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Preface

Diesel emissions control catalysis

The last few years have seen the field of catalytic emission control for diesel engines transition from extensive initial research to successful practical commercialization, in response to the evolving emission standards worldwide, most notably Euro IV and V regulations and US EPA 2007 and 2010 regulations. In particular, this led to the large-scale commercialization of lean-NOX traps (LNTs) and selective catalytic reduction systems using urea as a reductant source (SCR), as well as very elegant combined LNT/SCR systems. The success of these systems in meeting the inherent challenge of reducing NO_X to N_2 in an oxidizing environment stemmed from significant research over several years prior, at universities, national labs and within industry. Even with commercial products being seen on new vehicle models, it is expected that the field will continue to evolve. This is based not only on different legislative demands, with more yet coming, but also on the wide range of engine sizes and applications that have yet to have aftertreatment systems included. This also means that the technology, in terms of NO_X reduction to N_2 in lean-burn engine exhaust gas, is unlikely to converge on one solution as it has with gasoline engines on three-way catalysts. With predictions of increased diesel engine sales, due to its better fuel economy and therefore lower CO_2 emissions, more complete application of aftertreatment systems on diesel vehicles, as well as introduction of lean-burn gasoline engines, there is significant pressure to better understand these systems, including reaction mechanisms and degradation modes, develop predictive models, and ultimately improve overall efficiencies.

Based on these trends, there have been well-organized special technical sessions at the last three North American Meetings (NAM) of the North American Catalysis Society; the 19th NAM in Philadelphia in 2005, the 20th NAM in Houston in 2007, and the 21st NAM in San Francisco in 2009. At the most recent meeting, four half-day sessions were dedicated to lean-burn engine emissions reduction. There were presentations from industry, academia and national laboratories, from both U.S. and international institutions. The papers in this special issue of Catalysis Today are based on presentations given at the 21st NAM of the North American Catalysis Society in San Francisco.

Consistent with commercialization and near-term product launches, the papers published in this issue of Catalysis Today represent a mix of LNT and SCR topics, including some with not only combinations of the catalysts, but also relating the similarities in chemistry between the two. Some features of this issue are papers addressing degradation causes and impacts, with several papers demonstrating thermal and chemical deactivation modes. Another topic highly discussed in this issue, and that was first highlighted at the NAM in Houston in 2007, is the role of NH_3 in LNT catalysis and the similarities in some reaction chemistry between LNTs and SCR. This was also the basis of a standing room only Keynote Presentation by Dr. Nova given at the conference, with an accompanying paper in this issue. There are also papers targeted at more fundamental, or detailed, understanding of the reaction mechanisms of these catalysts. Specific highlights are effects of Pt/Ba active site proximities in LNTS and acid/base chemistry details in relation to SCR chemistry.

The guest editors thank all of the catalyst scientists and engineers who presented in the Catalysis for the Environment sessions at the 21st NAM and the authors who submitted manuscripts. Finally, we would like to thank the Keynote Speakers in these sessions, Dr. Isabella Nova and Dr. Bill Partridge.

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