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Editorial

Catalytic Diesel and Gasoline Particulate Filters

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I am honored to be the Guest Editor of this Special Issue of the journal *Catalysts* dedicated to "Catalytic Diesel and Gasoline Particulate Filters". Particulate filters remove particulate matter (PM), which is mostly composed of soot, from the exhaust of both diesel engines and gasoline direct injection (GDI) engines. Soot particles are first trapped in the filter via filtration, and then eliminated via oxidation, thus regenerating the filter. In order to lower the temperature and time required for filter regeneration, as well as the associated fuel consumption, a catalytic coating can be placed on the filter walls with the purpose of promoting soot oxidation.

This Special Issue includes three reviews [1–3] and three articles [4–6]. The review by Lisi et al. [1] addresses the most important issue to an effective regeneration of catalytic (i.e., catalyst-coated) diesel particulate filters (DPFs): the contact between soot and catalyst. The main conclusion drawn from the literature analysis is that, in order to fully exploit the potential of catalytic DPFs in soot abatement, both a widespread and homogeneous presence of catalyst in the macropores of the filter walls and a suitably low soot load are needed (see, e.g., [7]). Under optimal soot-catalyst contact conditions, the consequent decrease in the temperature required for soot oxidation to values within the temperature range of diesel exhausts suggests the passage to a continuous functioning mode for catalytic filters with simultaneous filtration and regeneration. This functioning mode enables overcoming the drawbacks of periodic regeneration performed in current applications, including the formation of excessively hot regions that may severely damage the catalytic DPF [8–10].

Gasoline particulate filters (GPFs) are surely much further from being a consolidated technology than DPFs. Giechaskiel et al. [2] reviewed the evolution of PM mass emissions from gasoline-fueled light duty vehicles available in the market from the early 1990s until 2019 in different parts of the world. Data included in the review showed that, in some circumstances, emission levels from traditional port fuel injection (PFI) gasoline vehicles can exceed those from GDI vehicles. Suarez-Bertoa et al. [4] investigated one of the first vehicles with GPF available in the European market in mass production. Their results confirmed the effectiveness of GPFs in controlling particle emissions under different driving and boundary conditions.

Although GPFs have the same design as DPFs, their regeneration is more critical, mainly because it occurs under oxygen deficiency [11]. This makes soot oxidation catalysts proposed for DPFs unsuitable for GPFs and, hence, justifies the recent scientific interest to develop materials that fit the peculiar gasoline operating conditions. In this framework, Aneggi and Trovarelli [5] compared the behavior of ceria-zirconia and zirconia in soot oxidation under oxygen-poor conditions, showing that lattice and surface oxygen in the former can help with oxidation at low oxygen partial pressure. Sartoretti et al. [6] investigated a nanostructured equimolar ceria-praseodymia catalyst for different reactions, namely CO oxidation, ethylene and propylene total oxidation, and soot combustion, in low oxygen availability. They found that, thanks to its capability of releasing active oxygen species, this catalyst exhibited a remarkable activity and CO_2 selectivity at low oxygen concentrations. Matarrese [3] reviewed the most relevant and significant publications regarding soot oxidation catalysts for GPFs, highlighting that, besides ceria-based materials, perovskite-based formulations (see, e.g., [12,13]) are also emerging as the most promising catalysts.

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