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Carbon-based catalytic membranes: An effective tool to empower advanced water and wastewater treatment in continuous flow operating mode

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Context

High operational and maintenance costs, formation of toxic by-products, and absence of residual effect are among the drawbacks of the existing technologies for the oxidation of organic pollutants and removal of microbial loads. This prompted the development of alternative water and wastewater treatment options, namely the so-called advanced oxidation technologies such as activated persulfate oxidation. Despite powder carbon materials have been extensively employed in persulfate activation in batch mode of operation, no real-scale applications are known. That is mostly because a subsequent step to recover the powder catalyst after the treatment stage is needed.

Objectives

Our focus has been to develop a continuous flow mode system for water and wastewater treatment based on metal-free carbon-based catalytic membranes; and thus avoid the need for a secondary step for powder catalyst recovery. Accordingly, we aimed to demonstrate the effectiveness of our system in eliminating the organic pollutants while promoting microbiological stability in the treated waters.

Results

Due to its known catalytic activity for persulfate activation, optimization of the methodology used to synthesize nitrogen-doped reduced graphene oxide was carried out first [1]. The best-performing material was then incorporated within a polymeric

matrix to fabricate a carbon-based catalytic membrane that enabled the degradation of a mix of organic pollutants in lab and surface waters (at 100 μg L^{-1} each) in continuous flow mode of operation (Fig. 1) [2]. Experiments were also performed with industrial wastewater. We have then demonstrated the suitability of our system for water and wastewater treatment, as well as the microbiological stability of the treated water (considering both bacterial cells and genes) after storage for 7 days [3].

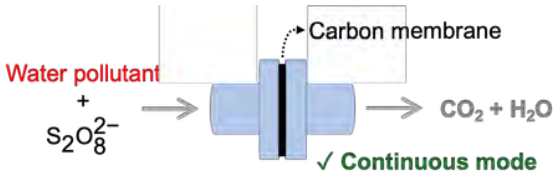

Fig. 1. Proposed continuous flow mode system for water and wastewater treatment.

Significance of the work

This communication features metal-free carbon-based catalytic membranes as an alternative to conventional powder catalysts.

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