Title
SUMMARY OF REMARKS MADE AT SHERWOOD CONFERENCE IN BERKELEY, FEBRUARY 1955 THE OCCLUDED-GAS ION SOURCE

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Lawrence Ruby

March 3, 1955

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SUMMARY OF REMARKS MADE AT SHERWOOD CONFERENCE IN BERKELEY, FEBRUARY 1955

THE OCCLUDED-GAS ION SOURCE

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March 3, 1955

As one phase of an effort to develop a suitable ion source for the magnetic mirror machine, a program[1,2] involving work on an occluded-gas ion source has been under way in Berkeley. This source embodies a method of obtaining large quantities of ions and electrons from hydrogenated titanium. The plasma is released when a spark is initiated on the surface of the metal. To achieve this in vacuum, a capacitor or pulse line is discharged across a sandwich of titanium separated by a thin insulator. The insulator has the function of lowering the threshold voltage for a discharge. In this form, the source has been used in several experiments reported elsewhere herein (cf. papers by Frederic H. Coensgen and Winston H. Bostick).

When consistency is a factor, a stack of such metal-insulator elements is used to average out individual variations in the sparks. A typical stack is 0.25 inch in diameter and 1 inch long. As first developed the stack was clamped between two stainless steel support rods to give a filamentlike appearance. The discharge proceeded down some irregular path on the surface of the stack. Because the plasma was unconfined no success was experienced in accelerating an ion beam by using an aperture electrode adjacent to the source. However, several hundred amperes of ions were drawn off the plasma by surrounding the source with a collector biased a few volts negative.

In a second geometrical arrangement, the stack has been made hollow and the discharge has been confined to the inside surface. To do this it has been necessary to add a third electrode, which triggers the discharge along the proper path. With only a small area of the plasma at one end of the stack exposed to the extractor, it has been possible to obtain accelerated ion beams by several methods. With axial symmetry and a 3/32-inch source opening, 10 ma at 10 kv have been extracted with an aperture electrode, and 250 ma, correspondingly, with a grid electrode. In addition, ions have been extracted radially using both slot and grid electrodes. Pulse lengths have ranged from 10 microseconds to 1 millisecond at rates as high as 5 pps.

In the mass emission spectrum H^+ dominates H_2^+ by a factor of three. Other ions ranging in mass up through titanium are present, and their distribution is influenced by the particular material used for the insulators.

Because of its compact size it will be possible to put a source right into the mirror region of the 6-inch machine (tabletop). Additional advantages are that no auxiliary magnetic field is required by the source and that the only neutral gas injected is a small amount accompanying the ion emission.

REFERENCES

1. L. Ruby, Special Developments Project Progress Report to February 1, 1954, UCRL-2552.
2. L. Ruby, Special Developments Project Progress Report to November 1, 1954, UCRL-2775.