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Large scale air decontamination system using dielectric barrier discharge combined with UV activated TiO2

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Indoor air can be polluted by many different harmful contaminants, such as chemicals, viruses or bacteria, aerosols or fine particles from combustion, among others [1]. The recent global pandemic is the perfect example showing how contaminants such as viruses are dealt with. Instead of destroying or inactivating them, physical barriers, i.e. filters, were mostly used. Similarly, current decontamination systems mostly rely on filters (HEPA, mechanical, electrostatic), whatever the pollutant. Such non-destructive methods work but they induce lots of maintenance costs for changing filters, which "store"the pollutants and produce potentially harmful wastes if not handled carefully.
For these reasons, alternative destructive methods have been developed. Among advanced oxidation processes, the combination of cold atmospheric pressure plasma with UV activated photocatalysts is very promising [2]. The plasma generated electrons, ions, reactive oxygen and nitrogen species, combined with the photocatalyst-generated radicals (OH, O2•−) allow for the oxidation or decomposition of most chemical pollutants, as well as the inactivation of bio contaminants [3].
This work focuses on a large-scale air decontamination system, which combines a volume dielectric barrier discharge (DBD), with a UV-activated TiO2-coated textile as photocatalyst. The latter is activated using UV-C lamps. An important feature of the setup is that it can treat large volumes of air (several hundred L.min-1) in a single pass, making it closer to real applications than typical lab reactors. The efficiency of the system against VOC (formaldehyde) is assessed using FTIR measurements of the outlet gas. The production of ozone is also monitored using UV absorption spectroscopy. To better understand the process, the importance of the different elements (DBD, UV, photocatalyst) are also studied separately. Additionally, the influence of the specific input energy and the distance to the discharge are investigated, giving a better view of the synergetic effects between the discharge and the photocatalytic effect, as well as the fragmentation pathways of the VOC. Finally, preliminary results on the deactivation of E. Coli and S. Aureus by the systems are presented [4].

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Keywords: Indoor air decontamination; Plasma photocatalysis; FTIR.

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