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Investigation of the Electro-sprayed Water Micro-droplets Using Optical Methods (Extended Abstract)

Mostafa Elsayed Hassan*
Supervisor: Zdenko Machala†, Mário Janda

Department of Astronomy, Earth Physics and Meteorology, FMFI UK, Mlynská dolina, 842 48 Bratislava

Atmospheric air plasma created in contact with water creates acidic solutions containing reactive oxygen and nitrogen species (RONS), which are effective in killing bacteria in biomedical applications [Burlica R et al., 2010].

The transport phenomena of various RONS from the plasma into water, which have various Henry's law solubility coefficients, is determined by the water droplet size [Machala Z et al., 2019].

We apply two optical techniques to control the electro-sprayed deionized water droplet size and density and investigate the transport of the gaseous plasma species into the liquid through the plasma-liquid interface.

The first technique is the photodetector method which used to detect the light intensity signal decrease caused by passing the electro-sprayed water droplets through the light beam of the strong white LED. The second technique is the fast camera imaging method which records photographs (CASIO EXILIM, with typical record parameters 60 fps and shutter speed 40,000) of the magnified electro-sprayed water droplets using a convex lens during illumination with the strong white LED.

The diameter (d) of the electro-sprayed water droplets is estimated in the first technique from the relative decrease of light intensity that is directly proportional to the ratio of droplet shadow size and the active detector area, while in the second technique from the photograph sequences after processing and analyzing by software (Microsoft Office Picture Manager and GIMP). The droplet size distribution histograms were created for each technique after analysis of several waveforms and 20 groups of photographs (60 photos for each group), as shown in Figure 1.

We found the most abundant droplets are with d=20-40 μm using both techniques. We assume the camera did not detect all droplets with a diameter <20 μm correctly because some of the microdroplets deviated from the focusing plane of the lens and camera. Also, the camera exposure time=25 μs is not short enough to detect all droplets precisely and so they appear elongated.

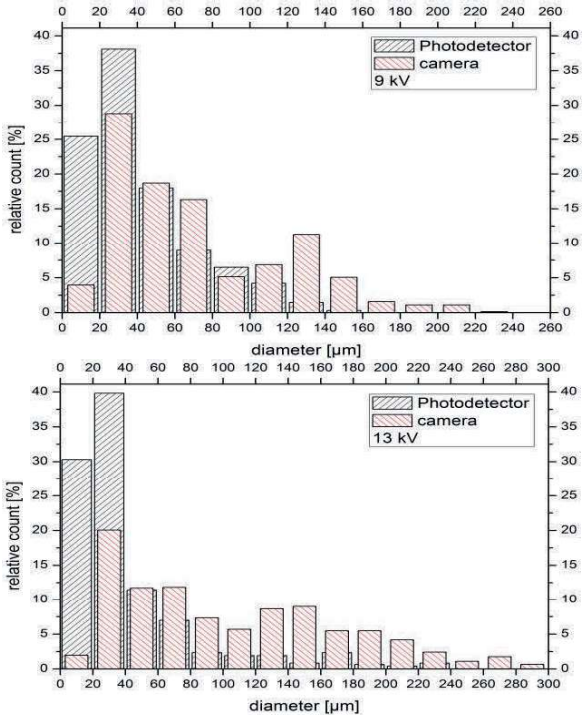

Figure 1: Microdroplet size distribution

The camera imaging technique demonstrated a good correlation with the size distributions measured by the photodetector technique.

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* Mostafa.Hassan@uniba.sk
† machala@fmph.uniba.sk