MODERN TRENDS IN THE DEVELOPMENT OF CATALYTIC AFTERTREATMENT SYSTEMS FOR LEAN-BURN AND DIESEL ENGINES

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Use of "three-way" catalytic converters remains by now the most popular method of automotive exhaust gases aftertreatment. However stringency of upcoming environmental legislations, wide spreading of diesel engines, and development of a new generation of lean-burn engines operating under lean conditions (at high air to fuel ratios) require new catalytic systems which are capable of carrying out several processes simultaneously: selectively reduce nitrogen oxides in the presence of oxygen, oxidize unburnt hydrocarbons and CO, remove soot particles.

It is not possible to carry out effectively all these process over a single catalyst. The modern trend in the development of new aftertreatment catalysts consists in designing a complex catalytic system comprises several components:

1. First, exhaust gases pass trough a deep oxidation catalyst for removal of unburnt hydrocarbons and CO. Additionally this catalyst oxidizes NO to NO_2 for improving efficiency of NO_x reduction into N_2 over a catalyst for selective catalytic reduction of NO_x (SCR) installed downstream.

2. Particulate filter is installed on diesel engines between deep oxidation catalyst and SCR catalyst for removal of particulate matter (PM) or soot. It is desirable to improve self-regeneration of particulate filter by designing a catalytically active filter which enhances soot oxidation either by oxygen or by NO_2.

3. NO_x SCR catalyst is usually disposed after oxidation catalyst and particulate filter. Nowadays the most widely used process for selective NO_x reduction is based on the reaction with NH_3 or urea. Alternatively NO_x can be reduced by selective catalytic reduction with hydrocarbons or by NSR (NO_x sorption-reduction) over NO_x trap.

4. Downstream of SCR catalyst an ammonia slip catalyst (or hydrocarbon slip catalyst) is installed for elimination of traces of reductant used over SCR catalyst for NO_x reduction to N_2 (traces of NH_3 or hydrocarbons)

Development of a competitive catalytic system requires a solution of several tasks for improving its efficiency and cost reduction:

- Lowering the cost of catalytic system by reduction of the amount of noble metal (Pt) or by development of catalyst based on transition metal oxide compositions (without noble metals).
- Replacement of vanadium-containing SCR catalyst by ecologically friendly zeolite-based catalyst.
- Development of a new generation of catalysts for NO_x selective catalytic reduction with hydrocarbons.
- Improvement of "life period" and durability of the overall catalytic system by enhancement of sulfur tolerance, hydrothermal stability, and suppression of active sites.