Analytical Calculation of Corona Discharge Thresholds for Arbitrary Electrospraying Geometries

Cornelius Louwrens Pieterse[1], Paul Papka[2], and Willem Jacobus Perold[1]
[1]Department of Electrical and Electronic Engineering
[2]Department of Physics
University of Stellenbosch, South Africa
e-mail: clpietese@sun.ac.za

***Abstract*— Electrospraying is a well-known process during which nanoparticles are generated and charged by means of an electrostatic field. From the literature, it is clear that the use of nanoparticles is essential to make advances in the fields of industrial and medical applications in the near future. Currently, this process is limited by corona, and complete discharges, due to the highly inhomogeneous electric fields generated by these geometries. This work proposes a new analytical model to be used for approximating the corona onset thresholds for general electrospraying geometries. Previously, similar work was published by the author, although that model is primarily dependent on knowing the polarization fields generated by the given geometry, which was based on numerical results. In this work, an improved model is presented for calculating these polarization fields. Apart from Buraev and Vereshchagin, only Borra et al. published quantitative results on electrospraying corona discharges. Jaworek et al. noted in the most recent study on corona discharges that this phenomenon was still not studied sufficiently and that it is generally not considered in the models found in literature. The newly proposed model from this work is analytical, which is favored above the numerical results. This model agrees with the experimental results of other researchers and also with the previous model itself. Using this model, it is possible to calculate the maximum surface tension of the liquids to be electrosprayed for arbitrary geometries.**