SYNERGETIC EFFECT OF CATALYSTS AND COLD ATMOSPHERIC PLASMA FOR THE DEGRADATION OF ANTIBIOTICS IN AQUEOUS MEDIA

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Water contamination is a significant environmental concern with adverse effects on both human health and ecosystems resulting in an intense need for effective remediation methods. Antibiotics can affect water quality when improperly disposed of, excreted by humans or animals, or released from pharmaceutical manufacturing processes. Therefore, they are easily released to environment and can be found in high concentrations, being responsible for numerous diseases and the development of Antimicrobial resistance (AMR) of microbes. Advanced Oxidation Processes (AOPs) are considered promising due to their low energy requirements and their eco-friendly characteristics. Cold Atmospheric Plasma (CAP) is a well-known method examined for the degradation of antibiotics in water, producing highly reactive oxygen and nitrogen species (e.g. ·OH, O_3, NO_2, etc.) that are able to transform persistent pollutants into non-toxic intermediates.

The combination of cold plasma with catalysts generates a new field (plasma-catalysis) which could result in a further increase of the degradation and energy efficiency. More specifically, in a conceptual design, photocatalysts (e.g. TiO_2 and ZnO) which are well-known for their photocatalytic performance towards the degradation of organic molecules, could join forces with the reactive plasma species for the rapid and effective degradation of pollutants. In this work, ZnO is combined with underwater plasma microbubbles, energized by low-frequency high voltage nanopulses, for the degradation of the antibiotic Trimethoprim (TMP) in water. The reactive species involved in the process in the presence/absence of ZnO and the water physicochemical properties were investigated. Additionally, important parameters affecting the degradation of TMP were examined such as plasma gas and catalyst loading. The role of plasma species was also investigated, while the overall performance of plasma-catalysis was assessed through TMP mineralization measurements. This study contributes to further acknowledge the synergetic effect of plasma and catalysts for the destruction of recalcitrant pollutants.

KEYWORDS: Plasmacatalysis, Plasma bubbles, Trimethoprim, ZnO, Wastewater treatment

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