NH₃-SCR over Copper-exchanged Zeolite Y

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Introduction
Selective catalytic reduction of NOx by NH₃ (NH₃-SCR) is used as an efficient technology to eliminate NOx from the diesel exhausts. Several research groups have reported property-activity relationships for Cu-containing molecular sieves, e.g., Cu-ZSM-5 [1] or Cu-SSZ-13 [2]. Additionally, mesopores have been shown to provide high dispersion of the metal component in comparison to conventional microporous materials and thus also enhanced activity and N₂ selectivity in NH₃-SCR. However, the catalytic properties of Cu-Y has been less extensively investigated compared to other Cu-containing zeolites [3]. In view of these challenges, zeolite Y was synthesized and exposed to a variety of acid or base treatments [4]. In this study, the effect of the structural and textural properties of the zeolites on the nature and distribution of copper species and the associated catalytic properties were investigated over hierarchical micro-/mesoporous Cu-Y.

Experimental Section

Catalytic tests

NH₃/He

NO/He

O₂

SO₂/He

Fixed-bed quartz tube reactor:
- h = 20 cm
- d = 0.6 cm
- w = 0.2 g

Reaction Conditions:
- GHSV = 50,000 h⁻¹
- c(NH₃) = 500 ppm
- c(NO) = 575 ppm
- V = 120 ml min⁻¹
- c(O₂) = 4 Vol-%

Result and Discussion

• Catalyst morphology
  - Copper particles are dispersed homogeneously throughout the zeolite samples

• Copper species in catalysts
  - Charge transfer (CT) from framework oxygen to isolated Cu⁺ and/or Cu²⁺

• d-d transition - presence of aggregated CuO₄

Conclusions
- Across the investigated materials, copper species were mainly present as isolated cations (the light blue colored ion-exchanged materials) and bulky CuO clusters Cu-Y (Na₂H₂EDTA)
- The Cu²⁺ species serve as active sites for NH₃-SCR, while NH₃ is oxidized to NO over CuO sites

References