SIMCO ION™
An ITW Company

Technical Note

Emitter Points

ESD Solutions Through Superior Emitter Point Technology

Ionization has been used for decades to reduce losses caused by static charges. Until 1984, ionizer emitter points were commonly made of stainless steel. When the semiconductor industry moved to production requiring Class 10 conditions, these stainless steel emitter points were identified as an unacceptable source of particles. Pure tungsten and thoriated tungsten emitter point materials were substituted in 1985 as possible solutions to this problem. Further research indicated that these materials were generally acceptable in Class 100 conditions, but their tendency to produce episodic particle bursts was unsuitable in better quality environments. Another tungsten alloy was investigated and found to produce acceptably low particle levels without the particle bursts.

As the specifications for cleanrooms continued to improve, research in emitter point materials produced alternatives to tungsten-based materials. Machined titanium emitter points reduced the level of particles by almost an order of magnitude compared to tungsten, and they are the standard for most cleanroom ionization outside the semiconductor industry. In semiconductor manufacturing, the problem of “killer particles” remained to be solved. Any metallic particles falling on the wafer surface may be processed into the silicon and result in a defect site. The need to eliminate metallic particles from ion emitters was the impetus for Ion’s patented single crystal silicon emitter points. Introduced in 1992, these points have reduced particle levels by a factor of 40 compared to tungsten, and cannot produce killer particles.

Single Crystal Silicon

Ion’s patented single crystal silicon emitter points represent the cleanest option available in the industry. Far exceeding Class 1 cleanliness requirements, these non-metallic points produce no particle bursts and emit an average of less than 5 particles per cubic foot (less than 0.05 microns in size verified with condensation nucleus (CNC) and optical particle counters).

Class compatibility:	Class 1 or better
Estimated life:	2-4 years
Maintenance interval:	Recommended 3 months depending on environment conditions
Replacement interval:	Recommended 3 years

#22-0375 (.65”)
with sleeve

Products:
Model 4630 (pre serial #6001), 4610TF-U

#22-0365 (.86”)
with sleeve

Products:
Models 4190U, 5225U, 5285EU, 5585EU, 5685U

#22-0360 (.86”)
without sleeve

Products:
Models 5184, 5509EU, 5511U, 5512U

#22-0376 (.48”)
without sleeve

Products:
Models 4630EU (from serial #6001 on) and 4632EU

#22-0390 (1.28”)

Products:
Models 5290EU/5292EU

Tungsten Alloy

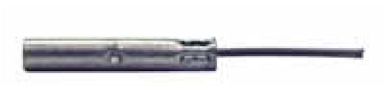
The most common material in industrial ionization applications, tungsten alloy offers long emitter point life and low maintenance requirements. Ion's tungsten alloy emitter points will not erode as quickly as conventional tungsten wire, and fewer particle bursts result in cleaner operation.

Class compatibility:	Class 10 and higher recommended
Estimated life:	3-5 years
Maintenance interval:	Recommended 3 months
Replacement interval:	Recommended 4 years

#22-0405 (.86")

Products:
Models 5810, 5802T, 5810T, 6412A

#33-1890
(.86")



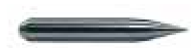
Products:
Models 4610TF, 5285, 5585T

Machined Titanium

Ion's titanium needles are recommended for many cleanrooms. Titanium emitters meet Class 1 requirements for particle emissions, erode less quickly than tungsten, produce no particle bursts, and are easily maintained.

Class compatibility:	Class 1 or better
Estimated life:	2-4 years
Maintenance interval:	Recommended 3 months
Replacement interval:	Recommended 3 years

#22-0356 (.58")

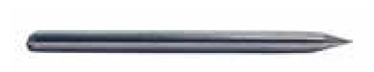


Products:
Models 5802i, 5810i

#22-0350
(.86")

Products:
Models 5285E, 5285EC, 5509EC, 5511C, 5585C, 5685C, 5810i-4C

#22-0380
(1.32")



Products:
Models 5290EC, 5292EC

Cleanliness Data

The table below details particle levels for a number of emitter point materials. Results on single crystal silicon, machined titanium, tungsten alloy, pure tungsten, and silicon carbide points were taken in an isolated ultraclean test chamber with 450 cu.ft./min. (55 ft./min) of laminar airflow to simulate cleanroom operating conditions. All measurements were made with a condensation nucleus counter particle counter as most particles from air ionizers are under 0.05 microns in size. Please note that all data is presented in units of particles per cubic foot.

Results on germanium are from a paper written by a manufacturer of emitters using these materials. Since the test method used does not simulate cleanroom conditions, it probably overstates particle levels. For instance, the flow rate was only about 0.05 cu.ft/min., compared to 450cu.ft./min., which better replicates an average cleanroom. In addition, the emitter points were placed 16mm from a ground electrode, which would never happen in a cleanroom.

Clearly, more testing should be performed on germanium to accurately characterize it. For more information on testing methods that replicate cleanroom conditions, please refer to the attached paper, "Method for Measuring Particles from Air Ionization," by Michael Yost and Al Lieberman.

Electrode Material	Electrode Type	Particles - Average/cu.ft.	Cleanroom Class
Single crystal silicon	Needle	5	better than Class 1
Machined titanium	Needle	21	better than Class 1
Tungsten alloy	Wire	54	Class 10-100
Pure tungsten	Wire	200	Class 100
Silicon carbide	Needle	30	Class 1-10
Germanium	Needle	1,764,000** (63/cm3)	Unsuitable for cleanroom use

Additional Considerations

It should also be remembered that when choosing a material for use in a cleanroom environment, there may be other emitter point issues besides particle levels. The semiconductor industry is extremely concerned about any level of metallic particles. Single crystal silicon emitter points match the requirements for low particles and for being non-metallic. On the other hand, disk drive production and many other critical applications requiring low particle levels use either silicon or titanium emitter points. In many cleanroom applications, the critical particle size is decreasing. It is not good practice to allow large numbers of very small particles from emitter points, as these may be larger than the critical size with the next change in the product technology. In general, cleanroom compatibility requires consideration of many different ionizer characteristics besides the choice of emitter point materials.

In electronics assembly, medical applications, and most areas outside high quality cleanrooms, any of these emitter point materials may be used, but wire points should be avoided when precise ionizer balance is required.

Please contact Ion Systems for additional information concerning emitter point materials and cleanroom compatible ionizers.