Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **197** Type: **Oral Competition (Undergraduate Student) / Compétition orale (Étudiant(e) du 1er cycle)**

(U*) Statistical analysis of pulsed spark discharges in dielectric liquids

Wednesday, June 9, 2021 5:10 PM (15 minutes)

Currently, the focus of plasma discharges in liquid is mainly to produce nanoparticles, to remove pollutant from water or to transform liquid fuels. In this paper, we aim to put forward a statistical study of the influence of various discharge parameters (e.g. applied voltage, pulse width, nature of liquid and electrode geometry) on the discharge characteristics, such as the discharge probability, the breakdown voltage, the discharge current and others. These characteristics are monitored as a function of time, until the moment when no discharges occurred. Although the mechanisms that lead to a gas breakdown are well-reported, those describing a breakdown in liquid are far to be completely understood. This is partially due to multiple phenomena that are not present in gas, such as phase change, presence of impurities, or the presence of microbubbles. In this paper, the time evolution of the discharge is mainly due to electrode erosion that induces i) an increase of the interelectrode gap, a modification of the electrode geometry, and a change in liquid properties. Each experiment lasted between 400 and 38 000 discharges, depending on the four parameters mentioned previously. This study goes beyond a qualitative analysis as we will introduce predictive models of the injected charges as a function of the average current and the discharge delay (or a model of the injected energy as a function of the average power and the discharge delay). The findings allowed further understanding of the discharge behavior based on its voltage-current characteristics. Furthermore, our results can be utilized in the context of the production of nanoparticles, where a control of the discharge characteristics is required.

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Session Classification: W4-4 Application of Atmospheric Pressure Plasmas II (DPP) / Applications des plasmas à pression atmosphérique II (DPP)

Track Classification: Plasma Physics / Physique des plasmas (DPP)