REPORT DOCUMENTATION PAGE

AFRL-SR-BL-TR-01-

0475

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	August 2001	FINAL REPORT 1 Apr 00 - 31 Mar 01

4. TITLE AND SUBTITLE
(DURIP00) THERMAL ANALYSIS AND POTENTIOSTATIC INSTRUMENTS FOR RELAXOR FERROELECTRIC RESEARCH

5. FUNDING NUMBERS
F49620-00-1-0234

3484/US
61103D

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
ARIZONA STATE UNIVERSITY
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
AIR FORCE OFFICE OF SCIENTIFIC RESEARCH
801 N. RANDOLPH STREET, ROOM 732
ARLINGTON, VA 22203-1977

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

20011005 115

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE, DISTRIBUTION IS UNLIMITED

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The funds provided by this grant was used to purchase a thermoanalytical balance, with additional thermal analytical capabilities, and a generalpurpose potentiostat/galvanostat in support of ongoing research on the thermochemistry of ferroelectric relaxors of ceramic system of PbO-MgO-Nb2O5-TiO2. This research is being carried out at Arizona State University, funded by a primary grant awarded by the AFOSR (ISSA-99-0013, entitled "Grain Growth in Relaxor Ferroelectrics"). The equipment includes a high vacuum system capable of maintaining better than 10-8 bar pressure in the measuring chamber. Early trials indicate that the equipment will provide the needed accuracy for the required measurements. An auxiliary differential thermal analyzer (DTA) was constructed out of individually purchased parts andcombined with existing equipment. This will enable testing of new compositionsprior to their introduction into the thermal analyzer and allow for a survey of general reaction behavior of the samples. In addition, this procedure was used as a precaution to identify situations of excessive corrosion that might damage the main instrument. A potentiostat/galvanostat was purchased with two purposes in mind. One was to develop a method of analyzing lead content in liquid metal probes embedded in lead oxide samples. This method is being attempted to provide thermochemical data that would corroborate the information obtained from the gravimetric experiments. The second purpose of this equipment was to be used in the development of mictrochemical cells designed to control the lead oxide vapor pressure to which ferroelectric relaxor materials are exposed during synthesis.

14. SUBJECT TERMS	15. NUMBER OF PAGES
	4
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
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Final Performance Report for Grant No. F49620-00-1-0234
(Sponsored by the Air Force Office of Scientific Research/NA)

"(DURIP00) Thermal Analysis and Potentiostatic Instruments for Relaxor Ferroelectric Research"

Submitted 30 August 2001 by

William T. Petuskey, Principal Investigator
Professor, Chemistry and Biochemistry
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Introduction

The funds provided by this grant was used to purchase a thermoanalytical balance, with additional thermal analytical capabilities, and a general purpose potentiostat/galvanostat in support of ongoing research on the thermochemistry of ferroelectric relaxors of ceramic system of PbO-MgO-Nb_2O_5-TiO_2. This research is being carried out at Arizona State University, funded by a primary grant awarded by the AFOSR (ISSA-99-0013, entitled "Grain Growth in Relaxor Ferroelectrics") to a scientific collaboration led by Dr. John Blendell of the National Institutes of Standards and Testing, Department of Commerce. Arizona State University's segment of this collaboration was funded via a sub-grant/contract (NIST # 60NANB0D0004/02, entitled phase Chemistry and General Thermochemistry of the PbO-PMN-$PbTiO_3$ System). The equipment resides at Arizona State University.

The financial forms 269 and 272 have already been submitted to AFOSR. Copies are included in the Appendices with this report as well. In addition, a breakdown of the specific equipment purchased, organized by manufacturer, is also detailed in the appendix.

Thermoanalysis Equipment

The thermoanalytical equipment purchased was selected after three companies responded to an open "request for bids" that specified the necessary operation requirements. The equipment selected and purchased was model **STA 449C/4/F Netzsch Simultaneous TG-DSC System** (manufactured by **Netzsch Instruments, Inc.**; 37 Industrial Blvd. Section D; Paoli, PA 19301; Tel: 610-722-0520; Fax: 610-722-0522). While not a deciding factor in the selection of this instrument, Netzsch Instruments, Inc., also supplied the magnesium oxide Knudsen cells that were needed to carry out the specific experiments intended for the new equipment. This equipment was selected on the basis of best cost advantage, and the fact that it possessed a configuration judged to be best for conducting Knudsen cell measurements. This equipment

includes a high vacuum system capable of maintaining better than 10^{-8} bar pressure in the measuring chamber. Early trials indicate that the equipment will provide the needed accuracy for the measurements. Currently, we are working out problems and installing modifications to improve long-term reliability.

An auxiliary differential thermal analyzer (DTA) was constructed out of individually purchased parts and combined with existing equipment. The purchase of this was to test new compositions prior to their introduction into the thermal analyzer. The purpose was to survey general reaction behavior of the samples, and preserve the time of the thermal balance for high priority measurements. In addition, this procedure was used as a precaution to identify situations of excessive corrosion that might damage the main instrument.

Electrochemical Equipment

A potentiostat/galvanostat was purchased with two purposes in mind. One was to develop a method of analyzing lead content in liquid metal probes embedded in lead oxide samples. This method is being attempted to provide thermochemical data that would corroborate the information obtained from the Knudsen cell gravimetric experiments. The second purpose of this equipment was to be used in the development of electrochemical cells designed to control the lead oxide vapor pressure to which ferroelectric relaxor materials are exposed during synthesis.

The equipment purchased was **Potentiostat/Galvanostat Model 263A** (manufactured by **Perkin Elmer Instruments, Princeton Applied Research**; 801 S. Illinois Ave.; Oak Ridge, TN 37831-0895; Tel: 800-366-2741; Fax: 865-425-1334); . Also purchased was a computer, data/control interface and software to drive the equipment. In addition, an aqueous microcell was purchased to conduct the compositional analyses of the liquid metal probes.

Financial Summary

Overall, this grant, with matching funds included, was budgeted for $118,710. Out of the AFOSR/DURIP contribution of $98,710, a total of $98,068.32 was expended leaving an unobligated balance of $642.68. Out of the University's contribution of $20,000, a total of $19,876.58 was expended leaving an unobligated balance of $123.42. Consequently, a total of $117,944.90 was expended.

Appendices Index

- Equipment Purchased and Items for Equipment Construction
- Financial Status Report: Form 269 (Official copy has been sent separately)
- Federal Cash Transactions Report: Form 272 (Official copy has been sent separately)

Equipment Purchased and Items for Equipment Construction

(Please note: This is not part of the official accounting but reflects the costs of items when ordered. Final adjustments that account for such costs as shipping and other costs are included in Other Miscellaneous Expenses. This table is meant to provide a general view of how the funds were apportioned between the different objectives.)

Thermal Analysis Equipment (Primary and Auxiliary Equipment)

Thermal Analyzer (STA 449C/4/F Netzsch Simultaneous TG-DSC System)	$86,650.00
Accessories & Spare Parts for Thermal Analyzer (Netzsch Instruments)	6,246.00
Computer and Monitor (USSI)	1,601.15
Printer (Sehi Computer Products)	358.27
Digital Multimeter w/multiplexer Card (Keithley)	1,672.00
Ceramic ware (Vesuvius-McDanel)	1,758.14
Alumina Knudsen cells, mold and cells (Ceramco)	1,681.31
Vacuum Pump (VWR Scientific)	1,410.81
Vacuum Pump gauge (MKS Instruments)	692.51
Magnesium oxide ware (Ozark Technical Ceramics)	210.00
Datalogger (Saelig)	445.20
Precious metals (Goodfellow)	434.70
Subtotal	**$103,160.09**

Electrochemical Equipment

Potentiostat/Galvanostat (Perkin Elmer Instruments)	$11489.00
Accessories for Pot/Galv (Perkin Elmer Instruments)	1,225.50
Computer and Monitor (USSI)	1,601.15
Printer (Sehi Computer Products)	358.27
Subtotal	**$14,673.92**

Other Miscellaneous Expenses	**$110.89**
Total Expended	**$117,944.90**

FINANCIAL STATUS REPORT

(Short Form)

(Follow instructions on the back)

1. Federal Agency and Organizational Element to Which Report is Submitted	2. Federal Grant or Other Identifying Number Assigned By Federal Agency	OMB Approval No. 0348-0038	Page of
AFOSR/PK - DURIP	GRANT #F49620-00-1-0234		1 1 pages

3. Recipient Organization (Name and complete address, including ZIP code)

ARIZONA STATE UNIVERSITY
Grant & Contract Accounting
PO Box 873503
Tempe, AZ 85287-3503

4. Employer Identification Number	5. Recipient Account Number or Identifying Number	6. Final Report	7. Basis
1-860196696-A1	MPE0004/MPX0014/RE	☐ Ye ☐ Nc	☐ Cash ☐ Accru

8. Funding/Grant Period (See Instructions) From: (Month, Day, Year)	To: (Month, Day, Year)	9. Period Covered by this Report From: (Month, Day, Year)	To: (Month, Day, Year)
04/01/00	03/31/01	04/01/00	03/31/01

10. Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$0.00	$0.00	$117,944.90
b. Recipient share of outlays	$0.00	$0.00	$19,876.58
c. Federal share of outlays	$0.00	$0.00	$98,068.32
d. Total unliquidated obligations			$0.00
e. Recipient share of unliquidated obligations			$0.00
f. Federal share of unliquidated obligations			$0.00
g. Total Federal share *(Sum of lines c and f)*			$98,068.32
h. Total Federal funds authorized for this funding period			$98,710.00
i. Unobligated balance of Federal funds *(Line h minus line g)*			$641.68

11. Indirect Expense	a. Type of Rate *(Place "X" in appropriate box)* ☐ Provisio ☐ Predetermin ☐ Fina ☐ Fixe			
	b. Rate	c. Base	d. Total Amount	e. Federal Share
	52.5%	$0.00	$0.00	$0.00

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation.

FINAL FSR

13. Certification: **I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.**

Typed or Printed Name and Title	Telephone (Area code, number and extension)
Bob Ryberg Accountant, Principal, Grant & Contract Accounting	(480) 965-2342 robert.ryberg@asu.edu
Signature of Authorized Certifying Official	Date Report Submitted June 21, 2001

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A)

OMB APPROVAL NO. 0348-0003

1. Federal sponsoring agency and organizational element to which this report is submitted
AFOSR - Defense University Research Instrumentation Program

2. RECIPIENT ORGANIZATION

Name : Grant & Contract Accounting
Arizona State University

Number and Street : P.O. Box 873503

City, State and ZIP Code: Tempe, AZ 85287-3503

4. Federal grant or other identification number: F49620-00-1-0234

5. Recipient's account number or identifying number: MPE0004-02R/RE

6. Letter of credit number: N/A

7. Last payment voucher number:

Give total number for this period

8. Payment Vouchers credited to your account:

9. Treasury checks received *(whether or not deposited)*: 0

3. FEDERAL EMPLOYER IDENTIFICATION NO. 1-860196696-A1

10. PERIOD COVERED BY THIS REPORT

FROM (month,day,year): 01/01/01 **TO** (month,day,year): 03/31/01

11. STATUS OF FEDERAL CASH *(See specific instructions on the back)*

a. Cash on hand beginning of reporting period	$14,626.64
b. Letter of credit withdrawls	$0.00
c. Treasury check payments	$0.00
d. Total receipts (Sum of lines b and c)	$0.00
e. Total cash available (Sum of lines a and d)	$14,626.64
f. Gross disbursements	$13,984.96
g. Federal share of program income	$0.00
h. Net disbursements (Line f minus line g)	$13,984.96
i. Adjustments of prior periods	$0.00
j. Cash on hand end of period	$641.68

12. THE AMOUNT SHOWN ON LINE 11J, ABOVE, REPRESENTS CASH REQUIREMENTS FOR THE ENSUING Days

13. OTHER INFORMATION

a. Interest income	$0.00
b. Advances to subgrantees or subcontractors	$0.00

14. REMARKS *(Attach additional sheets of plain paper, if more space is required)*

REVISED FINAL 272

15. CERTIFICATION

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

AUTHORIZED CERTIFYING OFFICIAL

SIGNATURE

DATE REPORT SUBMITTED: 06/21/01

TYPED OR PRINTED NAME AND TITLE
Bob Ryberg
Accountant, Principal, Grant & Contract Accounting

TELEPHONE *Area Code/Number*: (480) 965-2342

Email: robert.ryberg@asu.edu

THIS SPACE FOR AGENCY USE