Development of combined pulsed corona discharge plasma with photocatalytic oxidation technology for efficient environmental application in aqueous and gaseous media

Summary

This doctoral study aims to develop the state-of-the-art technology for the degradation of hazardous aqueous and airborne contaminants. For this purpose, an energy effective method of low-temperature plasma generated by gas-phase pulsed corona discharge (PCD) in combination with photocatalytic oxidation is to be studied.

Research field:	Chemical and Materials Technology
Supervisors:	Juri Bolobajev Marina Kritševskaja
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between May 03, 2021 00:00 and May 31, 2021 23:59 (Europe/Zurich)

Description

This PhD study comprises the development of the state-of-the-art technology aimed to deal with aqueous and airborne contaminants. Conventional water-based air treatment processes, such as absorption columns and biofilters are respectively either transferring volatile organic compounds (VOCs) to liquid phase or are inefficient in degrading refractory pollutants. Advanced oxidation technologies (AOTs) can effectively degrade airborne VOCs as well as aqueous pollutants. However, the main drawback of many AOTs is high consumption of energy and materials, and, as a consequence, high treatment cost. In this perspective, the present doctoral study aims to explore the application of an energy effective method of low-temperature plasma generated by gas-phase pulsed corona discharge (PCD) in combination with photocatalytic oxidation. This approach requires fundamental research to establish the performance of the process and the limitations of efficiency with respect to aqueous and airborne contaminants.

The doctoral study aims to reveal chemical reaction kinetics, reaction products and, thus, reaction paths in respect of airborne and aqueous pollutants, treated with gas-phase PCD plasma combined with photocatalytic oxidation process. A tentative list of VOCs and pollutants to be studied includes hazardous solvents, toxic components of industrial exhaust gases, plasticizers, agricultural chemicals, pharmaceuticals etc. The characterization of target contaminants needs the development of methods for precise instrumental analysis. Methods include gas and liquid chromatography equipped with mass-spectrometry, FTIR spectroscopy etc.

The scale-up activity will be among the most important tasks. This research project will include the construction and optimization of the experimental setup for the application of plasma-photocatalytic oxidation system. The novelty of study is based on the use of the most energetically expedient AOT in combination with heterogeneous catalysis.

Applicants should fulfil the following requirements:

- Language skills: English (speaking, reading and writing: good/excellent), Estonian (highly beneficial)
- Previous experience with application of water treatment technologies or air purification (beneficial)

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