

A HIGH VACUUM WATER-COOLED ROTATABLE  
SPUTTER CATHODE

Michael L. Rappaport

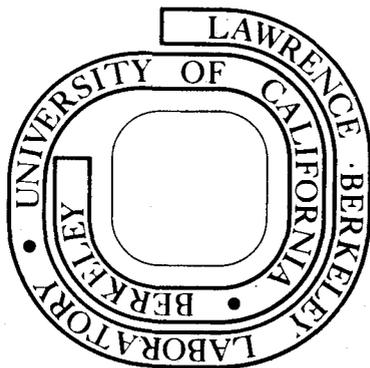
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ABSTRACT

A water-cooled rotatable sputtering cathode is described. It can be rotated with pressure bursts of  $< 10^{-9}$  Torr in a system which attains  $4 \times 10^{-9}$  Torr.

In an experiment on the proximity effect between superconductors and normal metals, we required metal foils (e.g., Cu and Ag) with no surface contamination on either side onto which we could evaporate precisely positioned disks of Sn or Pb. A method of cleaning the foils which has worked for all metals of interest is sputter-etching. Described below is a sputter cathode in which such specimens were made. It meets these criteria: 1) allows both sides of the foils to be sputter-etched; 2) rotates the sputter-etched surface over the boat for vapor deposition; 3) does not recontaminate the cleaned surface during rotation; 4) masks the foils precisely on both sides; 5) keeps the foils cool during sputtering and evaporation in order to prevent diffusion of one metal

into the other.

The sputter electrodes, boat, and shutter-guard are shown in Fig. 1. The shutter-guard allows outgassing of the evaporant and prevents discharge to the baseplate during sputtering.

The details of the flange containing the cathode are presented in Fig. 2. The heart of the assembly is a metal-glass-metal seal, A, made of two 35mm o.d. stainless-to-Pyrex graded seals. The right end is capped with a plate containing two stainless (nom. 3/16") Swagelok<sup>1</sup> butt weld male connectors, B. Water-cooling tubes, C, are soldered to the left sides of the connectors before the plate is welded to the glass-metal seal. Aluminum tubing, D, is welded to one of the aluminum masks, E, and is swaged with aluminum ferrules.<sup>2</sup>

Welded to the left end of the glass-metal seal is a 12.7mm o.d. x 1.6mm stainless tube, F. This tube was polished with emery paper and metal polish until it had a mirror finish, free of scratches, over the length in contact with the Teflon<sup>3</sup> ferrules of the bored-through Swagelok connector, G.

The water-cooling tubes, C, which also serve as voltage leads, are isolated from the grounded tube, F, by a tube of 1.6mm wall Teflon,<sup>3</sup> H. Discharges from the anode to high voltage sections other than the masks is prevented by the guard, I, and high voltage extension, J. The guard is a split thin wall stainless tube welded to a ring which is clamped to the grounded side of the metal-glass-metal seal. The extension is similarly constructed and is clamped to the aluminum tubes. It is important that there be no gap between the extension and the glass-metal seal.

The cathode assembly is supported in a stainless collar, K, and is rotated by a handle, L, clamped to tube, F. The handle also keeps the cathode from being pushed inward by atmospheric pressure.

The cathode has been baked repeatedly at 120°C in a system which attains  $4 \times 10^{-9}$  Torr. With the Teflon ferrules tightly clamped, it can be rotated with pressure bursts of  $< 10^{-9}$  Torr.

The temperature of the specimens while sputtering at 5kV and 20mA is  $< 60^\circ\text{C}$ . This was conveniently measured by sputter etching Al foil glued to a set of temperature sensitive disks which turn black irreversibly at rated temperatures.<sup>4</sup>

The cathode can also be used without modification for sputter deposition of two different metals. If disks of the target materials are attached to the welded mask with screws of the same materials, then a substrate supported at the edge of discharge area can be coated with each metal.

#### ACKNOWLEDGEMENTS

I would like to thank Dr. John Coburn of IBM, San Jose for the idea of the metal-glass-metal seal; Dr. James B. Kruger for useful suggestions; and Walter Schwartz for careful construction.

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REFERENCES

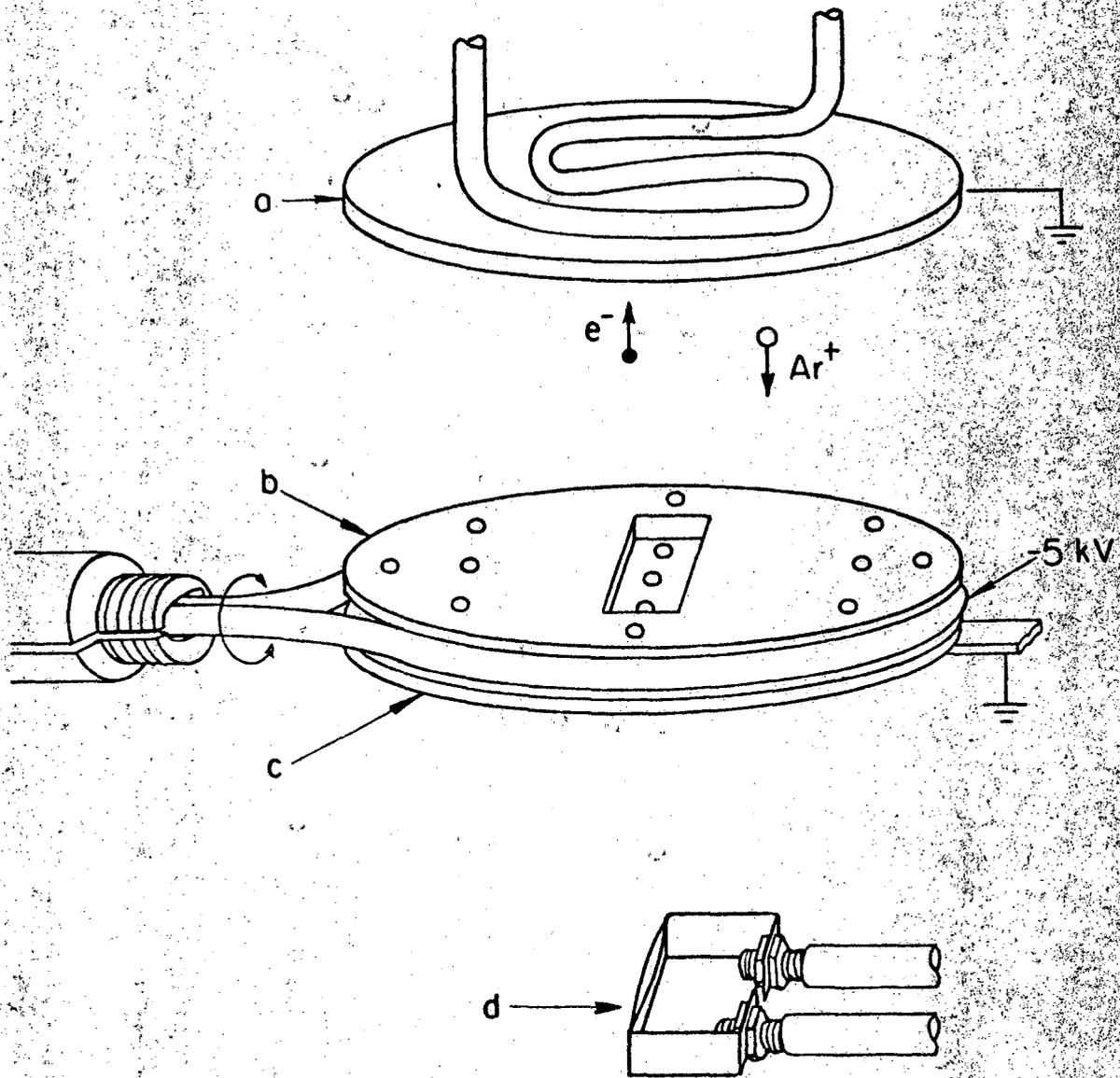
\* Present address: Department of Physics and Astronomy, Tel-Aviv University, Israel.

1. Crawford Fitting Company, 29500 Solon Road, Cleveland, Ohio 44139.
2. Stainless steel ferrules do not seal reliably on aluminum or copper tubing.
3. Trademark of E. I. duPont de Nemours and Co.
4. Omega Engineering, Inc., Box 4045, Stamford, Conn. 06907.

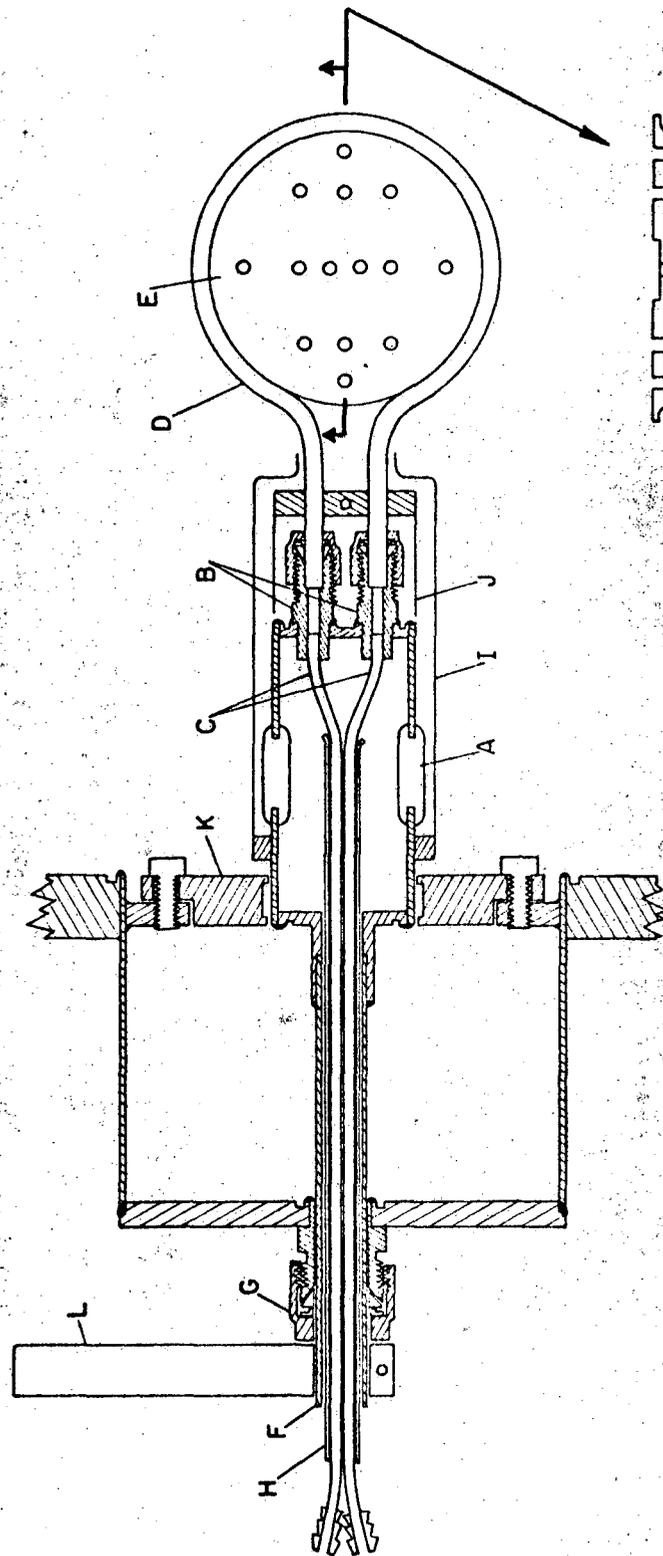
FIGURE CAPTIONS

Fig. 1. Discharge area with evaporator boat. a) Liquid nitrogen cooled sputter anode; b) Sputter cathode; c) Magnetically actuated shutter-guard (pulled to right before rotation of cathode and during evaporation); d) Evaporator boat.

Fig. 2. Section of flange containing sputter cathode. Cross-hatching indicates stainless steel. All welds (solid black) are TIG. Insert: section of masks showing welded water-cooling tube and aligning pins.



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