Morphology and Composition cycle of BaO/Al2O3 NSR Catalysts during NO2 Uptake and Release: A multi spectroscopy and microscopy study

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Introduction

- Aimed at developing a practically useful fundamental understanding of NOx adsorber materials, especially focusing on:
  1. the NOx adsorption/desorption process over barium oxides,
  2. the behavior of barium morphology with different environment and temperature,
  3. the reactivity of H2 and CO with stored NOx.

- Studies initiated 1 year ago.

Change of barium morphology with different environment and temperature

Reduction behavior of stored NOx on Pt/BaO/Al2O3 with H2 and CO

As loading decreases

Ionic (IN) (bulk) and bridging (BN) (surface) nitrates are observed on both BaO/Al2O3 catalysts. The ratio of bridging/ionic nitrates varies with BaO loading. Al2O3-bound nitrates (AN) are also present.

Declaration of barium morphology with different environment and temperature

Decomposition of Ba(NO3)2/Al2O3: TR-XRD

BaNO3 particles completely decomposes at ~450°C
Weak BaO lines form (nano particle formation)

Analysis of TR-XRD: NOx uptake on BaO/Al2O3

TEM/EDS

The morphology cycle of BaO/Al2O3 in NO2 uptake/release

Conclusions

1. FTIR and NMR spectroscopies show the feature of three types of nitrates (on Al2O3, monolayer type and bulk type) over NO2 adsorbed BaO/Al2O3. The species have different desorption behavior.

2. Barium phase is cycling with respect to the gas environment and temperature. After NO2 adsorption, larger Ba(NO3)2 crystalline is formed upon heat treatment at 200 °C, and decomposed to form nano crystalline BaO.

3. H2 is a much more effective in reducing nitrates than CO. Especially, the surface nitrates are reduced faster at lower temperature than bulk nitrates with hydrogen. During the reduction of CO, isocyanates (-NCO) are observed and stable up to 573 K.

Acknowledgement

Financial support was provided from US DOE, Office of Freedom Car and Vehicle Technologies.