22 B. Fischer, D. Freund, A. Behrends, D. Lupton and J. Merker, 22nd Int. Precious Metals Conf., IPMI, Toronto, Canada, June 14–17, 1998

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Developments in Emission Control Technology

The main "Congress and Exposition" of the Society of Automotive Engineers (SAE) takes place in Detroit each Spring and smaller meetings are also held. One such meeting was the 1998 "International Fall Fuels and Lubricants Meeting and Exposition" held in San Francisco, October 19th to 22nd, 1998. Some 306 papers were presented to 1163 participants and a selection from sessions on the aftertreatment for petrol and diesel engines are reviewed here.

Plasma Technology Plasma is formed when very high voltage is applied across a zone through which exhaust gas flows. A variety of often novel chemical reactions is induced which might be useful in destroying pollutants. The papers presented probed fundamental questions. Siemens (982428) used dielectric barrier discharge devices in diesel exhaust gas to show that non-thermal plasma oxidation of NO to NO_2 is unfortunately favoured over dissociation to nitrogen and oxygen! Addition of ammonia in the presence of a Selective Catalytic Reduction catalyst brought about NOx reduction at 100°C. A related contribution from Lawrence Livermore National Laboratory, Northwestern University and Engelhard (982508) reported that SO_2 is not oxidised under conditions where NO_2 is formed. This could be useful in situations where sulfate formation is detrimental.

Three-Way Catalysts (TWCs) Ford (982549) reported on hydrocarbon (HC) conversion efficiencies over Pd-only, Pt/Pd/Rh, Pd/Rh and Pt/Rh formulations during stoichiometric and rich operation. Their Pd-only and Pt/Pt/Rh catalysts had higher HC efficiency than Pt/Rh or Pd/Rh catalysts, the conversion efficiency for ethyne was > 98% for Pd-based catalysts, and > 96% for methyl *t*-butyl ether (MTBE) with all catalysts. MTBE and formaldehyde emissions from a warm engine were concluded not to be environmentally significant. Concentrations were given for the ten most abundant HCs in fuel, exhaust gas and post-catalyst gas and, with the exception of methane, there was significant reduction of already low HC levels over the catalyst. This paper has data for conversions for 154 HCs over aged Pt/Pd/Rh catalyst. Toyota (982706) described work on thermal deterioration of Pt/Rh TWCs and found that oxygen storage capacity depends on Pt metal particle size.

The complexity in providing On-Board Diagnostics compliance and low emissions was evident in papers from Hyundai (982551) and Engelhard (982553). The former included evaporative and catalyst requirements, while the latter focused on development of ULEV catalysts, and included geometric surface area and heat capacity effects on catalyst light-off. The influences of substrate cell structure and catalyst configuration were emphasised by Corning, Johnson Matthey, Daimler Chrysler, and Southwest Research Institute (982634). There is advantage in having high cell density (high geometric surface area) during cold start; low thermal mass is important, and square cross-section cells are better than triangular ones. The viability of thin wall substrate in terms of processing necessary for incorporation into exhaust systems was confirmed by Corning (982635); thermal shock properties can be better than with conventional products. Emitec (982633) reported that conical metal substrates give enhanced gas flow over the main catalyst, and provide improved light-off due to heat cascade.

Lean-Burn Gasoline Engine Aftertreatment

Contributions from Daimler-Benz, Johnson Matthey, Chalmers, Leuven and Strasbourg Universities (982592) described the use of an absorber to trap NOx, and intermittently recycle it back to the engine. A second paper (982593) focused on trap materials for this application. With appropriate formulations NOx-traps can be regenerated in-situ in lean-burn gasoline or diesel engine applications. A major problem is sulfation of the trap components, which leads to performance deterioration. Renault (982607) found that temperatures of at least 600°C were needed for complete regeneration of a development NOx-trap.

Two-Stroke Engine Aftertreatment

Exhaust emissions from 2-stroke engines contribute to urban pollution in developing countries. Because of high HC levels, exotherms during oxidation can increase gas temperature to 900°C. In addition, low oxygen content limits CO/HC oxidation under some conditions, and so HC steam reforming and reaction of CO with steam (water gas shift reaction) are important in the design of 2-stroke catalysts. ICT and Degussa (982710) reviewed these requirements and their achievement by thermal stabilisation of wash-coat components, appropriate selection of active metals and maintaining ceria surface area under rich ageing conditions.

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