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Title:

Photoactive polymer membranes – using photosensitizers and sunlight for degradation of micropollutants

Authors & affiliations:

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Preparation of Your Abstract

1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word ONLY (place names excluded). No full stop at the end.
2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.

Introduction: Clearly state the purpose of the abstract
Methods: Describe your selection of observations or experimental subjects clearly
Results: Present your results in a logical sequence in text, tables and illustrations
Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

The problem of micropollutants in our (waste)water is well known. Concepts for their elimination continue to be a major research focus. Our approach is to use covalently immobilized photoactive molecules - like photosensitizers - on polymer membranes, which can combine the advantages of membrane technology with advanced oxidation processes. This could provide ideal materials for water purification due to the combined properties: physical separation, adsorption, and direct degradation of the contaminants.
Using triclosan as a model - which is despite restrictions still relevant as a broad-spectrum biocide - it was shown that simply a photoactive membrane and the irradiation with sunlight is sufficient to obtain less-toxic water.

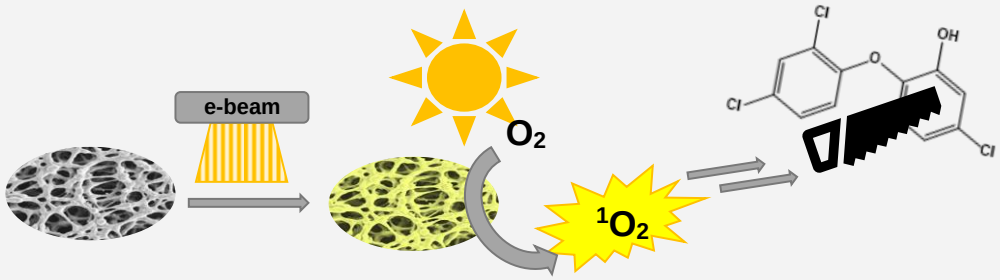

Figure 1: *P*hotoactive polymer membranes for degradation of triclosan

The use of the elegant method of electron beam grafting allows a fast, environmentally friendly and upscaleable functionalization of commercial polymer membranes. When the photosensitizer-grafted membranes are irradiated with light in the visible range they are able to generate singlet oxygen ($^1O_2$), a very reactive oxygen species, which furthermore can degrade pollutants in water. In this work experiments were performed to determine the most efficient modification method for PVDF membranes and the photosensitizer TMPyP.
XPS, zeta potential and photometrical measurements confirmed a successful immobilization and the photoactivity was verified using the $^1O_2$ sensitive fluorescent dye ABDA. The degradation of triclosan in aqueous solution was successfully demonstrated when the modified membrane was exposed to imitated sunlight. The triclosan degradation was analyzed primary photometrically and confirmed by HPLC analysis. Ion chromatography, GC-MS and TOC analysis gave further indications of the photodegradation process.

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Final a significantly reduced toxicity of the triclosan degradation solution was confirmed.

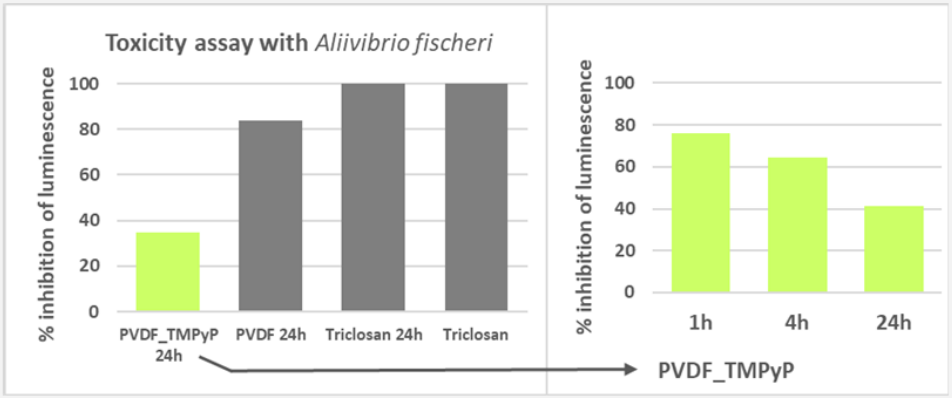

Figure 1: Confirmation of reduced toxicity via assay with luminescence bacteria of Aliivibrio fischeri / left: comparison between modified & pristine membrane vs. pristine and irradiated triclosan solution / right: time dependance of toxicity and irradiation time / explanation: less inhibition of luminescence indicated less toxicity to aquatic organism

The proposed photoactive membrane systems, which can reduce pollutants or microorganisms in water simply by irradiation with sunlight, could represent a promising technology for (waste)water treatment in many areas.