

TB-118 Aluminosilicate Ion Sources

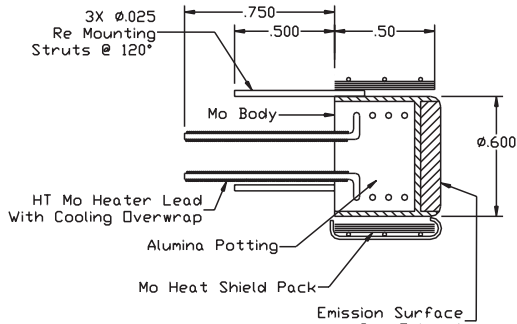
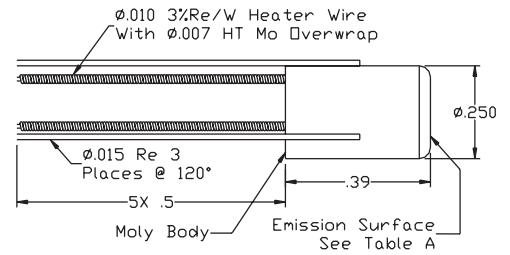


Figure 1
Model 101142 Ø.600 Ion Source
(Includes Shield Assembly)



Model 101139 Ø.250" Ion Source



Thermionic emission of positive ions from solid materials has been known for many years.¹ The best ion emitters are known to be a group of minerals called aluminosilicates.² Ion emitters fabricated from these materials are relatively easy to use and find a variety of applications including mass spectroscopy, accelerators, plasma synthesis, plasma diagnostics, atomic physics and ultrahigh vacuum overlayer studies.

The ion emitters are particularly suited to low energy experiments (less than 100eV) where ion beams with small energy spreads are essential. The ion emitter material has the advantage that it does not react with the atmosphere. At high pulse voltages, the emitted ion current exhibits the Schottky effect; that is, increasing ion current with increasing extraction voltage. Mass analysis of beams from these ion emitters indicate that there are small amounts of impurities (alkali ions other than the desired one) present when the emitter is first heated but the levels decrease rapidly within several hours of heating leaving ion beams of very high purity. The impurity fraction of the ion beam decreases as the temperature of the ion emitter material increases.

While the exact ratio of ions to neutral atoms emitted is not known, it appears that ions predominate by a very large factor. Negative ion and primary electron emission are not normally observed. Current densities of 1-10 mA/cm² are achieved at operating temperatures between 950°C and 1100°C_B.

Figure 1 shows a typical 101142 emitter consisting of an indirectly heated, porous plug into which the emitter material has been fused. The molybdenum body holding the plug is machined with a solid partition for complete isolation between the emitter and the heater cavity. Three rhenium support struts are brazed at a 120 degree spacing yielding a ductile and versatile mounting tripod. The heater is a non-inductively wound coil of molybdenum wire solidly potted into the body cavity with high purity Al₂O₃. The heater leads are overwrapped with Molybdenum wire for greater reliability. The emitter matrix is an extremely porous tungsten heliarc welded to the Molybdenum heater body. The ion emitter material is placed on the emitter face in controlled amounts and melted into the porous tungsten in a Hydrogen atmosphere. A simple heat shield consisting of three dimpled layers of .002 inch thick Molybdenum foil is attached (101142 only) around the assembly by brazing at 2000°C.

Ion emitter material may be Spodumene, B-Eucryptite (Li₆⁺ or Li₇⁺ is available by using isotopically purified Li₂CO₃ in preparing the emitter material), cesium, sodium, rubidium, or potassium. Experimental units have been fabricated using barium, calcium, beryllium, strontium, magnesium, and aluminum. Ion emitters may also be fabricated to yield ion beams of mixed ions.

Alkaline Metals: Cs, K, Li₆^{*}, Li₇^{*}, Na and Rb

* Li₆ is standard if isotope is not specified. Both are Beta Eucryptite.

* Li₇ isotopically pure is also available by request only.

* Li₆ and Li₇ Spodumene by request only.

Alkaline Earths:** Ba, Be^{***}, Ca, Mg, Sr, Al

** Alkaline Earth sources are considered experimental and are quoted on a best efforts basis only.

*** Be is quoted separately and by special arrangement as components are hazardous.

Combined mixes: Any of the above can be combined into any mix ratio.

1. O.W. Richardson. "The Emission of Electricity from Hot Bodies", Longman's, Green and Company, London, 1916.

2. J.P. Blewett and E.J. Jones: Phys. Rev. 50, 465, (1936).

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