PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

BIOFUELS & ENVIRONMENTAL CATALYSIS

Investigation of Aging Mechanisms in Lean NO_x Trap Catalysts

Lean NO_x traps (LNTs), also known as NO_x Adsorber Catalysts (NACs) or NO_x Storage-Reduction (NSR) catalysts, represent a promising technology for the abatement of NO_x under lean conditions. Catalysts of this type possess dual functionality, namely, a storage function (in the form of a basic metal oxide, typically BaO), and a NO_x reduction component, typically composed of supported Pt and Rh metals. Under lean conditions NO is oxidized to NO_2 (over Pt) and stored on the metal oxide as a nitrate. Periodically a switch is made to reducing conditions, causing the NO_x to be released and converted to N_2 over the precious metal sites.

While LNTs are starting to find commercial application, the issue of catalyst durability remains problematic. LNT susceptibility to sulfur poisoning is the single most important factor determining effective catalyst lifetime. The NO_x storage element of the catalyst has a greater affinity for SO_x than it does for NO_x, and the resulting sulfate is more stable than the stored nitrate. Although this sulfate can be removed from the catalyst by means of high temperature treatment under rich conditions, the required conditions give rise to deactivation mechanisms such as precious metal sintering, total surface area loss, and solid state reactions between the various oxides present.

The principle objective of this project is to improve understanding of the mechanisms of lean NO_x trap aging. The approach utilized makes use of detailed characterization of model catalysts prior to and after aging, in tandem with measurement of catalyst performance in NO_x storage and reduction. The effect of washcoat composition on catalyst aging characteristics is studied by systematic variation of the concentration of the four main active components, Pt, Rh, CeO_2 (or CeO_2-ZrO_2) and BaO (supported on alumina). In addition to the use of standard physico-chemical analytical techniques for studying catalyst aging, advanced tools for characterizing the NO_x storage/reduction and sulfation/desulfation characteristics of the fresh (de-greened) and aged model catalysts are being employed. These tools comprise Spatially-resolved capillary-inlet Mass Spectrometry (SpaciMS), *in situ* Diffuse Reflectance Infrared Fourier Transform Spectroscopy (DRIFTS), and on-line chemical ionization mass spectrometry.

PARTICIPANTS

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SPONSORS

Kentucky Rural Energy Consortium (KREC)

Kentucky Office of Energy Policy (KOEP)

PROJECT VALUE

KREC: $101,083
KOEP: $27,302

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