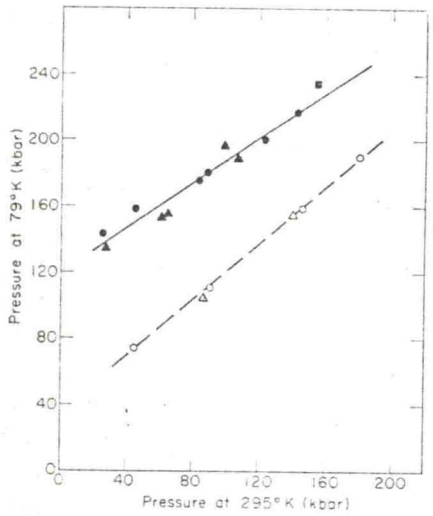

FIG. 2. Pressure intensification at liquid nitrogen temperature. Be–Cu cell: ●—NaF, ▲—Al, and ■—MgO. Steel cell: ○—NaF and △—Al.

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Simple Design for an Ion Source of the Oscillating Electron Beam Type

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A MAJOR requirement of ion implantation doping of semiconductors is the production of stable ion beams of sufficient intensity in the desired ion species to allow one to achieve the doping levels required in semiconductor device fabrication in a reasonable time period. The accelerator we are using is a 300 kV Cockcroft–Walton machine manufactured by Texas Nuclear. Such machines are often equipped with a low power rf source (120 W), which is quite adequate for gases which do not decompose into condensable species. Such a source is not adequate for extended operation with gases such as BF_3 or PF_5 since the output quickly degrades—presumably due to the shorting effect of the condensed film on the walls of the source. In this note we wish to report on the design of a lightweight source which is simple to construct and which can be used as a direct replacement for the conventional rf source.

The source that we are describing is an oscillating electron source. In this source, electrons emitted from a heated filament oscillate in helical paths through a hollow anode between two ground planes under the combined action of the electric field and a magnetic field from a solenoid. The theory of operation of such a source has been studied in detail.[1,2]

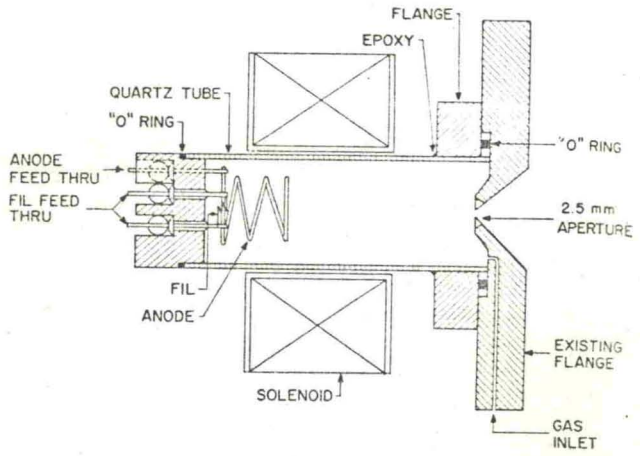

FIG. 1. Schematic drawing of the oscillating electron source.

The mechanical construction of our source is shown in Fig. 1. The body of the source is quartz tubing (3.5 cm diam and 9 cm length) which is sealed to a stainless steel or aluminum flange with epoxy. This flange is made to fasten directly onto the ion source base flange supplied for use with the rf ion source. The only modification necessary in the latter flange is the use of a circular aperture (2.5 mm diam) instead of the metal exit canal and quartz sleeve used with the rf source. The filament (0.18 mm W) and the anode (0.635 mm Mo) are attached to feedthroughs fastened in a stainless steel end plug. The vacuum seal to the quartz tubing at this end is made by a Viton O-ring as shown. The anode is made in the form of a

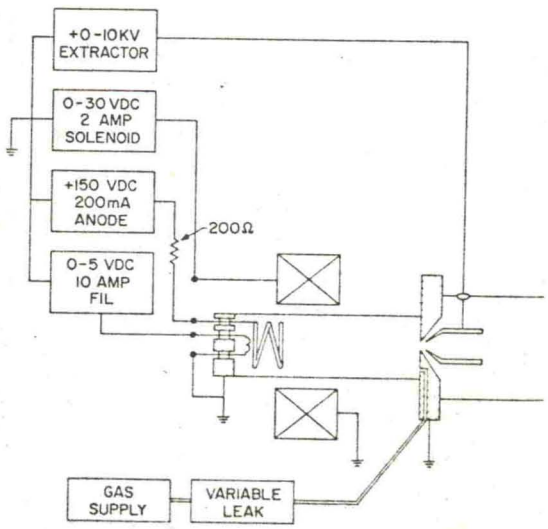

FIG. 2. Schematic drawing of the wiring diagram for the oscillating electron source.