Foreword

Oxygen Storage Materials in Automotive Three-Way Catalysts

Research-Domain 31 Research Leader

Hiroshi Shinjoh

Three-way catalysts have been used in automotive exhaust systems since the late 1970s. They have been implemented in vehicle production around the world. Three-way catalysts are composed of several components, including noble metals as active sites, alumina-based supports with a large specific surface, but most remarkably, metal oxide promoter materials that regulate oxygen storage properties. It is well known that, for the control of nitrogen oxide (NOx), carbon monoxide (CO), and hydrocarbon (HC) emissions, three-way catalysts operate under atmospheres with fluctuating air to fuel ratios (A/F) in order to maintain the average A/F close to stoichiometry. Oxygen storage materials are necessary for storing excess oxygen in an oxidizing atmosphere and releasing it in a reducing atmosphere. Through oxygen storage and release, a buffer is obtained against fluctuations in exhaust gas composition during vehicle operation, enabling the system to maintain a stoichiometric atmosphere in which NOx, CO and HC can be converted efficiently.

Ceria (CeO_2) was the first material to be recognized as having promising oxygen storage properties. Later on, the CeO_2-ZrO_2 solid solution was found to have superior oxygen storage capacity and thermal stability as compared to CeO_2. As Toyota researchers, we are very proud of our contribution to the development of this high performance material and the technology surrounding it. The material's oxygen storage capacity is being enhanced up to the theoretical limit in real catalysts. In addition to their capacity for oxygen storage and release, oxygen storage materials can suppress the sintering of supported noble metals, and enhance hydrogen formation under a reducing atmosphere. We aim to fully exploit the potentials of CeO_2-ZrO_2 in automotive catalysts in order to achieve the goal of zero emission.