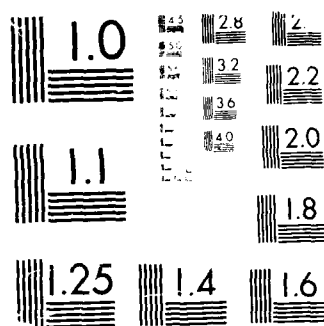


AD-A192 959 EQUIPMENT FOR BUILDING AND TESTING SUPERCONDUCTIVE FLUX 171
FLOW ELECTRONIC D. (U) WISCONSIN UNIV-MADISON DEPT OF
ELECTRICAL AND COMPUTER ENGINE. J E NORDMAN ET AL.
UNCLASSIFIED 30 NOV 87 AFOSR-TR-88-0303 AFOSR-87-0061 F/G 9/1 NL





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Final Report
to
Air Force Office of Scientific Research
for
DOD Equipment Grant #AFOSR-87-0061
entitled

**EQUIPMENT FOR BUILDING AND TESTING SUPERCONDUCTIVE FLUX FLOW
ELECTRONIC DEVICES**

Submitted by
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The equipment authorized by the grant is a thin film vacuum deposition system containing provisions for ion beam and magnetron sputter deposition and for ion beam etching. A system with an estimated total cost of \$240,000, manufactured by Ion Tech Incorporated, was specified in the budget request. When the grant funds arrived in November 1986, this specification was then sent out for bids. Attractive competing bids were offered by Ion Tech, Perkin Elmer, Commonwealth Scientific, Oxford, and American Plasma Tech. After careful comparison of features and company reputations, it was decided to buy the system from American Plasma Tech. For essentially the same money as the Ion Tech system, it was possible to obtain a significantly better quality system containing better valving, better vacuum flanges and feedthroughs and more sophisticated process control. The fact that the basic system would be more leak tight than the Ion Tech system was considered a very important advantage because the superconductor films which we intend to fabricate with the system are extremely sensitive to gaseous impurities. The penalty we paid was simply that the builder has less experience with ion beam deposition than Ion Tech and this necessitated our being more closely associated with the final design and also with some final installation of components.

The system was delivered near the end of July 1987. Installation was nominally completed by the middle of August. However there have been a number of initial problems which are still being worked on by the builder. These entail some design errors in the sputtering target holder, power supply interlock errors, custom feedthrough design problems and an incomplete data logging capability. As we have worked with the vendor to cure these problems, we have also performed a number of tasks necessary to properly characterize the system performance before it is ready for routine use. These tasks

include tests and characterizations of the ion guns, characterization of the end point detector and installation of a residual gas analyzer purchased with other funding. We anticipate resolution of all significant problems will be completed before the end of December, at which time the system should be fully operational.

Initially, the system will be used to produce very thin high quality niobium films needed for transmission line structures in our research on superconductive thin film electronic devices under AFOSR Grant #86-0025 entitled, "Vortices in Long Josephson Junctions". It is expected that the good vacuum and ability to ion bombard the growing film will allow purer films to be made than is done currently in this laboratory. The deposition is possible with both magnetron sputtering and ion beam sputtering in this new system. After establishing a technique for depositing good Nb films, we will add nitrogen gas to the sputtering atmosphere to make NbN films. Although this is presently being done with an existing system, we expect better control with this new system. Because of its well controlled etch capability, we expect to eventually use this system for all of the crucial steps in the fabrication of NbN based Josephson tunnel junction circuits.

Presently, there is a considerable world-wide effort to develop good techniques for thin film deposition of the new high transition temperature superconductors, in particular $Y_1Ba_2Cu_3O_7$. We have given careful consideration to using this new system for that purpose because of the considerable potential offered by the ability to bombard the growing film with ions. We have decided that, at this time, it is more practical to devote this deposition system to Nb and NbN device work. However, if it becomes clear in the future that the oxide superconductors will be usable in Josephson devices, it will be possible to convert the system fairly rapidly. At present, we are attempting to make good oxide superconductor films with more conventional sputtering techniques.

It is expected that this vacuum deposition system will be a very useful tool for the thin film research efforts the the College of Engineering for at least 10 years. For the foreseeable future, it will be used exclusively for superconductor electronic device research. However, it is basically a very versatile, high quality system that will ultimately find use by graduate students involved in other areas of thin film research as well. At the present time there are more than 10 professors in the college involved in some type of thin film research with their graduate students.



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EQUIPMENT LIST OF DUAL ION BEAM THIN FILM DEPOSITION SYSTEM

This equipment consists of a stainless steel vacuum jar fitted with a large number of components including pumps, valves, ion sources, shutters, flanges, windows, various types of feedthroughs, gauge tubes and associated electronic control and monitors. The list, below, includes the manufacturers of the major components of the system. Most components were purchased by American Plasma Tech (APT), and installed in the system by them.

Pumping System:

-CVI 10" cryopump, 2 mechanical pumps (Leybold), trap lines, interlocks, gauges, valves (VAT gate valve)	
-process controller (APT using HP Vectra PC)	\$58,924

Vacuum Chamber:

-26" diameter by 30" long stainless steel (APT)	
-all conflat ports, feedthroughs (Ferrofluidic rotaries)	
-two windows, liners, coolant pump	33,349

Target, substrate holders (Ion Tech) targets	20,715
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Ion Guns:

-15 cm and 5 cm sources, power supplies (Ion Tech)	
-two gas controllers (Ion Tech)	
-six MKS flow controllers, gas regulators, installation	95,570

To inch sputter gun, power supply (US Inc.), installation	9,745
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End point detector (Xinix)	16,725
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Miscellaneous:

-sputtering sensor	1,160
-thermocouples for substrate	506
-instrument rack	920
-shipping	<u>2,300</u>

TOTAL	\$239,914
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