 12 May 2018

Please cite this article as: A. Wei-Lun Ting, M.P. Harold, V. Balakotaiah, Elucidating the Mechanism of Fast Cycling NOx Storage and Reduction Using C_3H_6 and H_2 as Reductants, *Chemical Engineering Science* (2018), doi: https://doi.org/10.1016/j.ces.2018.05.021

Elucidating the Mechanism of Fast Cycling NOx Storage and Reduction Using C_3H_6 and H_2 as Reductants

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Abstract

A focused experimental study describes fast cycling NOx storage and reduction (NSR) with H_2 and C_3H_6 as reductants on a $Pt/BaO/CeO_2/Al_2O_3$ lean NOx 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 NOx reduction pathway emerges when hydrocarbon reductant is used. Differentiation is made between two NOx conversion enhancement mechanisms — the conventional NSR mechanism with improved NOx storage utilization and a hydrocarbon-intermediate mechanism. A comparison of cycle-average NOx conversion using H_2 and C_3H_6 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 H_2-generating water-gas shift and propylene steam reforming. The observed NOx conversion enhancement of up to 45% (absolute) with 10x faster cycling is independent of reductant type and is attributed to improved NOx storage utilization. Exothermic heat effects with temperature rise as high as 275 ^oC and significant temperature spatial gradients are encountered with H_2 during slow cycling, which makes H_2 an unexpectedly less effective reductant than C_3H_6. The hydrocarbon-intermediate pathway is shown to be responsible for a smaller fraction of the NOx conversion enhancement encountered during fast cycling.

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