LARGE SCALE AIR DECONTAMINATION SYSTEM USING DIELECTRIC BARRIER DISCHARGE COMBINED WITH UV ACTIVATED TIO2

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Abstract

Indoor air can be polluted by many different harmful contaminants, such as volatile organic compounds, viruses or bacteria, aerosols or fine particles from smoke, among others. The recent global pandemic showed the emerging need for indoor air decontamination methods. Instead of destroying or inactivating the bio-contaminants, physical barriers, i.e. filters, are mostly used (HEPA, mechanical, electrostatic). Such non-destructive methods induce maintenance costs for changing filters, which "store" the contaminants and produce potentially harmful wastes. Alternative destructive methods have been developed, e.g. various Advanced Oxidation Processes. Among them, the combination of cold atmospheric pressure plasma with UV activated photocatalysts is very promising [1,2]. The plasma generates electrons, ions, reactive oxygen and nitrogen species, combined with the photocatalyst-generated radicals (OH, $O_2{\bullet}^-$) allow for the oxidation or decomposition of most chemical pollutants, as well as the inactivation of bio contaminants [3]. The synergetic effect of both technologies also helps to overcome their drawbacks, e.g. the photocatalytic effect can dissociate ozone generated by the discharge.

This contribution focuses on a large-scale air decontamination system, which combines a volume dielectric barrier discharge, with a UV activated TiO_2 coated textile as a photocatalyst. The latter is activated using either UV-C lamps or UV-A LEDs. An important feature of the setup is that it can treat large volumes of air

(~100 l/min) in a single pass, making it closer to real applications than typical lab reactors treating just few l/min. The efficiency of the system against low concentration VOC contaminants is assessed using FTIR measurements of the outlet gas. Several model pollutants are tested, i.e., formaldehyde, acetaldehyde and acetone. The production of ozone is also monitored. To better understand the process, the effect of relative humidity and different elements (DBD, UV, photocatalyst) are also studied separately. The bio-aerosol decontamination tested on various bacteria (*E. coli and S. aureus*) achieved 3-log reduction up to total inactivation. This demonstrates a promising approach of the combined plasma-photocatalyst for scalable indoor air purification.

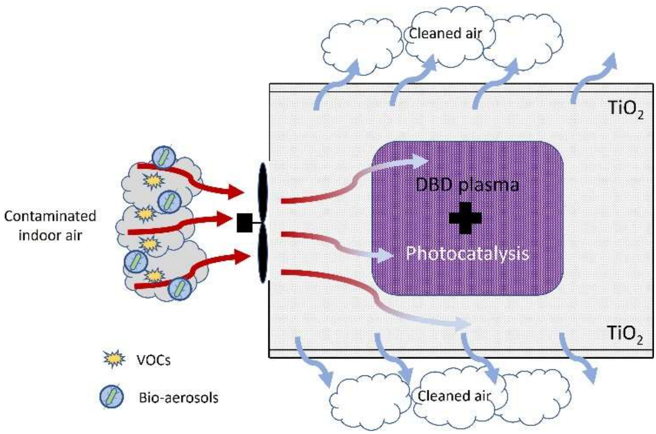

Fig. 1: Schematics of the DBD Plasma-photocatalyst indoor air decontamination [3].

Keywords: Indoor air decontamination; plasma photocatalysis; dielectric barrier discharge, VOC, bio-aerosols

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