Advanced Metal-Oxide based SCR Catalysts

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Agenda

Introduction
Current stage in the development of SCR catalysts
Metal-oxide based SCR catalysts
   NO-SCR activity & aging stability
   NH$_3$ storage capacity
   HC resistance
   Start-up behaviour
Summary
Introduction
NH₃-SCR – Basic Reactions

SCR-Reactions:

4 NH₃ + 4 NO + O₂ → 4 N₂ + 6 H₂O  Standard SCR
4 NH₃ + 2 NO + 2 NO₂ → 4 N₂ + 6 H₂O  Fast SCR

NH₃ from Urea:

1) thermal decomposition of urea to Isocyanic Acid

2) catalytic hydrolysis of Isocyanic Acid to NH₃
Current Status
From V-based to Zeolite-based Catalysts
NOx Conversion of State-of-the-art SCR Families

- Fe-SCR – 16h/750 C
- Cu-SCR – 16h/750 C
- V-SCR – 16h/600 C
Metal-Oxide based SCR Catalysts
NOx Conversion compared to Fe-zeolite

![Graph showing NOx conversion compared to Fe-zeolite](image)
NOx Conversion compared to Cu-zeolite

![Graph showing NOx conversion compared to Cu-zeolite](image)
Impact of NO/NO$_2$ Ratio
MO-SCR – Aging Influence

NOx-conversion [%]

T [°C]

- MO-SCR – Fresh
- MO-SCR – 200h/600 °C
- MO-SCR – 48h/650 °C
- MO-SCR – 16h/750 °C
Aging Stability compared to Fe-zeolite

- Very high aging stability compared to Fe-zeolite
NH₃ Storage Capacity

Target:
- stable NH₃ storage
  a) over temperature
  b) over aging
**NH₃ Storage Capacity**

**Target:**
- stable NH₃ storage
  - a) over temperature
  - b) over aging
Impact of HC/CO – Exotherm Generation

Risk:
- Thermal damage by exotherm generation e.g. over acceleration phase after HC storage
Influence of HC/CO

![Graph showing NOx conversion vs. temperature for different conditions.]

- MO-SCR – 16h/750 C
- MO-SCR – 16h/750 C w/ HC/CO

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Dynamic Start-up

- High dynamic start-up compared to Fe-SCR
- Fast NH₃ break-through in case of overdosing
Dynamic Start-up

- High dynamic start-up compared to Cu-SCR
- Fast NH$_3$ break-through in case of overdosing
NOx Conversion vs. Amount of NH$_3$ dosed
Summary
Characteristics of Metal-Oxide based SCR Catalysts

- Improved low temperature performance compared to Fe-zeolites
- No significant $\text{N}_2\text{O}$ formation
- High aging stability
- Stable $\text{NH}_3$ storage over temperature & over aging
- High tolerance towards hydrocarbon, no risk of exotherm generation
- High dynamic start-up behaviour
Thank you!

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