ELECTRO-OPTICAL SYSTEMS, INC.

TRANSMITTAL OF PROGRESS REPORT

Date 10 May 1963

TO: Lewis Research Center
Space Electric Power Office
21000 Brookpark Road
Cleveland 35, Ohio
Attn: Gerald R. Brendel

Reference (Contract No.) NAS 3-2529

Report No.	3410-ML-5	Date of Issue	8 May 1963
Short Title	Vapor Thermionic Converters	Covers Period	April 1963
Classification	U ~~XXXXXX~~	EOS Classified Doc. No.	

Transmitted herewith are the required copies of the progress report described above. Fund and labor reports, if required, are included and distributed as tabulated below. Should additional information be desired, please direct your inquiries to the undersigned.

Very truly yours,

ELECTRO-OPTICAL SYSTEMS, INC.

Al M. Carnesciali

Al M. Carnesciali, Manager
Contract Administration

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Monthly Progress Report
19 March 1963 to 19 April 1963

RESEARCH PROGRAM RELATED TO VAPOR THERMIONIC CONVERTERS FOR NUCLEAR APPLICATION

Prepared for:

Lewis Research Center
Space Electric Power Office
21000 Brookpark Road
Cleveland 35, Ohio

Contract NAS 3-2529

EOS Report 3410-ML-5 8 May 1963

Prepared by

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ELECTRO-OPTICAL SYSTEMS, INC. - PASADENA, CALIFORNIA

CONTENTS

1. INTRODUCTION

This is the fifth monthly report of progress on contract NAS 3-2529, a research program related to vapor thermionic converters for nuclear application.

2. PROGRAM STATUS

2.1 Process Investigation Studies

2.1.1 Process Specimens

The process investigation studies were summarized in EOS report 3410-Q-2 (second quarterly report under contract NAS 3-2529). Quantitative information of molybdenum bar and plate stock grain growth as a function of process time and temperature was reported. In addition, the process specimen microstructure was observed and qualitatively discussed. We feel that an important facet of this investigation is to identify the crystal orientation associated with the various grain patterns present in this microstructure.

At present, we are indexing with a diamond point the grains which have various patterns of interest in the observed microstructure. The indexed grains are then analyzed by X-ray diffraction techniques for preferred crystal direction. After obtaining this initial information, the specimens will be operated for 100 hours or more at 1800^{O}K to determine if there is any further selective growth in the microstructure.

2.1.2 Pole Figures

The (100) pole figure of a plate stock molybdenum sample in the "as received" condition was determined by the method described in the second quarterly report. As can be seen from Figure 2-1, this sample does not have the large degree of preferred orientation that the bar stock exhibited. The plate stock sample is more randomly

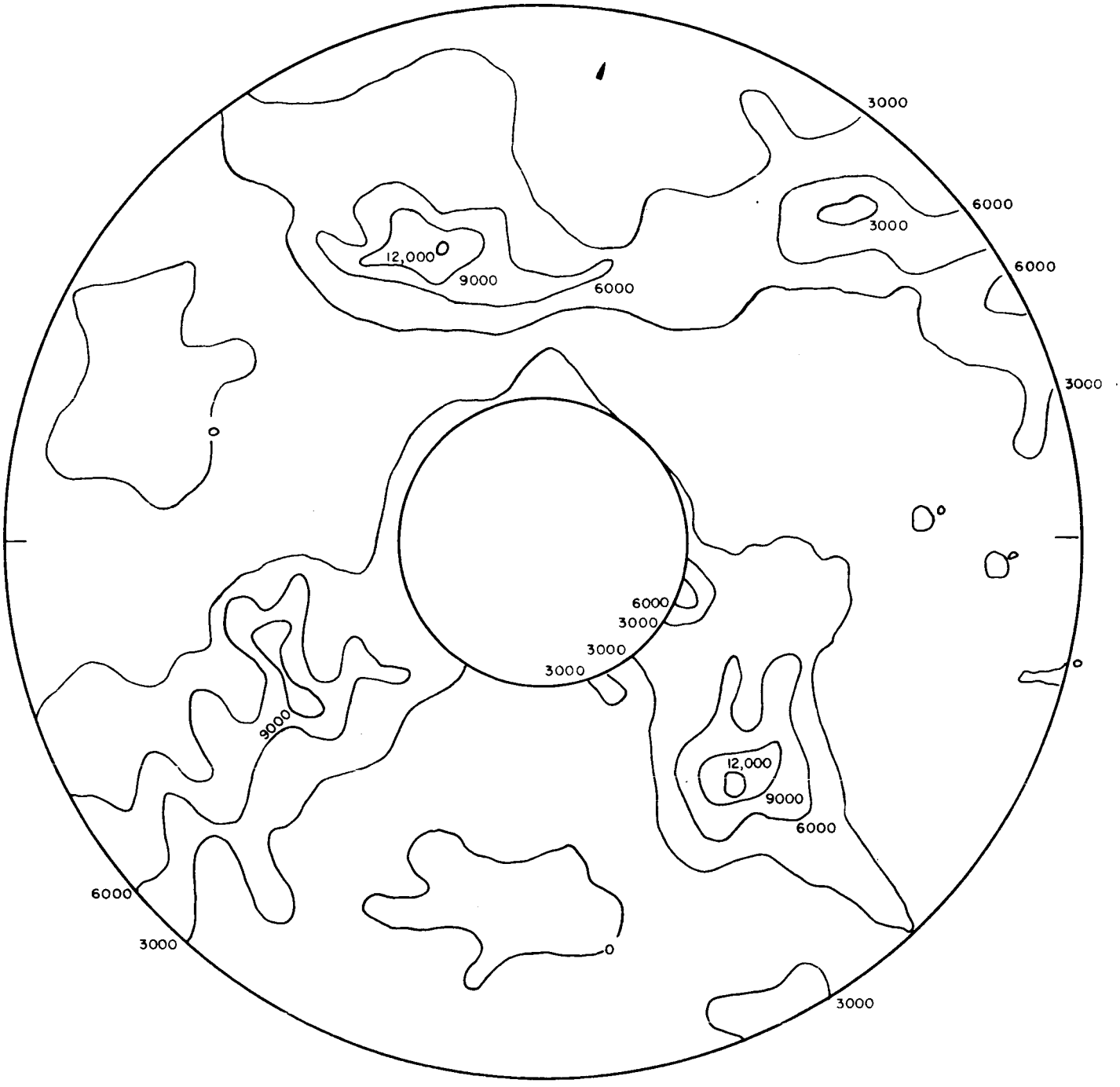

FIG. 2-1 POLE FIGURE OF RECRYSTALLIZED PLATE STOCK

oriented with a smaller amount of preferred texture. The (111) plane is parallel to the specimen surface.

2.2 Grain Growth Investigation

2.2.1 Vehicle Fabrication

The vehicles for long time grain growth studies of molybdenum and cesium vapor have been fabricated. Samples for this investigation have been processed according to the schedule outlined in EOS report 3410-Q-2. Reviewed briefly, the specimens were divided into separate categories: rod and plate stock. Two rod stock specimens received initial outgassing of 1700°C and 1900°C for 30 minutes, respectively. Two plate stock specimens received identical time at temperature treatment. These schedules were chosen to allow for sufficient outgassing of contaminants, yet provide two different initial grain sizes for grain growth comparison.

The vehicles and samples will receive a final outgas before the introduction of high purity cesium. Once loaded with cesium, the vehicle will commence operation.

2.3 Cesiated Emission Investigation

An emission test vehicle has been assembled and fabricated. The final metal-to-ceramic vacuum seal was completed and the device tested leak tight on a helium leak detector of high sensitivity (1.8×10^{-11} stan. cc/sec.) The vehicle is being loaded with cesium on a Varian appendage pump. Testing will commence immediately after cesium is admitted to the vehicle.

2.4 Electron Emission Microscope

The preceding report (3410-Q-2) showed two of the first pictures of the image of a hot emitter surface which have been obtained with the aid of the electron emission microscope. In these pictures, details of the emitter surface were clearly visible and in focus, indicating that the lens and phosphorous green were functioning properly. The variations in brightness in the image of the emitter surface indicate

that areas of different work function were clearly delineated on the clean molybdenum surface.

The first experimental operation of the electron emission microscope indicated a need for more careful shielding of the electron beam of the microscope from the stray magnetic field of the ion pump magnet. This shielding is being accomplished by separating the magnet and the ion pump from the electron beam region by a greater distance and enclosing the pump and magnet in a high permeability box to shield the electron beam from stray magnetic fields. Stray magnetic fields on the order of 20 gauss have been found to have a very serious affect on the formation of proper images.

3. PROGRAM FOR NEXT INTERVAL

During the next month effort will be primarily applied to the gathering, reduction, and analysis of data from the various test vehicles.

3.1 Sample Processing Investigations

We will continue to classify and identify the microstructure of the process specimens. The preferred crystal direction associated with the microstructure will be established by X-ray diffraction techniques.

3.2 Grain Growth Investigation

The vehicle for the cesiated grain growth study will be put into operation during this next reporting period.

3.3 Cesiated Emission Investigations

We will gather and reduce data from the cesiated emission test vehicle. The results will be plotted as typical Langmuir "S" curves and where possible compared to other emission data for molybdenum.

3.4 Electron Emission Microscope

During the next interval the electron beam region of the microscope will be shielded from the stray magnetic field of the ion pump magnet and the microscope put back into operation to gather time at temperature information on surface crystal structure characteristics of molybdenum emitter samples.

4. FINANCIAL STATUS

Man-hours, dollar expenditures, and purchase committments from 19 March 1963 to 19 April 1963 are submitted as a separate enclosure to this report.

5. PROGRESS DESCRIPTION

We estimate that approximately 64 percent of the program has been completed.

6. PRINCIPAL CONTRIBUTORS

The following personnel have been principal contributors to the program over the past period.

A. O. Jensen, A. E. Campbell, D. G. Worden, W. Dong, H. Todd

ELECTRO-OPTICAL SYSTEMS, INC.

13 May 1963

Contract # NAS 3-2529
Status Report as of 20 April 1963

	Expenditures To Date	Remaining Balances
Hours:	6,724.00	3,776.00
Costs:	$82,608.96	$50,758.04
Committments:		$1,669.25

By_____
S. L. Kuhn
Assistant Controller