

“Catalytic Air Pollution Control: Commercial Technology”, 3rd Edition

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Introduction

Thirty-five years ago the use of catalytic systems for controlling tailpipe pollutants from vehicles was virtually non-existent, yet now every new car in the major countries of the world is equipped with one or more emissions control catalysts. Over this time the autocatalyst industry has grown to become a multi-billion dollar worldwide business, and underpinning this success is the extremely high catalytic activity of the platinum group metals (pgms), especially rhodium and palladium as well as platinum itself.

On a vehicle, operating conditions are not smooth and steady as they are on a large single-stream methanol or ammonia plant (1). Low-temperature catalyst activity is vital during ‘cold-starts’ and very high temperatures (>1000°C) can result from occasional engine misfires so very good catalyst thermal durability is a prerequisite. Conditions are highly transient – the gas flow rate changes often and it pulsates as exhaust gas is discharged from each cylinder in turn. The exhaust gas flow can be very high and the corresponding space velocity much higher than in a chemical plant, and there can be detrimental catalyst poisons such as sulfur and phosphorus species in the exhaust gas, as well as continuous physical vibration etc.

The primary pollutants from combustion of petrol, diesel and other hydrocarbon fuels such as liquefied petroleum gas (LPG) and compressed natural gas (CNG) are unburnt or partially oxidised hydrocarbons (HCs) and carbon monoxide (CO). Nitric oxide (NO) is also present, being formed from oxygen and nitrogen combining at the high-temperature flame front during combustion. Once in the air HCs and NO can undergo a series of photochemical reactions that lead to even more noxious secondary oxidising pollutants such as ozone (O₃) and organic compounds like peroxyacetyl nitrate (PAN) that are powerful and

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