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Preface

The control of greenhouse gas emissions from the burning of fossil fuels, including those derived from petroleum, is now considered to be perhaps the most significant challenge for global economic and environmental security. In the U.S., as it is in most of the world, dependence on oil is driven by transportation. No other economic sector accounts for a major share of the U.S. total oil consumption, or is as dependent on oil. In 2006, the transportation sector alone consumed almost twice as much oil as was produced domestically, resulting in reliance on ever increasing quantities of imported oil [1].

Thus, there is a need for major improvements in transportation energy efficiency. Diesel and other "lean-burn" engine technologies can be a major step in that direction. Use of lean-burn engines that are more energy efficient in place of current production gasoline engines can improve overall transportation energy efficiency. Use of diesel engines has been estimated to potentially improve the fuel economy (in miles driven per gallon of fuel, mpg) of vehicles by 25–35% compared to similar gasoline engine-powered vehicles. Correspondingly, such improvements in fuel economy mean that carbon dioxide emissions are reduced to the same extent. Indeed, a recent study [2] comparing the fuel economy benefits provided by (inherently) lean-burn diesel engines compared to newly introduced hybrid vehicles, showed that in many situations diesel engines outperform these hybrid technologies. However, dramatic improvements in the technologies used to control emissions are needed to realize the benefits of these fuel-efficient vehicle engines [3].

While current generation "three-way" catalytic converters are remarkable devices that are very effective in controlling exhaust emissions from gasoline engine-powered vehicles, the catalyst materials in these devices are not effective for reducing NOx emissions from lean-burn engine exhaust. Furthermore, vehicles utilizing diesel lean-burn engines will have additional mandated limits on emissions of particulate matter (soot). As such, a critical barrier to diesels and other lean-burn engines being commercially competitive with production gasoline engines is the effectiveness of the exhaust after treatment system needed to meet regulated vehicle emissions standards that are becoming increasingly more stringent.

These technical and political drivers account for a dramatic increase of interest in the science and technology of catalytic diesel emission control. In view of this, we and others have organized special technical sessions at the last two meetings of the North American Catalysis Society in Philadelphia in May, 2005 (19th NAM), and in Houston in June, 2007 (20th NAM). At the more recent 20th NAM, four half-day sessions were dedicated to catalytic diesel emissions reduction, and were some of the most highly attended sessions at this meeting. The sessions were dedicated to current research topics concerning catalyst-based particulate control, lean-NOx catalysis via selective catalytic reduction (SCR) with ammonia or hydrocarbons, and to the NOx storage/reduction (NSR) catalyst technology. One keynote address and 16 contributed oral presentations were augmented by over 50 posters. Interestingly, each session contained presentations from industry, academia and national laboratories from the U.S., as well as a considerable number of international representatives.

This edition of Catalysis Today continues a tradition of publishing the highlights from these catalytic diesel emission control sessions established after the first special symposium at the 19th NAM [4], and contains 21 manuscripts based on the oral or poster presentations given at the 20th NAM meeting. Soot oxidation, SCR with ammonia and hydrocarbons, NSR catalysis and NO oxidation are all addressed in the papers presented. Among the highlights of the papers in this edition of Catalysis Today are a few papers on the modeling of NSR performance, including new fundamental computational studies of some of these processes, studies of new catalysts for soot oxidation as well as optimum methodologies for soot/catalyst contact, a new emphasis on the performance and stability of zeolite-based urea SCR catalysts as these now appear to be the material of choice for this application, and summaries of recent experimental and computational studies of novel hydrocarbon SCR catalysts.

The Guest Editors thank all of the catalyst scientists and engineers who presented in the Diesel Emission Control sessions at the 20th NAM, the authors who submitted manuscripts with such a short time frame, and the conference "Environmental Catalysis" session chairs, especially Prof. Chunshan Song, for allowing us to organize these special sessions. Finally, we would like to thank the Keynote Speaker of these sessions, Dr. Aleksey Yezerets of Cummins, Inc., who presented a truly outstanding perspective on the state-of-the-art and future needs for catalytic diesel emission control.

References

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