Development of Alternative Diesel Oxidation Catalysts

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INTRODUCTION

Emissions, smog and pollutants are under strict regulation worldwide, which requires the manufacturers of emitting equipment to take precautionary steps to meet emission regulation standards. For diesel engines, a series of catalytic units is used to treat the exhaust gas, see figure 1. An important unit in the diesel exhaust aftertreatment system is the Diesel Oxidation Catalyst (DOC), which oxidizes CO and unburnt hydrocarbons to CO_2. The DOC is commonly a 1% platinum on aluminum oxide (1wt.% Pt/Al_2O_3), possibly with some Palladium. The use of noble metals makes the DOC an expensive aftertreatment component. An effective/efficient use of the noble metals is therefore important for the development of the DOC both in terms of effectiveness, economy and environmental aspect.

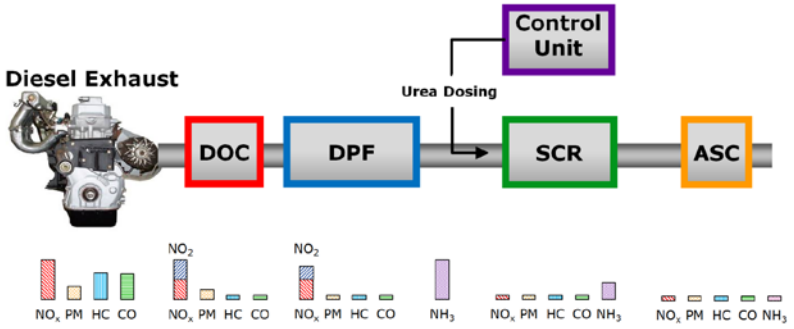

Figure 1: An example of the standard diesel exhaust aftertreatment system[1].
[1](R. M. Heck, R. J. Farrauto, and S. T. Gulati, Catalytic air pollution control: commercial technology. John Wiley & Sons, 2012.)

EXPERIMENTAL WORK

To get a better understanding on the effects of Pt dispersion, a series of 1 wt.% Pt/Al_2O_3 catalysts have been developed with varying Pt particle sizes to analyze the CO oxidation. The catalysts were prepared by varying calcination atmosphere and/or subsequent aging with varied duration and temperature. The prepared catalysts were tested for CO oxidation in a gas flow reactor for varying temperatures and in humid environment.

RESULTS

Preliminary results show that lower dispersion (25%) can be achieved by using a pretreatment with higher temperatures (750°C) and longer exposure time (12-48 hours) in nitrogen gas. If higher dispersion is desired it is recommended to use lower temperatures (550°C) and using simulated atmosphere consisting of nitrogen, oxygen(10%) and water (3%). All versions obtained a desired full conversion from CO to CO_2 with varying light-off temperatures favoring a high pretreatment temperature.