NOx emission control: UNDERSTANDING PERFORMANCE REQUIRES INSIGHTS AT THE NANOMETER LEVEL

Background
Lean NOx Traps (LNT) are an important component in automotive catalytic converters, as their primary purpose is to control the emission of nitrogen oxides during engine operation. In this study, two commercially available LNTs were investigated with focus on washcoat composition and catalytic properties to assess their performance for future coupling with SCR catalysts. For the latter, an LNT must meet several requirements. Aside a high storage capacity for NOx high NH₃ selectivity during regeneration as a reductive for the slipped NOx in a downstream SCR catalyst is also crucial. With the aim to gain a deeper understanding of the performances of different LNT layouts, it became paramount to characterise the LNT internal architecture and local chemical composition at the micro- and nanoscale.

Materials and Methods
Fully canned catalysts were obtained from two different diesel vehicles and prepared for cross-section analysis. Electron transparent lamella of the samples for the TEM investigations were obtained by focused ion beam machining (FIB) using a FEI Strata 205. The characterisation by scanning transmission electron microscopy (STEM) was carried out with a 200 kV LIBRA 200FE (Carl Zeiss Microscopy GmbH) equipped with EDX (Bruker AXS GmbH) and annular-dark-field (ADF) detectors (E.A. Fischione Instruments Inc.).

Summary
Both investigated LNTs lower layers revealed the same set of components, namely platinum group metals loaded ceria, BaCO₃ and MgAl₂O₄ phases, but with significant different amounts and distributions within the washcoat layered structures. These findings explain why both catalysts showed comparable and reproducible NOx storage capacities, but with fundamental different gas compositions during regeneration. Moreover, both LNTs showed different NH₃ and N₂O selectivity during the regeneration process, which is related to the nature and spatial distribution of each component.

Credits
This study was performed in collaboration with members of ACA Center for Automotive Catalytic Systems Aachen at RWTH Aachen University. The full story of this investigation is published in ChemCatChem 2021, 13, 1787. doi/10.1002/cctc.202001761