A Study of the Charge Carrier Population for an Electrically Assisted Polonium 210 Ionizer in Nitrogen

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***Abstract*— Air ionizers are used to add a balanced population of negative and positive charge carriers to the air to dissipate surface static charge. Some processes require a pure Nitrogen atmosphere . Such applications include high temperature chambers where oxidation can be a problem and low temperature environments where liquid Nitrogen is required for cooling. A pure Nitrogen atmosphere is a challenge for an ionizer since it is so difficult to create negative ions of Nitrogen.**

This paper discusses the use of a hybrid electrical ionizer previously reported. It uses the kinetic energy of Alpha particles to create ion pairs and electric fields to propel them toward the target object. This ionizer produces a flux of air ions which is intrinsically polarity balanced (conservation of charge dictates) and discharges objects to zero Volts. In a pure Nitrogen atmosphere, it was found to produce a moderate offset in voltage caused by an imbalance in the delivery of the two polarities of charge carriers. This is not the case when an electrical acceleration mechanism is not employed.

In order to understand the difference between the performance of the ionizer in air and in Nitrogen, a wide bandwidth (~1 MHz) picoAmmeter circuit was used to collect the charge carriers from corona and hybrid Alpha ionizers in a glove box. It was found that the negative charge carrier signal from the hybrid Alpha ionizer was prompt (~ 1 us) over a distance of 20 cm but the arrival of the positive charge carriers was ~100 ms. In air, however, the two times were nearly equal.

From this we conclude that the negative charge carriers are free electrons and the positive charge carriers are positive Nitrogen ions as compared with O-*n H2O and N+ n H2O in air. Given that information, the mechanism for charge carrier delivery in Nitrogen is primarily laminar flow and for the electrons it is primarily the Coulomb force.