MULTI–SAMPLE CS–SPUTTER NEGATIVE ION SOURCE

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Negative ion sources based on the sputter principle have been used for many years for injection into tandem electrostatic accelerators for fundamental nuclear and astrophysics research applications, and for applied research such as Accelerator Mass Spectrometry (AMS), high-energy ion implantation and modification of materials. In addition, these sources are being used in a variety of low-energy, atomic and molecular physics research applications and for batch mode, radioactive ion beam generation for astrophysics and nuclear physics research. For applications that require short-duration, beam-on-target, it is desirable to be able to quickly and remotely change samples without vacuum disruption to save time and to preserve similar surface conditions between samples. A multi-sample Cs sputter negative ion source, equipped with a conical-geometry, W-surface ionizer has been designed, fabricated, and extensively evaluated that permits sample changes without disruption of on-line accelerator operation. Sample changing is effected by actuating an electro-pneumatic control system located at ground potential that drives an air-motor-driven sample-indexing-system mounted at high voltage; this arrangement avoids complications associated with indexing mechanisms that rely on electronic power-supplies located at high potential. In-beam targets are identified by LED indicator lights derived from a fiber-optic, Gray-code target-position sensor. The source is illustrated schematically in Fig. 1. The source consists of five main assemblies: the high-voltage acceleration electrode assembly; the ion source module; the vacuum-air-lock assembly; the H_2O-cooled, rotary-motion target-holder assembly; and the indexing mechanism/target position read-out assembly. The samples are screw attached to a Cu or Al holder that in turn, is screw attached to a H_2O cooled Cu heat-sink assembly. The assembly is mounted at sample-plus-source potential. The sample holder is offset relative to the optic axis of the source so that a simple rotary motion can be executed to move individual samples into beam position. Because of physical restrictions in radius, in combination with the type of indexing mechanism chosen for moving samples into beam position, the sample holder is limited to eight, 7.9-mm diameter samples. The belt-driven, coolant shaft is vacuum-sealed with a low friction, ferro-fluidic rotary-motion feed-through. To date, the single sample version of the source has been utilized to generate *dc* negative ion beams for a variety of species, including: Li^- (3–12μA); C^- (160–275 μA); B^- (30–60 μA); O^- (250–310 μA); F^- (50–110 μA); Si^- (300–440 μA); P^- (90–125 μA); S^- (60–110 μA); Cl^- (100–150 μA); Ni^-

(80–120 μA); Cu^- (100–150 μA); As^- (50–60 μA); Se^- (30–100 μA); Ag^- (50–90 μA); Pt^- (40–80 μA); Au^- (20–50 μA). The normalized emittance ε_n of the source at the 80% contour level is ε_n ~8.5 π mm.mrad(MeV)$^{1/2}$.

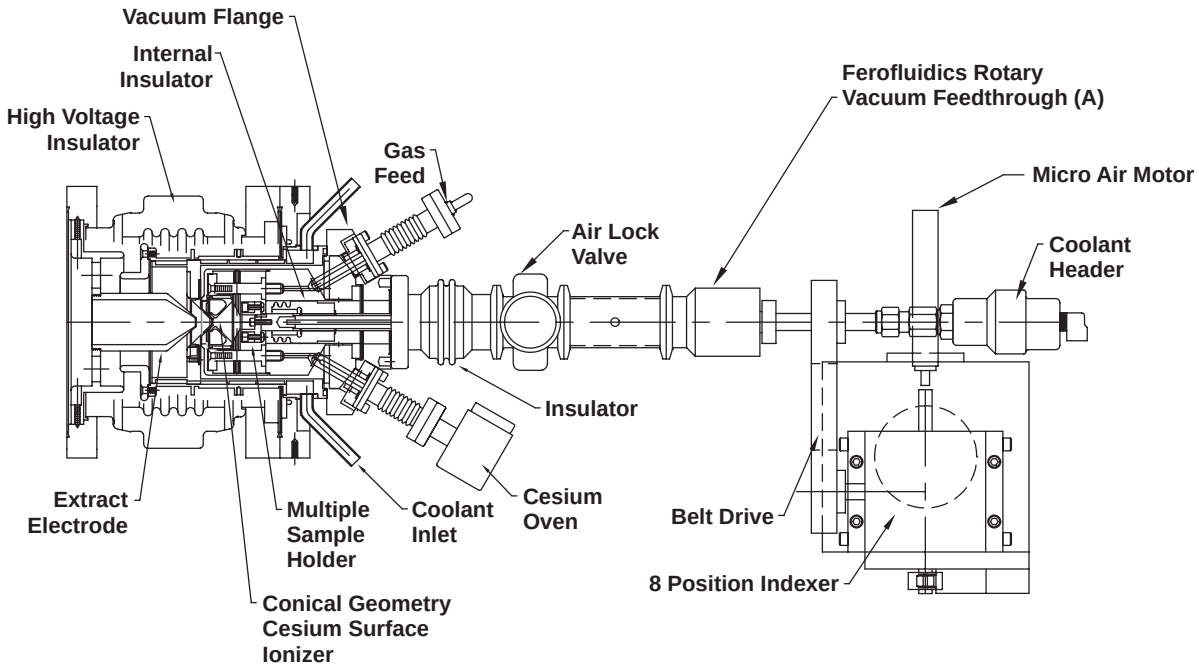

Fig. 1. Multiple sample negative ion source (top view).

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