The use of pulsed DBD discharge above water in combination with nano-fiber filtration for control of micro-pollutants in water

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Many hazardous organic contaminants are not sufficiently removed by modern wastewater treatment plants. Therefore, they often occur as micropollution in wastewater and drinking water. Due to the growing need for more efficient treatment techniques, a new environmentally friendly method to destroy traces of persistent organic pollutants in wastewater is tested. This method combines pollutant adsorption on a microporous membrane and pulsed DBD plasma discharge in contact with water. As our experiments show, decomposition of atrazine, a persistent and hazardous pesticide, is significantly more efficient when the microporous membrane is added in the setup.

Amongst the contaminants of emerging concern, organic pollutants take a prominent place, including pesticides, antibiotics and hormones. Some of these pollutants are hazardous in relatively small concentrations, to humans, animals, aquatic life, the global ecosystem or a combination thereof. Others have uncertain long-term effects on health and environment. Modern wastewater treatment plants are not able to remove or decompose the persistent contaminants [1]. As reported by many authors, traces of these contaminants are detected in surface water, ground water and drinking water [2]. To address this global issue, more efficient and cheaper water treatment techniques need to be developed.

Plasma discharge in or in contact with water is a promising new technique for water treatment applications [3]. We developed a new type of reactor that combines phase-transfer by a microporous polyamide membrane and decomposition by an atmospheric pulsed DBD plasma in air. The setup is given in figure 1. Atrazine, a persistent and hazardous pesticide, is chosen as a model micropollutant in our experiments, with an initial concentration of 30 µg/l. The water solution is pumped in a closed circuit through the polyamide membrane, on which a thin water layer is formed. This water layer is used as a ground electrode and located underneath HV electrode with a dielectric barrier of about 100 µm. Pulses with an amplitude of 22 kV, a width of 500 ns and a frequency of 550 Hz are applied to the system.

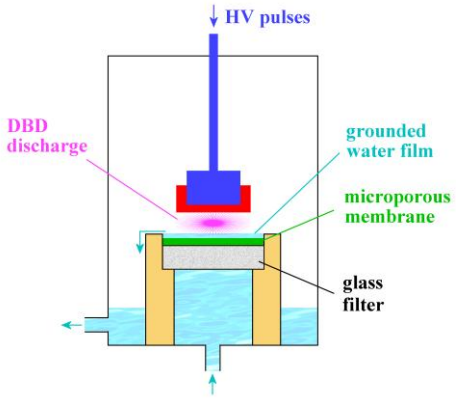

Fig. 1. Our reactor for DBD discharge over a grounded water layer on a microporous membrane.

It is found that while the H_2O_2 and O_3 production in the reactor is not influenced by the presence of the membrane, there is a significant increase in atrazine decomposition when the membrane is added in the setup. It is found that more than 70% destruction of the atrazine can be obtained with membrane at plasma power of 5 W (treated volume 100 ml, treatment time 45 min) where only about 38% removing is reached without the membrane. We can explain this by a effect of atrazine adsorption on the membrane close to the plasma

active region so higher local concentration of the atrazine is obtained in the place of active species generation by the plasma. The by-products of atrazine destruction are determined by HPLC-UV and HPLC-MS methods.

References

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