Formation of reactive species in water falling film DBD

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1. Introduction

In this study formation of reactive oxygen (ROS) and reactive nitrogen species (RNS) in water falling film dielectric barrier discharge (DBD) generated at atmospheric pressure in air, nitrogen, oxygen, argon or helium was investigated. Focus of this research was on OH radical production since it is one of the most reactive species produced by water containing plasmas. Using the chemical probe dimethyl sulfoxide (DMSO) quantification of short-living OH• in water exposed to plasma was obtained.

2. Methods

Water falling film DBD reactor configuration employed in this experiment was previously used for numerous applications in water purification processes [1,2]. To investigate formation of ROS and RNS such as H_2O_2, O_3, NO_3^- and NO_2^- in water treated by plasma standard analytical methods based on color forming reaction with reagent were used. Measurement of OH radical is based on method developed by Tai et. all [3] which uses trapping reaction of hydroxyl radical and DMSO. This reaction quantitatively and selectively generates formaldehyde which is analyzed by liquid chromatography. Also the overview emission spectra were taken in order to have insight in plasma –liquid interaction.

3. Results

Production of OH• in different gases as a function of specific energy density is shown in Fig. 1. Linear increase and first order kinetics in formation of hydroxyl radical, but also of hydrogen peroxide, could be observed. Estimated rate constant of OH• production and G value in different gases are presented in Fig. 2. The values of rate formation of hydroxyl radical are up to several orders of magnitude higher in comparison to some data reported in the literature [4,5] which could be explained by larger surface-to volume ratio in a thin film as compared with deep layers, which results in a faster rate of transfer of reactive species from gas into liquid.

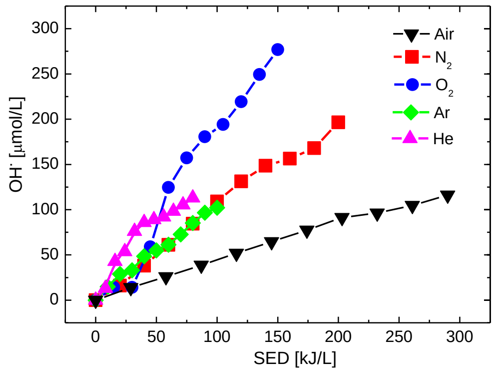

Fig. 1: *Production of OH• as a function of SED in different gases in water falling film DBD*

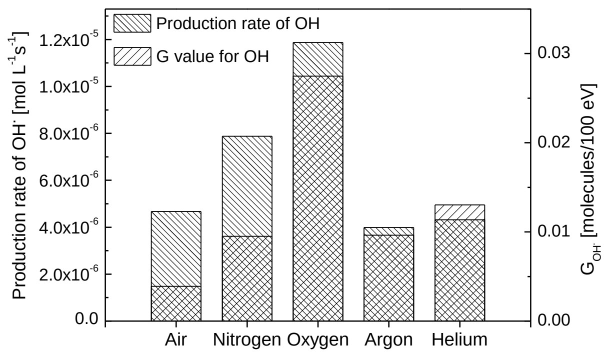

Fig. 2: *Production rate of OH• and G value in different gases in water falling film DBD*

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