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Editorial

Heterogeneous Catalysis and Advanced Oxidation Processes (AOPs) for Environmental Protection (VOC Oxidation, Air and Water Purification)

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The quality of air and water is a crucial and critical contemporary problem. The more globalized economy, and the rapid growth of new economic powers, have given rise to new problems related to environmental protection. The science of catalysis has always given smart, green, and scalable, eco-friendly solutions. In the last year, together with the traditional and efficient catalytic thermal treatments, new and emerging techniques such as photothermal treatments or advanced oxidation processes (AOPs such as photocatalysis, Fenton and photo-Fenton, ozonation, etc.) have provided good results both in air and water purification [1,2]. All these technologies can also drive the transition from “classical” industrial chemistry to sustainable industrial chemistry, where not only are the processes involved in environmental purification versatile, green and environmentally friendly, but the employed catalysts are as well. This approach can help to overcome some relevant contemporary issues, some of which have been amplified by the COVID-19 pandemic situation. This has highlighted the necessity to ensure a high quality of air in both indoor and outdoor environments, or has drastically drawn attention to water polluted by the plastic waste (used face masks, for example). Plastics, together with other emerging water contaminants (such as pesticides, pharmaceutics, and antibiotics), are serious problems for water purity; conventional treatments do not work efficiently on these dangerous compounds.

All these aspects are well discussed and investigated in this Special Issue.

In particular, for air purification (including volatile organic compound (VOC) removal), the reviews of *Fiorenza* [3] and *Zhou and Yun* [4] examined two different aspects. The advantages and drawbacks on the utilization of bimetallic-based catalysts were analyzed in the first review, with particular attention on the bimetallic-gold-based samples, and considering both catalytic and the photocatalytic approaches [3]. In the second review, the attention focused on harmful pharmaceutical VOCs emitted in China. The developments in catalytic combustion, photocatalytic oxidation, non-thermal plasma, and electron beam treatments were discussed, together with the development of catalysts used in these processes [4].

The developments of eco-friendly catalysts and unconventional photocatalysts, not based on TiO_2, which can also represent possible solutions to the crisis of the raw material exportation [5] was also explored in two other papers of this Special Issue [6,7]; the good catalytic, photocatalytic, and phothermo-catalytic properties of MnO_x-ZrO_2 are presented, making these composites a promising future choice, as an example of an economical, not-critical, and high-performing catalyst applied for the removal of some dangerous VOCs such as toluene.

The innovative aspect that joins the water remediation from emerging contaminants with new materials was the core of this collection of papers. The degradation of fluoroquinolone antibiotics [8] and dyes [9], the treatment of cosmetic wastewaters [10], and the removal of bisphenol A [11] were originally investigated, employing Au@ZnO-rGO-gC_3N_4 [8], ZnO thin film [9], magnetite, hematite, and zero-valent iron [10], and alkaline active materials [11], respectively. These studies demonstrated synergisms between the

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photocatalytic properties of the new compounds, or that combinations of different AOPs can be the most attractive and valuable strategies to remove these recalcitrant pollutants from water. In this context, the use of aqueous ozone and UV photolysis represents a sustainable solution for the bleaching of fabrics with a low environmental impact [12].

Finally, the Fenton and photo-Fenton-like processes were proposed to remove other water pollutants such as pesticides [13] and rhodamine B dye [14], using alternative catalysts such as reduced CeO_2 [13] and the chalcopyrite ($CuFeS_2$) [14].

In conclusion, as the Guest Editor of this Special Issue, I would like to extend my appreciation to all the authors for their high-level articles, and I thank all the reviewers for their comments on the manuscripts. I hope that readers will find the results in the articles on this topic interesting and useful for their research. Thanks also to the editorial staff of *Catalysts*, for their help and ensuring the success of this Special Issue.

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