The catalytic abatement of emissions for a sustainable mobility: an overview

Fabio A. Deorsola

Department of Applied Science and Technology, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy

The almost entirety of vehicles are nowadays equipped with internal combustion engines (ICEs), which invariably emit pollutants during operation. Two engine types are most commonly used today, spark ignition gasoline (based on the Otto cycle) and Diesel ones. The pollutants of concern are carbon monoxide (CO), volatile organic or hydrocarbon compounds (VOC or THC), nitrogen oxides (NO, NO_2), sulphur oxides (SO_2, SO_3, SO_x) and the combination of particulate matter (PM) and naphthalene colloquially called “soot”. The mentioned pollutants are toxic, especially to the respiratory organs and aggravating existing chronic conditions such as asthma or bronchitis. The estimated daily adjusted life years lost through the world is, on average, 2 years, significantly higher than cancer and other medical conditions. Moreover, these pollutants also contribute to air pollution, namely smog and acid rains. For these reasons, the major regulatory boards have ruled since Eighties decreasing concentrations of criteria pollutants in tailpipe emissions. Vehicles original equipment manufacturers (OEMs) have dealt with more and more stringent regulations focusing on the improvement of engine efficiency and, on the other hand, exploiting the capability of catalysis to accelerate the reactions related to the abatement of the harmful substances. Therefore, in the last years vehicles have hosted complex catalytic converters consisting of several “bricks” with different functionalities, forming the so-called aftertreatment system (ATS). In parallel, the increased focus on greenhouse gas emissions and the decarbonization goals pushed the development of alternative powertrains like hybrids, electrics and engines running on renewable and/or non-conventional fuels as well as hydrogen. The ongoing transition towards the decarbonizing mobility and near-zero emissions can be long-lasting and complicated, as well as cannot be envisaged for all the different types of mobility, and so it is necessary to continue the improvement of the traditional ICE technologies and aftertreatment systems. This work summarises and describes the most recent progresses in the field of the catalytic abatement of pollutants deriving from light-duty and heavy-duty vehicles for a sustainable mobility.