

# Lawrence Berkeley National Laboratory

## Recent Work

**Title**

SUPERCONDUCTING Pb TO Nb UNIONS

**Permalink**

<https://escholarship.org/uc/item/8cr0677h>

**Author**

Rappaport, Michael L.

**Publication Date**

1974-10-01

SUPERCONDUCTING Pb TO Nb UNIONS

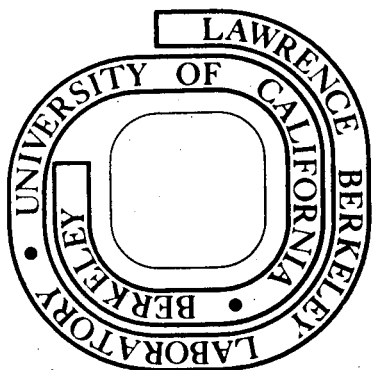
Michael L. Rappaport

October, 1974

Prepared for the U. S. Atomic Energy Commission  
under Contract W-7405-ENG-48

**For Reference**

Not to be taken from this room



## **DISCLAIMER**

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

## Superconducting Pb to Nb Unions

Michael L. Rappaport

Department of Physics, University of California  
and  
Inorganic Materials Research Division,  
Lawrence Berkeley Laboratory,  
Berkeley, California 94720

## ABSTRACT

Two simple methods of making superconducting unions which can be soldered to Pb and spotwelded to Nb are described.

Because niobium oxidizes so rapidly and forms such a tenacious oxide, it is not possible to solder to it by conventional methods. It has therefore been inconvenient to make small, robust superconducting connections between Nb wires and Pb leads, e.g., in circuits with SQUIDS. Described here are two methods of fabricating unions which are only  $\sim 1 \times 1 \times 4$  mm and weigh  $\sim .1$  gm, yet have critical currents of  $\sim 10$  mA at 4.2K and  $> 100$  mA at the  $\lambda$ -point.

The first method requires an electron beam gun. A short length ( $\sim 5$  mm) of 1.6 mm diameter 5N- grade Sn wire is placed on a water-cooled

copper plate in a vacuum system. The middle of a rectangle ( $\sim 6 \times 20$  mm) of technical grade .125 mm Ta foil ( $T_c = 4.5K$ ) is then set on top of the wire.

After evacuating to  $\sim 10^{-6}$  Torr, the foil is heated to incandescence with an electron beam gun. Near the melting point of  $Ta_2O_5$  ( $1800^\circ C$ ), the Sn melts and wets the foil. Because the area of the Sn in contact with the water-cooled plate is increased, it immediately cools below its melting point and the process stops. The beam gun<sup>1</sup> power required is  $\sim 3$  kW.

The Ta foil, with Sn covering the center, can then be cut with a scissors into strips  $\sim 1$  mm wide and with Sn on one end. Pb wires can be soldered to the Sn and Nb wires spotwelded to the Ta.

The second method requires the fashioning of a shallow boat out of the Ta foil similar to that used in evaporation. A short length of 5N-grade Sn wire is melted in the boat in a vacuum of  $\sim 10^{-5}$  Torr. When the boat is hot enough, the Sn will wet the surface. The unions can then be cut as in the first method.

Although the  $T_c$  of Sn is 3.7K, the solder used to attach the Pb wires penetrates down to the  $SnTa_3$  ( $T_c = 6.0K$ ) interface which is presumably formed, and the Pb wire-union-.125 mm Nb wire system has a critical current of  $\sim 10$  mA at 4.2K.<sup>2</sup>

Similar results were obtained with the second method when fluxless 60/40 Sn/Pb solder was substituted for the pure Sn. It should also be possible to substitute Nb foil for the Ta. Then the unions should be usable up to  $\sim 7K$ , the critical temperature for Sn/Pb solder.<sup>3</sup>

## FOOTNOTES

- \* This work was supported by the U.S. Atomic Energy Commission.
1. A Veeco VeB-6.
  2. 10 mA is the critical current for the spotweld. The Sn-Ta interface has  $I_c \sim 1$  A at 4.2K.
  3. W. H. Warren and W. G. Bader, Rev. Sci. Instr. 40, 180 (1969).

LEGAL NOTICE

*This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.*

TECHNICAL INFORMATION DIVISION  
LAWRENCE BERKELEY LABORATORY  
UNIVERSITY OF CALIFORNIA  
BERKELEY, CALIFORNIA 94720