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Final Report: Acquisition of Thermal Gravimetric Analyzer and Differential Scanning Calorimeter for Enhancing Science and Engineering Education and DOD-relevant research at Miami University

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6. AUTHORS

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5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES AND ADDRESSES

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500 E. High Street
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Oxford, OH 45056 -1863

8. PERFORMING ORGANIZATION REPORT NUMBER

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The views, opinions and/or findings contained in this report are those of the author(s) and should not contrued as an official Department of the Army position, policy or decision, unless so designated by other documentation.

14. ABSTRACT

Miami University acquired a Thermal Gravimetric Analyzer (TGA500), a Differential Scanning

Calorimeter (DSC2000), and a refrigeration unit for cooling the DSC sample to -90 C, all from TA

Instruments, Inc. for a sum of $81136. In addition, Miami purchased supplies and consumables to

15. SUBJECT TERMS

TGA DSC

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	15. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Catherine Almquist
UU	UU	UU	UU		19b. TELEPHONE NUMBER 513-529-0767

Report Title

Final Report: Acquisition of Thermal Gravimetric Analyzer and Differential Scanning Calorimeter for Enhancing Science and Engineering Education and DOD-relevant research at Miami University

ABSTRACT

Miami University acquired a Thermal Gravimetric Analyzer (TGA500), a Differential Scanning Calorimeter (DSC2000), and a refrigeration unit for cooling the DSC sample to -90 C, all from TA Instruments, Inc. for a sum of $81136. In addition, Miami purchased supplies and consumables to maintain and support this new equipment for a total of $3078.93. Our total expenditures for the TGA and DSC at Miami were $84,214.93. This newly purchased equipment has supported multiple faculty in the Chemical, Paper, and Biomedical Engineering Department and in the Geology Department.

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

Received Paper

TOTAL:

Number of Papers published in peer-reviewed journals:

(b) Papers published in non-peer-reviewed journals (N/A for none)

Received Paper

TOTAL:

Number of Papers published in non peer-reviewed journals:

(c) Presentations

Number of Presentations: 0.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):

(d) Manuscripts

Received Paper

TOTAL:

Number of Manuscripts:

Books

Received Book

TOTAL:

Received	Book Chapter

TOTAL:

Patents Submitted

Patents Awarded

Awards

Graduate Students

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Post Doctorates

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Faculty Supported

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Under Graduate students supported

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: 0.00

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:..... 0.00

Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):..... 0.00

Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense 0.00

The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields:..... 0.00

Names of Personnel receiving masters degrees

NAME

Total Number:

Names of personnel receiving PHDs

NAME

Total Number:

Names of other research staff

NAME PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Sub Contractors (DD882)

Inventions (DD882)

Scientific Progress

Overview

Miami University acquired a Thermal Gravimetric Analyzer (TGA500), a Differential Scanning Calorimeter (DSC2000), and a refrigeration unit for cooling the DSC sample to -90 C, all from TA Instruments, Inc. for a sum of $81136. In addition, Miami purchased supplies and consumables to maintain and support this new equipment for a total of $3078.93. Our total expenditures for the TGA and DSC at Miami were $84,214.93. This newly purchased equipment has supported multiple faculty in the Chemical, Paper, and Biomedical Engineering Department and in the Geology Department.

The equipment has supported, and will continue to support, both research and educational goals of Miami University in the areas of materials characterization. Applications for the materials that were characterized over the past year with our new TGA and DSC include those applied to adsorption processes, VOC oxidation catalysts, coagulants for water treatment, and for bio- and synthetic polymer characterization for tissue engineering and drug delivery. The proposed equipment has greatly enhanced our existing strengths of the department and of Miami University in undergraduate education and research in materials characterization.

Description of Research Instrumentation Acquired Through the DOD Instrumentation Grant

Miami University has excellent research capabilities in materials characterization. The TGA (Q500) and DSC (Q2000) from TA Instruments, which were acquired through the DOD Instrumentation Grant, have greatly enhanced our capabilities in materials characterization at Miami University. These instruments are capable of producing quantitative, high-quality data for a wide array of applications that span from chemistry to geology, from chemical engineering to bioengineering.

The Q500 TGA has a temperature range of up to 1100°C with heating and cooling rates from 0.001 K/min to 200 K/min. The measuring range is 1 g with a resolution of 0.1 µg. The atmosphere around the sample is nitrogen. This instrument has been used to assess weight loss vs temperature profiles to assess thermal stability of materials, temperatures at which materials dehydrate or degrade; and temperatures at which materials change phases.

The DSC has a temperature range from -90 C to 350 C. It has a wide range of heating rates and fast cooling rates (up to 200 K / minute). The DSC has been used for both educational and research purposes to, for example, measure glass transition temperatures and melting temperatures of various polymeric and biological materials, and to assess crystallinity and crystal phase changes.

Impact on Research and Training

The addition of modern TGA and DSC instruments to the existing laboratory infrastructure has greatly enhanced our ability to accommodate growing numbers of in-house student users, to more easily

accommodate users with diverse applications and sample types, and to develop new analytical techniques. The new TGA and DSC are used to train undergraduate and graduate students in materials characterizations that span wide applications in bioengineering, chemical engineering, energy, geology, chemistry, and environmental remediation. These students will enter graduate and professional schools and/or will take their place in the private and public sector workforce.

In Miami University's mission statement, Miami provides the opportunities of a major university while offering the personalized attention found in the best small colleges. It values teaching and intense engagement of faculty with students through its teacher-scholar model, by inviting students into the excitement of research and discovery.

In the College of Engineering and Computing (CEC), formerly the School of Engineering and Applied Science (SEAS)), the mission statement indicates that we work to continually assess and improve teaching, learning, and critical thinking; to engage in scholarship of discovery, application, integration, and teaching; to contribute to the accumulated knowledge of the centuries through faculty and student research; to encourage creativity; and to promote the continuing intellectual growth of our community. Mentoring students in research, thus providing inquiry-based learning and experiential learning fulfill the mission of both the University and CEC. According to the mission statement for the Chemical, Paper, and Biomedical Engineering Department at Miami University, " a central objective is to develop new knowledge about engineering and scientific fundamentals that focus on energy efficient manufacturing as well as sustainability and environmental management." Undergraduate research helps to fulfill the mission of the department by providing opportunities for students to engage in the process of "developing new engineering knowledge and scientific fundamentals."

The impact of undergraduate research on their scientific education is a more well-rounded experience that provides a basis for future discovery and life-long learning; whether it be through graduate school, industrial employment, government or civil service, or entrepreneurship. Undergraduate research provides experiences that cannot be obtained in a traditional classroom. By participating in undergraduate research, students will gain practical laboratory from designing, constructing, and operating test systems and working with analytical equipment and their operation, maintenance, and calibration; students will bridge theory with practice as they will learn to analyze data using theory to support their analyses and assess reasons for differences between theoretical and experimental results; students will learn to use published scientific literature to better understand their experimental methods and results; students will be exposed to technical and professional poster and platform presentations and

have opportunities to present their research at local, regional, and national conferences; and students will gain exposure to topics of their research interests that are not found in their textbooks. When students' experimental data is defensible and of high quality, student reports are enhanced to form manuscripts that are submitted for publication. Undergraduates who have publications have an advantage over most students pursuing positions in graduate schools.

The TGA and DSC have been used in the training of students (engineers and scientists), both at the masters and undergraduate levels. Over the past year, the new TGA and DSC impacted the research and projects of greater than 20 undergraduate students and 2 graduate students in the departments of Chemical, Paper, and Biomedical Engineering and Geology. Table 1 lists some of the projects that have utilized the TGA and DSC over the past year.

Table 1. Summary of projects on which the TGA and DSC have been used (2013-2014).

Faculty Mentor	Project	Equipment Used	Reason for Use
Dr. Justin Saul	Keratin hydrogel for novel adsorbent		
Dr. Jason Berberich			
Dr. Amy Yousefi			
Dr. Catherine Almquist			
Dr. Catherine Almquist			
Dr. Mark Krekeler			
Dr. Doug Coffin	Characterization of novel papers	TGA	Student project; synthesis.
	Moringa Seed Extract for novel coagulant for water treatment		
	Biopolymer hydrogels for scaffolds for tissue engineering		
	Silicone membranes for pervaporation	DSC; TGA	Senior Design;
	VOC Oxidation Catalyst Characterization	TGA	Student Project;
	Characterization of natural and synthetic		

minerals

DSC Senior Design;

DSC; TGA Senior Design;

DSC Senior Design;

TGA Student projects;

Education

Research;

Education

student projects;

research; education

research; education

Research;

education

research; education

research; education

Management Plan

The new TGA and DSC instruments reside in the chemical engineering research lab space within the Department of Chemical, Paper, and Biomedical Engineering. This space is a large climate-controlled laboratory that contains a dedicated space for sample weighing and standard preparation. Ovens, furnaces, and a fume hood are also available in or near this lab space.

Day-to-day operation and maintenance of these multi-user group instruments in the Department of Chemical, Paper, and Biomedical Engineering (CPB) are overseen and managed by the CPB faculty, especially Dr. Catherine Almquist for the TGA and Dr. Jason Berberich for the DSC.

The accessibility of the TGA and DSC will be open to all Miami faculty who will be primary users at all times. Although the CPB labs are constantly locked during off-hours, all faculty who are primary users will have access to the instruments at all times. In most cases, the instruments will be operated independently by graduate and undergraduate students directly involved in the projects utilizing this equipment once they are properly trained by Dr. Catherine Almquist or Dr. Amy Yousefi for the TGA and Drs. Jason Berberich and Justin Saul for the DSC. Other university and outside users also will be able to use the instrument or have their samples analyzed under guidance from one of the primary user faculty members in CPE.

Technology Transfer

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Acquisition of Thermal Gravimetric Analyzer and Differential Scanning Calorimeter for Enhancing Science and Engineering Education and DoD-relevant research at Miami U.

5a. CONTRACT NUMBER
W911NF-13-1-0325

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6. AUTHOR(S)
Catherine Almquist

5d. PROJECT NUMBER

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5f. WORK UNIT NUMBER

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Oxford OH 45056

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12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES
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Miami University has acquired these instruments: 1) Q500 TGA, and 2) Q2000 DSC, both from TA Instruments. These instruments have been used by several interdisciplinary faculty and students to enhance their research and education

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (Include area code)
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Standard Form 298 (Rev. 8/98)
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Enclosure 1

Acquisition of Thermal Gravimetric Analyzer and Differential Scanning Calorimeter for Enhancing Science and Engineering Education and DOD-Relevant Research at Miami University

Final Project Report
Contract # W911NF-13-1-0325
August, 2013 – July, 2014

Principle Investigator: Catherine Almquist
Miami University
Department of Chemical, Paper, Biomedical Engineering
650 E High Street
Oxford, Ohio 45056

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Dr. Jason Berberich	Moringa Seed Extract for novel coagulant for water treatment	DSC; TGA	Senior Design; Research; Education
Dr. Amy Yousefi	Biopolymer hydrogels for scaffolds for tissue engineering	DSC	Senior Design; student projects; research; education
Dr. Catherine Almquist	Silicone membranes for pervaporation	DSC; TGA	Senior Design; research; education
Dr. Catherine Almquist	VOC Oxidation Catalyst Characterization	TGA	Student Project; Research; education
Dr. Mark Krekeler	Characterization of natural and synthetic minerals	TGA	Student projects; research; education
Dr. Doug Coffin	Characterization of novel papers	TGA	Student project; research; education

Management Plan

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