SIMCO ION™
An ITW Company

TECHNICAL NOTE

Recommended Annual Maintenance

In-Line Ultra-clean Gas Ionizer Model 4214

Simco-Ion's Model 4214 ultra-clean in-line ionizer is designed to operate with 99.999% nitrogen gas. Ionization with pure nitrogen requires more precise control than ionization with air. Basic physics tells us a pure nitrogen ionizer must operate within a limited voltage-and-current domain. In contrast, an air ionizer can tolerate a wide voltage and current domain.

The 4214 is designed to be self-adjusting. Operator interaction is not needed on a daily basis for continued effective ionization. For this convenience, an annual maintenance plan is recommended to keep self-balancing components within their design parameters. There are two maintenance items: (1) changing the emitter assembly and (2) replacing the internal filter.

Deposit buildup can be expected even when operating a 4214 with nitrogen gas. Changing the emitter assembly restores the initial emitter characteristics that will result in continuous, effective ionization.

Although the internal filter within the 4214 could be used for years of efficient particle removal, Simco-Ion recommends changing the filter based on constant flow rate rather than particle removal. A constant flow rate is one of the design parameters that support the self-adjusting capability.

Composition of Emitter Buildup

SEM/EDX testing was performed at the Illinois Tool Works (Simco-Ion's parent company) Test Laboratory. An emitter from a Model 4214 ionizer that was previously used in the field was selected for testing.

SEM/EDX is a combination testing technique. The SEM (scanning electron microscope) procedure provides a high resolution picture of the emitter under test. The EDX(energy dispersive X-ray) procedure provides information on what elements are present at each location. A resultant graph will be displayed for each measured location.

Test Results

Operating the 4214 with nitrogen produced the expected result of silicon and nitrogen deposits on the emitter. Repeated sampling shows that silicon oxide is the major buildup component.

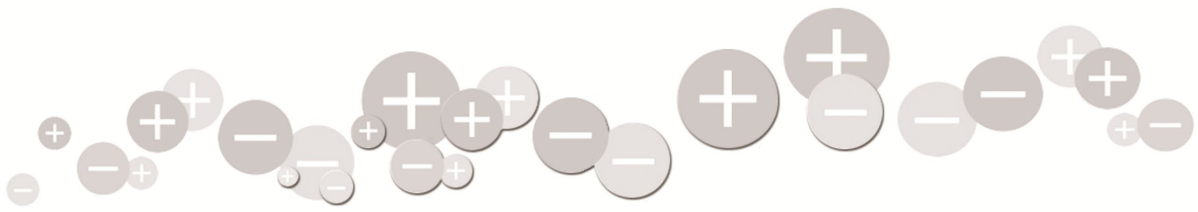
Nitrogen was the next major deposit material found during our analysis.

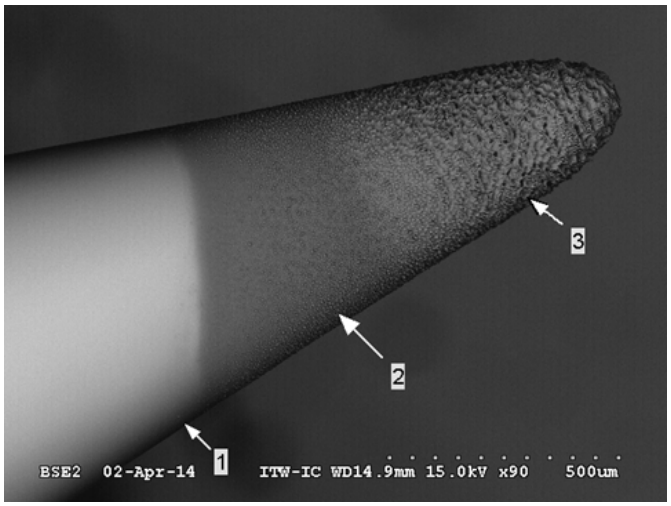
Carbon and fluorine were found at minor levels although it may be possible that human sample handling contributed to the addition of these materials to the emitter buildup.

Supporting Data/Major Elements by Energy Dispersive X-Ray (EDX)

1. Measurement Locations

   To document emitter deposit buildup, three positions on a used emitter were sampled for chemical analysis. They are shown in the picture below.



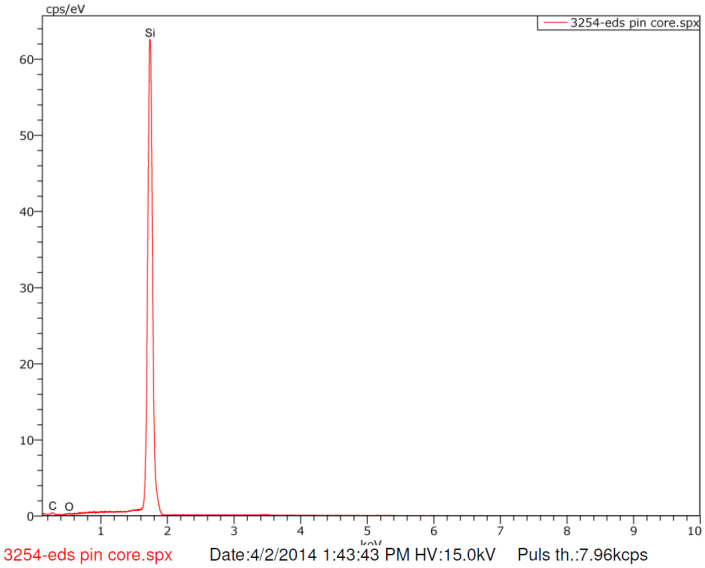


- Location 1 is a position on the emitter shaft, distant from the corona zone.
- Location 2 is in the point base, between the shaft and the tip.
- Location 3 is at the emitter tip, in the corona zone.

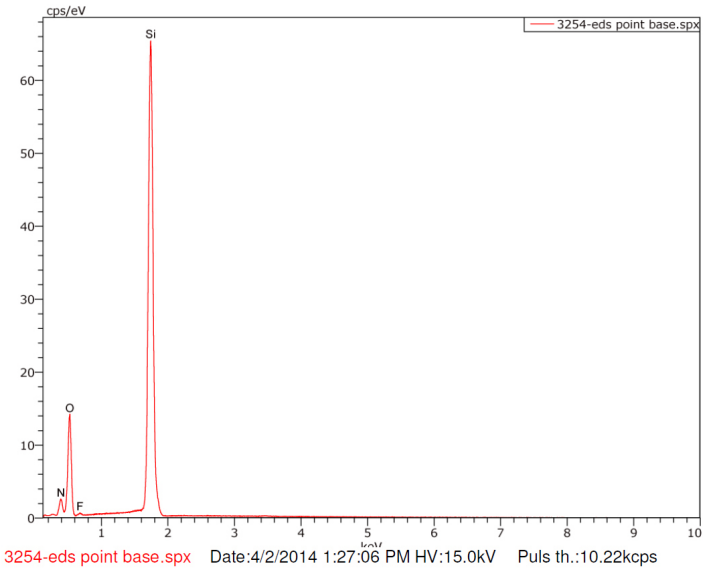
2. Chemical Results

The spectra below shows elemental composition at each of the 3 measured locations. In each graph, the elements present are defined their peak positions on the X-axis. Each peak is labeled with its chemical symbol [C = carbon, O = oxygen, N = nitrogen, and Si = silicon]. The amount of each element is quantified by either the height of its peak or the area under its peak.

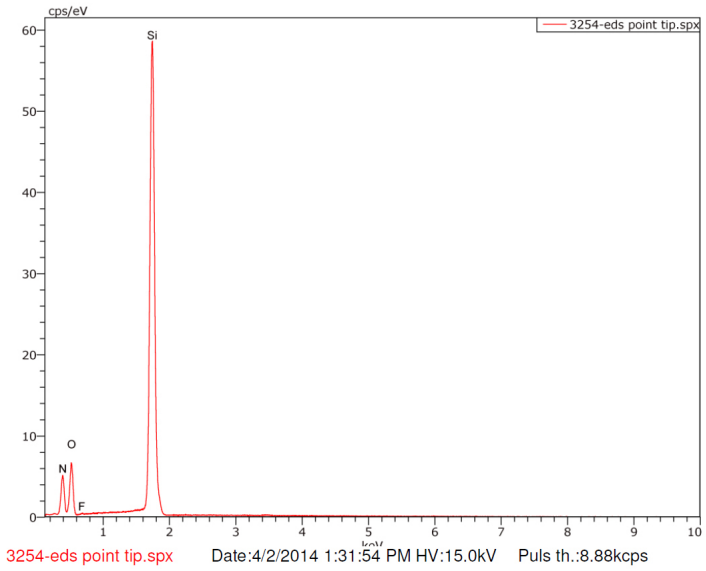
Location 1



Location 2



Location 3



At the silicon emitter tip (Location 3), both oxygen and nitrogen are reported. The oxygen peak is larger than the nitrogen peak. At the point base (Location 2), the ratio of oxygen to nitrogen is greater than is shown at the emitter tip.

The pin core (Location 1) shows silicon with trace levels of oxygen or nitrogen. This suggests neither nitrogen nor oxygen react significantly with silicon in a non-energetic emitter zone.

3. Buildup Sources

   The presence of silicon and nitrogen was predictable. The emitter is single crystal silicon, and it is surrounded with 99.999% nitrogen. Corona plasma provides the activation energy that can create a deposit of these elements.

   The presence of oxygen may arise from trace oxygen in the 99.999% nitrogen.

   Oxygen exposure might also relate to repairs, installations and similar operator interaction. An unmasked operator doesn't interact with the work area until the chamber approaches 21% oxygen. During that period, air will diffuse into the Model 4214 ionizer unless the nitrogen flow is continued. For safety reasons, nitrogen most likely will be turned off.

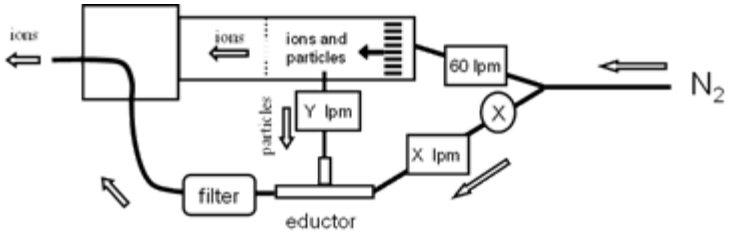
4. Recommendation: Annual Maintenance

   The testing and analysis of the testing results confirm the deposit of SiO2 found on the emitter in the Model 4214 ionizer. Annual maintenance of the Model 4214 will be required for uninterrupted, problem free ionization of the target area. Depending upon the use of the Model 4214, annual maintenance is considered a conservative estimate as to the frequency required for cleaning of the ionizer.

Maintaining Designed Internal Flow Rates

Particles have lower mobility than ions. The design of the 4214 creates a balance of ions flowing out while holding particles in. Ions flow outward with the air flow while particles are diverted through a filter.

The 4214 applies a vacuum to the emitter tip during operation that creates the designed balance. For each condition, there is an optimal educator vacuum flow. This is diagrammed below. An excessive buildup of particles restricts the flow of air within the 4214. The restriction in the filter could change the flow (Y) to a lower, less optimal, level.



Note: This is a simplified drawing illustrating the concept used to ensure cleanliness of the ionizer.

Recommended Yearly Maintenance Supplies

The following consumable parts are recommended for an annual replacement:

Description	Model 91-4214-04	Model 91-4214-03/-03A
Silicon emitter point replacement kit	71-24219-04	71-24219-01
Filter cartridge replacement kit	33-24214-41	33-24214-41

All parts are available from your local Simco-Ion distributor or contact Simco-Ion to determine who your local authorized distributor is. Instructions for replacing either of these consumable items can be found in the Model 4214 User's Manual. If further assistance is needed, call Simco-Ion Technical Support at 1-510-217-0470.

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