

10:01:23

OCA PAD AMENDMENT - PROJECT HEADER INFORMATION

02/08/96

Active

Project #: E-18-551 Cost share #: Rev #: 6
Center #: 10/11-6-P5241-0A0 Center shr #: OCA file #:
Contract#: NGT-51192 Mod #: BUDGET REVISION Document : GRANT
Prime #: Contract entity: GTRC

Subprojects ? : N CFDA:
Main project #: PE #:

Project unit: MSE Unit code: 02.010.112
Project director(s):
HILL D N MSE (404)894-6081

Sponsor/division names: NASA / HEADQUARTERS/WASHINGTON, DC
Sponsor/division codes: 105 / 002

Award period: 930901 to 960831 (performance) 961031 (reports)

Sponsor amount	New this change	Total to date
Contract value	0.00	66,000.00
Funded	0.00	66,000.00
Cost sharing amount		0.00

Does subcontracting plan apply ? : N

Title: THERMOCHEMICAL BEHAVIOR OF SELECTED BULK & THIN FILM SCANDIUM BASED CATHODES

PROJECT ADMINISTRATION DATA

OCA contact: Anita D. Rowland	894-4820
Sponsor technical contact	Sponsor issuing office
DEBBIE GLASCO, CODE FEH (202)358-1531	ELAINE POWELL (202)358-0412
NASA HEADQUARTERS PROGRAM OFFICE WASHINGTON, DC 20546	SAME ACQUISITION DIVISION

Security class (U,C,S,TS) : U ONR resident rep. is ACO (Y/N): N
Defense priority rating : supplemental sheet
Equipment title vests with: Sponsor GIT
USE OF TRAINING FUNDS TO PURCHASE EQUIPMENT IS STRICTLY PROHIBITED.
Administrative comments -
PROCESSED 1.31 REVISION

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

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NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 11/11/96

Project No. E-18-551_____ Center No. 10/11-6-P5241-0A0_
Project Director HILL D N_____ School/Lab MSE_____
Sponsor NASA/HEADQUARTERS/WASHINGTON, DC_____
Contract/Grant No. NGT-51192_____ Contract Entity GTRC
Prime Contract No. _____
Title THERMOCHEMICAL BEHAVIOR OF SELECTED BULK & THIN FILM SCANDIUM BASED CATHO
Effective Completion Date 960831 (Performance) 961031 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	_____
Final Report of Inventions and/or Subcontracts	Y	_____
Government Property Inventory & Related Certificate	N	_____
Classified Material Certificate	N	_____
Release and Assignment	N	_____
Other _____	N	_____
Comments _____		

Subproject Under Main Project No. _____

Continues Project No. _____

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Management	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other _____	N
_____	N

NOTE: Final Patent Questionnaire sent to PDPI.

Georgia Institute of Technology

Atlanta, Georgia 30332-0245

USA

FAX: 404-853-9140

TEL: 404-894-6081

May 24, 1996

NASA Headquarters
Graduate Student Researchers Program
Code FEH
ATTN: GSRP Manager
Washington, DC 20546-0001

Dear Sir:

This letter serves as the Final Administrative Report required for the Graduate Student Researcher Fellowship Program upon completion of the research and degree conferral. The student, Sandra H. Magnus, received her Ph.D. degree in Material Science & Engineering at the March 1996 commencement at Georgia Institute of Technology. The title of the doctoral dissertation was:

"An Investigation of the Relationship Between the Thermochemistry and Emission Properties of Thermionic Cathodes Based on the BaO-Sc₂O₃-WO₃ Ternary System"

As a result of her research, two papers will be presented at the International Vacuum Sources Conference in Eindhoven, The Netherlands, this summer. Three other papers will be submitted for journal publication; one in the Journal of the American Ceramic Society, one in the IEEE Transactions on Electron Devices, and one in Powder Diffraction. In addition, a presentation, based on the paper to be submitted to the Journal of the American Ceramic Society, was given at the Annual Meeting of the American Ceramic Society in Indianapolis in April of this year.

Dr. Magnus has received two awards for Outstanding Graduate Research/Teaching Assistant; one was awarded in the spring of 1994 and the other in the spring 1996. She was also awarded the Saturn Team Award, along with the other members of the Graduate Student Symposium Steering Committee, for their efforts in organizing and conducting a Graduate Student Symposium in Winter 1994.

In August Dr. Magnus will report to NASA-Johnson Space Center as an Astronaut Candidate. She was selected in May as a member of the class of 1996, and looks forward to an exciting career in the space program.

Sincerely,

D. Norman Hill
Associate Professor

DNH/jh
Enclosures

Proposals Due February 1

NASA Graduate Student Researchers Program Proposal Cover Sheet

I. Student Information

Name: (Mr./Ms.)

Magnus, Sandra Hall

Last First MI

Birth Date: October 30, 1964

Birthplace: Belleville, IL

Home Address: 3477 Vinings North Tr.
Smyrna, Ga 30080

Home Phone: (404) 438-7895

Target Degree: MS MS/PhD (joint) ☒ PhD

Discipline: Materials Science

Department: Materials Science & Engineering

Campus Address: 778 Atlantic Dr.

Mail Code: 0245

University: Georgia Institute of Technology

Street Address: 778 Atlantic Dr.

City, State, ZIP: Atlanta, Ga 30332

Campus Phone: (404) 894-2853 Fax No.: 853-9140

E-Mail: gt334b@prism.gatech.edu

Undergraduate GPA: 3.1 Out Of: 4.0

Discipline: Physics

Graduate GPA (If Applicable): 4.0 Out Of: 4.0

Discipline: Materials Science

I certify that I am a citizen of the United States and that I am or will be a full-time graduate student at the university during the period covered by this proposal.

Signature: [Signature] Date: 1/28/95

II. Faculty Advisor Information

Name: Dr. D.N. Hill

Department: Materials Science & Engineering

Campus Address: 778 Atlantic Dr.

Mail Code: 0245

University: Georgia Institute of Technology

Street Address: 778 Atlantic Dr.

City, State, ZIP: Atlanta, Ga 30332

Campus Phone: (404) 894-6081

Fax Number: (404) 853-9140

E-Mail: norm.hill@MSE.gatech.edu

Signature: [Signature] Date: 1/27/95

III. Official Responsible for Committing Institution

Name: Janis L. Goddard

Title: Contracting Officer

University: Georgia Tech Research Corporation

Street Address: Georgia Institute of Technology

City, State, ZIP: Atlanta, Ga 30332-0420

Campus Phone: 404/894-4817

Signature: [Signature] Date: 1/31/95

IV. Proposal Information

Type of Proposal: ☐ (1) New ☐ (2) Second Year ☒ (3) Third Year

If Renewal, Designate Grant No.: NGT- 51192 Proposed Start or Renewal Date: 9/95

Expected Graduation Date: 9/97 Budget Amount: _____

Proposal Title Thermochemistry of Scandium Adsorbate Generation

Time Spent at NASA Center during past year: 3 weeks _____ months

V. Submission Information

☐ Headquarters

☒ NASA Centers

☐ Astrophysics

☐ Ames/Dryden (ARC/DFRC)

☐ Information Systems

☐ Goddard (GSFC)

☐ Solar System Exploration

☐ Jet Propulsion Lab (JPL)

☐ Space Physics

☐ Johnson (JSC)

☐ Life Sciences

☐ Kennedy (KSC)

☐ Microgravity

☐ Langley (LaRC)

☐ Earth Sciences

☒ Lewis (LeRC)

☐ Marshall (MSFC)

☐ Stennis (SSC)

Center Technical Advisor:

James A. Dayton, Jr. (Ed Wintucky)

Other Facilities to which this proposal is being submitted: _____

VI. Proposal Checklist

☐ Original Proposal and 9 Copies

☐ Budget Form

☐ University Certifications

• Debarment and Suspension

• Drug Free Workplace

☐ Signed Advisor Evaluation or Letter of Recommendation

☐ Transcripts

VII. NASA Use Only

☐ Org/Cpys

☐ BdgtFrm

☐ UCert

☐ SAE

☐ T

THERMOCHEMISTRY OF SCANDIUM ADSORBATE GENERATION

Several tasks have been accomplished since the proposal award in September, 1993 and subsequent renewal in September, 1994. Initial experimental results exploring a hypothesized model defining the operating mechanism of a thin film scandate cathode were presented at the 1994 Tri-Service Cathode Workshop, hosted by NASA-Lewis in March 1994. Exploration of two ternary systems important to understanding the thermochemistry of scandate cathodes is proceeding. Finally, a visit made to NASA-Lewis in November 1994 to use some uniquely configured equipment, resulted in the first set of similar experiments to correlate surface results with bulk characteristics.

Yamamoto¹ published a model suggesting a mechanism to explain the necessary reaction occurring in his scandium tungstate film cathodes:



This reaction was thought to be responsible for the generation of scandium, responsible for the increased emission performance. Experiments were undertaken to evaluate the validity of this model. A simulated impregnated cathode (70 weight percent tungsten powder mixed with 30 weight percent standard 4:1:1 impregnant) was pressed into a molybdenum sample holder and a film, comprising 50 weight percent scandium tungstate/50 weight percent tungsten, simulating Yamamoto's system, was pressed on top. The samples were reacted in vacuum at 1200°C for 37 hours and the resultant products examined by X-ray diffraction and EDS on an SEM.

No evidence of free scandium was seen, although the barium tungstate compound, BaWO₄, was very much in evidence. In addition, a compound consisting of a solid solution of aluminum and scandium oxides was observed. The analysis indicated, as suspected, that the reactions occurring in scandate cathode systems are much more complex than previously thought. The results of these experiments were presented at the Cathode Workshop.

Based on the outcome of the tests, two ternary systems were defined to be of interest, the BaO•Sc₂O₃•WO₃ system, pertaining to Yamamoto's work, and the BaO•Sc₂O₃•Al₂O₃ system, because of the possibilities and significance of solid solution relationships between the compounds Ba₂ScAlO₅^{2,3} and Ba₂Sc₂O₅. An isothermal section of the BaO•Sc₂O₃•WO₃ system is being defined at 1100°C, in addition to detailed exploration of the subsolidus equilibria. Over 25 compositions have been examined. The compositions are thoroughly mixed, calcined in air at 1100°C, quenched, and examined for phase content using X-ray diffraction. Selected compositions are also examined by EDS in an SEM for overall compositional stability. A ternary compound, previously reported by the Russian authors, Yudinskaya⁴ et al, has been identified, although the exact stoichiometry has yet to be defined.

A visit to NASA-Lewis in November 1994 yielded experimental data which will be used to correlate surface analysis results with bulk characteristics. By utilization of unique surface analysis equipment at NASA-Lewis, designed for *in situ* Auger electron and emission measurements, data outlining surface compositional changes of six samples undergoing 70-100 hour heating profiles were recorded. Samples were prepared similarly as described above, a simulated impregnated cathode underneath a material of interest, in this case the barium scandate, scandium tungstate, and the barium scandium aluminate compounds. Characterization of the bulk material in the samples is planned to be performed using the HDS X-ray diffraction technique.

¹Yamamoto, S., *Hyomen Kagaku*, **9**, 26-31 (1988).

²Antipov, E.N. et al, *Kristallografiya*, **35**, 213-24 (1990)

³Kovba, L.N. et al, *Zhurnal Neorganicheskoi Khimii*, **32**, 1720-23 (1987)

⁴Yudinskaya, I.V. et al, *Iz. Ak. Nauk. USSR-Neorganicheskie Materialy*, **11**, n10, 1805-08 (1975)

Georgia Institute of Technology

Atlanta, Georgia 30332-0245

USA

FAX: 404-853-9140

TEL: 404-894-6081

January 26, 1995

To Whom It May Concern:

Ms. Sandra H. Magnus has been working diligently on her program of study as outlined in NASA GSRP Proposal dated January 28, 1993. She has successfully passed the Ph.D. comprehensive examination and she has also completed the fifteen quarter hours of minor courses required of all Ph.D. candidates; she also continues to maintain a graduate GPA of 4.0/4.0.

Ms. Magnus is making excellent progress in her experimental work. She has synthesized and analyzed over two dozen compositions in the $\text{BaO} \cdot \text{Sc}_2\text{O}_3 \cdot \text{WO}_3$ system and, based on her results, has begun to construct the sub-solidus phase diagram. She has rebuilt an annealing furnace for use in her materials synthesis work and is currently re-furbishing a high-temperature melting point apparatus, interfacing it to a computer for temperature control and data acquisition. The latter equipment will be used to make liquidus and solidus measurements in the $\text{BaO} \cdot \text{Sc}_2\text{O}_3 \cdot \text{WO}_3$ system, permitting her to locate the primary phase boundaries on the phase diagram. In March, she presented a paper describing some of her initial experimental work at the 1994 NASA-TriService Cathode Workshop, and she visited LeRC for several weeks during the year to work on the specialized surface analysis instruments located there.

In addition to her graduate studies, Ms. Magnus continues to provide a great deal of service to the Materials Science and Engineering Department. In addition to teaching the electron microscopy laboratories, Ms. Magnus is also responsible for instructing both faculty and graduate students in the use of the scanning electron microscope (SEM). This is a considerable responsibility, since we give access to the instrument to those whom she certifies as being competent to use it. The fact that this complex piece of equipment is seldom down for maintenance, even though it is used almost constantly by faculty and students from across the campus, can be largely credited to her excellent instructional ability.

In her teaching, Ms. Magnus makes it clear to the students that she truly cares that they learn the material. She is patient, and always willing to go over material until the student grasps it. She frequently tutors students in other courses, and since she speaks several languages (including Spanish, German, and Russian), she has been particularly helpful to the international students who have some difficulty with English. Last Spring, Ms. Magnus was recognized by the faculty as the Outstanding Graduate Teaching Assistant in the School of Materials Science & Engineering.

I continue to feel that Ms. Magnus is one of the truly outstanding students with whom I have been associated in my tenure at Georgia Tech. Her initiative, grasp of problems, and depth of understanding of the theoretical aspects of problems places her in the top 1-2% of the graduate student population. Ms. Magnus is a credit to the MSE Department, to Georgia Tech, and to the GSRP Program. I have no doubt that she will be a tremendous asset to the engineering profession when she graduates.

Sincerely,

D. Norman Hill
Associate Professor

DNH/ag

***NASA Graduate Student Researchers Program
Budget Information***

I. Student Stipend (Maximum of \$16,000) \$ 16,000.00

II. Student Allowance (Itemize if necessary)

Tuition and Fees	\$171.00/quarter	684.00
Travel to NASA-Lewis for research/coordination		2316.00

Student Allowance \$ 3000.00
(Maximum of \$3,000)

III. University Allowance (Itemize if necessary)

Travel for advisor to NASA-Lewis	2000.00
Materials	1000.00

University Allowance \$ 3000.00
(Maximum of \$3,000)

Total Requested \$ 22,000.00
(Maximum of \$22,000)

CERTIFICATIONS REGARDING LOBBYING; DEBARMENT, SUSPENSION AND OTHER RESPONSIBILITY MATTERS; AND DRUG-FREE WORKPLACE REQUIREMENTS

Applicants should refer to regulations cited below to determine the certification to which they are required to attest. Applicants should also review the instructions for certification included in the regulations before completing this form. Signature of this form provides for compliance with certification requirements under 31 U.S.C. §1352, "New Restrictions on Lobbying," and 15 CFR Part 26 "Government-wide Debarment and Suspension (Non procurement) and Government-wide Restrictions for Drug-Free Workplace (Grants)." The certifications shall be treated as material representation of fact upon which reliance will be placed when the Department of Commerce determines to award the covered transaction, grant, or cooperative agreement.

1. LOBBYING

As required by §1352, Title 31 of the U.S. Code for persons entering into a grant or cooperative agreement over \$100,000, the applicant certifies that:

(a) No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, in connection with making of any Federal grant, the entering into of any cooperative, and the extension, continuation, renewal, amendment, or modification of any Federal grant or cooperative agreement;

(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting an officer or employee of any agency, Member of Congress, and/or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions;

(c) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants and cooperative agreements, and subcontracts) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by §1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

2. DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS

As required by Executive Order 12549, Debarment and Suspension, and implemented under 15 CFR Part 26, for prospective participants in primary covered transactions.

A. The applicant certifies that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three-year period preceding this application been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statement, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph 2.A(b) of this certification; and...

(d) Have not within a three-year period preceding this application had one or more public transactions (Federal, State, or local) terminated for cause or default.

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion — Lower Tier Covered Transactions (Subgrants or Subcontracts)

(a) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department or agency.

(b) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

3. CERTIFICATION REGARDING DRUG-FREE WORKPLACE REQUIREMENTS

• GRANTEES OTHER THAN INDIVIDUALS

A. The grantee certifies that it will provide a drug-free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(b) Establishing a drug-free awareness program to inform employees about—

- (1) The dangers of drug abuse in the workplace;
- (2) The grantee's policy of maintaining a drug-free workplace;
- (3) Any available drug counseling, rehabilitation, and employee assistance programs; and
- (4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);

(d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will

- (1) Abide by the terms of the statement and
- (2) Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than five days after such conviction;

(e) Notifying the agency within ten days after receiving notice under subparagraph (d) (2) from an employee or otherwise receiving actual notice of such conviction;

(f) Taking one of the following actions, within 30 days of receiving notice under subparagraph (d)(2), with respect to any employee who is so convicted

(1) Taking appropriate personnel action against such an employee, up to and including termination;

or—

(2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;

(g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a), (b), (c), (d), (e) and (f).

B. The grantee shall insert in the space provided below the site(s) for the performance or work done in connection with the specific grant:

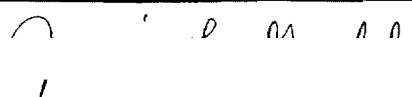
Place of Performance (street address, city, county, state, zip code)

Check box ☐ if there are workplaces on file that are not identified here.

• GRANTEES WHO ARE INDIVIDUALS

The grantee certifies that, as a condition of the grant, he or she will not engage in the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance in conducting any activity with the grant.

As the duly authorized of the applicant, I hereby certify that the applicant will comply with the above certifications.

NAME OF APPLICANT		PR/AWARD NUMBER AND/OR PROJECT NAME	
Sandra H. Magnus		Thermochemistry of Scandium Adsorbate Generation	
PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE			
Janis L. Goddard, Contracting Officer			
SIGNATURE		DATE	
		1/31/95	

This page has been redacted.