SCHOOL OF
MATERIALS SCIENCE AND ENGINEERING
College of Engineering, Architecture and Technology

THE CATALYTIC CONVERTER: ITS IMPACT ON EMISSIONS FROM MOBILE EMISSION SOURCES (GASOLINE/DIESEL); TECHNOLOGY REQUIREMENTS & CURRENT STATE-OF-THE–ART DESIGNS: ARCHITECTURE AND MATERIALS

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Wednesday, October 28, 2020 | 11am - 12pm | Platform - Zoom Meeting

Abstract

The introduction of Catalytic Converters in the mid 1970s has led to a dramatic reduction in the emissions from both gasoline and diesel powered vehicles (termed mobile emission sources). The emission components eliminated by the converter include carbon monoxide (CO), hydrocarbons (HCs), nitrogen oxides (NO & NO2) and particulates (PM). In the case of gasoline vehicles the most recent EPA legislated emission standards for 2025 will result in greater than a 99.5% average reduction in tailpipe HC + NOx emissions as compared to an average gasoline powdered vehicle without a catalytic converter in the 1960s. For CO the mandated emission reductions will be of the order of 85%.

Eliminating all three emissions simultaneously from the engine exhaust requires we simultaneously oxidation CO & HCs to CO2 and H2O while at the same time achieve the reduction NOx to N2. This simultaneous oxidation-reduction catalysis requires highly specialized catalysts and can only be achieved by the use of expensive and rare metals known as the precious group metals (platinum, palladium and rhodium). Further, unlike more typical idealized industrial catalytic systems, the catalytic converter has an operating temperature range varying from room temperature to over 1000oC, high and varying exhaust gas velocities, varying exhaust composition as determined by the vehicle operation as we go from cold start (initial engine ignition) to high speed driving inclusive of large accelerations and deaccelerations.

The seminar will focus on the state-of-the-are strategies used to meet the legislated emissions standards from the catalyst development point of view. These standards must be met at the mandated end of life of the vehicle (150,000 miles of driving) while at the same time minimizing the cost of the emission system, especially in terms of precious metal usage. Achieving these targets has resulted in the development of highly specialized supports for the precious metals, especially Rh and the introduction of advanced "oxygen storage materials" that enable essentially 100% conversion over varying exhaust composition ranges.

Currently there is a major concern about the availability and cost of the precious metals, especially Rh. Automotive emission control catalysts current utilize most of the Rh mined in the world. Today its cost per tr oz (31.1035 grams) is in the range of $14,000/tr oz as compared to $1,900 for gold.

Speaker

Ph.D. 1981 Physical Chemistry Dep. University College Galway, Ireland

2009-2020: Technology Director, North America; Umicore Autocat USA

2007-2009: AC-RM Director; Umicore Autocat-Research & Technology

2002-2007: Senior Catalyst Development Scientist; Delphi Catalyst – ASEC Manufacturing

1994-2001: Senior Research Scientist; AlliedSignal Environmental Catalysts

1987-1994: Research Scientist; Allied Signal, Research & Technology, Des Plaines, Chicago

1985-1987: Research Scientist/Engineer; Chemistry Dep., Lehigh University, Bethlehem, PA

1984-1985: Postdoctoral Research Fellow; Chemistry Dep., Lehigh University, Bethlehem, PA

1982-1984: Postdoctoral Research Fellow; Chemistry Dep., University College Cork, Ireland

Forty one Publications in refereed scientific and trade (SAE) journals

Twenty US patents and two trade secrets, not counting international patents

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