SIMCO® Ionization for Electronics Manufacture, © October 2005

Ionizer Emitter Pin Cleaning

Introduction

Emitter electrodes in ionizing systems for electrostatic charge control will become contaminated with environmental residues over time and these residues will compromise performance by reducing ion density and by generating particles.

Emitter tips should be cleaned once per quarter at a minimum. Consider more frequent cleaning if significant residues accumulated between cleanings.

The production of semiconductors, flat panel displays, disk drives, and medical devices involve a series of complex manufacturing processes. During manufacture, careful control of each process step and the environment is essential to insure consistent yields and quality products.

Many of the manufacturing processes used require non-conductive materials and isolated conductors. These materials generate and retain large charge potentials. Electrostatic charge is one variable found throughout the process that if left uncontrolled, affects both the yield rate and the quality of finished product. Control of electrostatic charge (static) in cleanroom manufacturing processes is critical.

Ionizers add molecules to the air that have the ability to carry charge. These charged air molecules are able to neutralize electrostatic charge on both insulators and conductors.

Corona Ionization

Electrically based, corona technology is the most widely used ion generation method for electrostatic charge control. Several types of commercial electrical ionizers are currently in use and all operate on the corona principle. Electrical ionizers generate ions by concentrating an electric field on a point. The three common types of corona ionizers are:

- AC
- Steady State DC
- Pulsed DC

Negative ions are produced in close proximity to emitter points driven by a negative power supply. Ions are generated in the plasma of the corona around the emitter. In the corona region, weakly bound electrons are driven from orbit and attach to a molecular cluster. The resulting negative molecule is repelled from the like charged emitter.

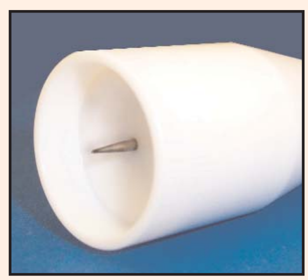
Positive ions are produced in the area around emitter points driven by a positive power supply. The free electron is attracted back to the positive polarity emitter point. In this case the resulting positive molecular cluster accelerates away from the like charged electric field of the emitter electrode.

Ion current strength is a function of applied voltage, emitter geometry, and conductivity. Duration of applied voltage influences the ion current strength and the distance the ions are capable of traveling.

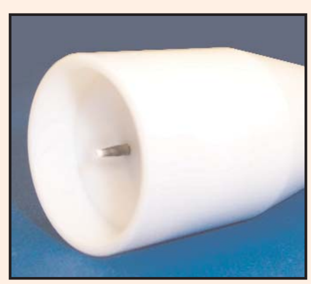
Ion current is affected by environmental conditions such as temperature, humidity, atmospheric pressure, and proximity to ground planes. Closely controlled environments such as minienvironments and cleanrooms eliminate much of the environmental variance concern for ionization.

A great deal of activity takes place at the emitter of an ionizer. The corona region at the tip of the emitter is a field of complex chemical reaction that results in the creation of ions, but also causes precipitation of trace elements from the environment onto the emitter. These deposits appear as a white substance at the end of the emitter electrode and are commonly referred to as white "fuzz". (Figure 1).

In a paper titled "Clean Corona Ionization" (Hobbs, Gross, Murray 1990), researchers found that the overwhelming percentage of particles identified on ionizer emitter tips was ammonium nitrate (NH_4NO_3). In the same study it was demonstrated that contamination problems could be avoided by isolating emitter electrodes in an environment of clean, dry air. The primary cause of emitter electrode contamination was found to be the result of interactions between the ionizers concentrated high voltage field and ambient humidity.



Clean Emitter Pin



White "fuzz" on Emitter Pin

Figure 1

Reduction in emitter performance

The buildup of deposits on the emitter electrode impacts ionizer performance. Deposits cause an increase in the emitter electrical resistance. Without a means of compensation this condition will cause a reduction in ion emission. With control and a means of compensation the result is a reduction in ionizer efficiency.

Ionizers designed with active feedback and control means are capable of compensating for dirty emitters. And to a point, deposition on the emitter will have no measurable performance impact. In these systems increased emitter resistance causes the power supply to increase output. Both the chemistry of the deposits and the increased drive level experienced by the emitter will result in a shortened life. A dirty emitter condition causes accelerated emitter wear.

The better ionizers on the market today contain an active feedback system to control output. A number of methods are used but the better methods function to maintain the selected output current level. As resistance increases on the pin the measured output current drops and the ionizer power supply must increase voltage in order to maintain the selected output current level.

The problem escalates when the power supply is running at its highest output level and is no longer capable of maintaining the selected output current. At or near this point a properly designed ionizer will issue a fault condition warning. This is a condition the user should avoid by properly cleaning and maintaining the emitter pins.

	BEFORE CLEANING	AFTER CLEANING
POSITIVE PIN VOLTAGE	7140	6460
NEGATIVE PIN VOLTAGE	7260	5960
POSITIVE DRIVE %	35.2	29.3
NEGATIVE DRIVE %	30.5	28.4
POSITIVE R EFFECTIVE / PIN	9.4X10E9 Ohm	8.5X10E9 Ohm
NEGATIVE R EFFECTIVE / PIN	9.8X10E9 Ohm	8.0X10E9 Ohm
POSITIVE CURRENT / PIN	0.76uA / pin	0.76uA / pin
NEGATIVE CURRENT / PIN	0.74uA / pin	0.74uA / pin

Run time 300+ hours. Ionizer utilizing current controlled closed loop feedback.

Emitter Cleaning Method

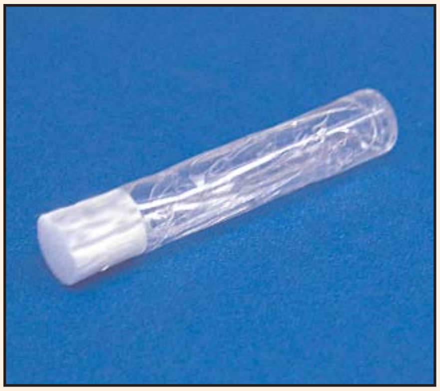


Figure 2

Figure 3

Figure 4

Given the contamination build up that occurs on the emitter tips over time, it is necessary to clean the tips at regular intervals to maintain optimum system performance. Disconnect power to the emitter tips before cleaning. The most convenient cleaning method is to use a pre-wetted swab such as shown in Figure 2. This type of swab is shipped with a protective sleeve covering the white foam swab end.

To use the swab, the protective sleeve is removed to expose the white foam swab end. The swab incorporates an inner glass vial of alcohol inside of a plastic tube. The inner glass vial is crushed by squeezing the plastic tube, then tipped so that the foam swab end is down to allow the alcohol to wet the swab.

The wetted swab end is carefully inserted onto the emitter point (Figure 3) slowly rotated, then withdrawn. This procedure is repeated until all visible deposited material has been removed (Figure 4). Each swab may be used to clean between 5 to 8 emitters, depending upon the amount of residue on each tip. When the swab fails to remove the residue, a new swab should be used. All emitter points in the ionizer assembly are cleaned in this manner. After waiting a few moments for the alcohol to evaporate, power to the ionizer assembly is reapplied.

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